

DESIGN FOR POSITIVE BREAST SELF-EXAMINATION EXPERIENCE: AN
INVESTIGATION INTO MOBILE HEALTH APPS

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ABSTRACT

DESIGN FOR POSITIVE BREAST SELF-EXAMINATION EXPERIENCE: AN INVESTIGATION INTO MOBILE HEALTH APPS

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Breast cancer is one of the most common cancer types among women, responsible for approximately 627,000 deaths globally in 2018. There are various screening methods to detect cancer early, and experts suggest that women should perform breast self-examination (BSE) once a month. Unfortunately, most women fail to do so even if they are aware of the risks and the importance of screening methods. Moreover, developments in technology provide people to manage their own health in their own environments with various mobile technologies. Particularly, a number of mobile apps have been developed for assisting women to maintain breast healthcare; but, they fall short to be insufficient to meet needs of women for BSE. Even though there are studies that explored breast health behavior of women, the researcher has not come across a detailed investigation regarding the relation of breast health behavior and related mobile apps. An in-depth investigation of experiences with BSE and mobile apps can give insights into behavior of women. Therefore, the aims of the thesis were to uncover i) motivations behind women to perform BSE, ii) to figure out women's needs to perform BSE, and iii) to recommend ways to enhance women's BSE experiences through the BSE apps. With this aim,

three selected mobile BSE apps were used by a total of 24 participants for four weeks. A three-phase study was carried out to uncover pre-usage, during-usage, and post-usage experiences of women. By utilizing the procedures of grounded theory, six categories as design strategies emerged: BSE: Strategies, BSE: Limitations, BSE: Emotions, Mobile BSE Apps: Needs, Mobile BSE Apps: Benefits, and Mobile BSE Apps: Limitations. Consequently, feeding on the result of the study and positive technology literature, design dimensions were identified, and design recommendations were made to enhance the positive mobile BSE apps experience.

Keywords: Breast Healthcare, Breast Self-Examination, Mobile Health, Persuasive Technology, Positive Technology

ÖZ

KENDİ KENDİNE MEME MUAYENESİNDE POZİTİF DENEYİM İÇİN TASARIM: MOBİL SAĞLIK UYGULAMALARINA YÖNELİK BİR ARAŞTIRMA

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Meme kanseri, kadınlar arasında en yaygın kanser türlerinden biri olup dünya çapında 2018 yılında yaklaşık 627.000 ölüme sebep olmuştur. Kanser erken teşhis etmek için çeşitli tarama yöntemleri vardır ve uzmanlar, kadınların ayda bir kendi kendine meme muayenesi (KKMM) yapmaları gerektiğini önermektedir. Ne yazık ki çoğu kadın, risklerin ve tarama yöntemlerinin öneminin farkında olsalar bile bunu başaramamaktadır. Ayrıca teknolojideki gelişmeler, insanların çeşitli mobil teknolojilerle kendi ortamlarında kendi sağlıklarını yönetmelerini sağlamaktadır. Özellikle kadınların meme sağlığını sürdürmelerine yardımcı olmak için bir dizi mobil uygulama geliştirildi; ancak bu uygulamalar kadınların KKMM için ihtiyaçlarını karşılama konusunda yetersiz kalmaktadır. Kadınların meme sağlığı davranışlarını araştıran çalışmalar olsa da, araştırmacı meme sağlığı davranışı ve ilgili mobil uygulamalar arasındaki ilişkiye dair ayrıntılı bir araştırmaya rastlanmadı. KKMM ve mobil uygulamalarla ilgili deneyimlerin derinlemesine araştırılması, kadınların KKMM davranışlarına dair fikir verebilir. Bu çalışmanın amacı, i) kadınların KKMM yapmak için motivasyonları; ii) kadınların KKMM için gereksinimlerini belirlemek; ve iii) KKMM için mobil uygulamalar aracılığıyla

kadınların KKMM deneyimlerini geliřtirmenin yollarıdır. Bu amala seilen üç mobil KKMM uygulaması dört hafta boyunca toplam 24 katılımcı tarafından kullanıldı. Kadınların kullanım öncesi, sırasında ve sonrası deneyimlerini ortaya çıkarmak için üç aşamalı bir alıřma gerekleřtirildi. Temel teorinin prosedürlerini kullanarak, tasarım öęeleri olan altı kategori ortaya ıktı: KKMM: Stratejiler, KKMM: Sınırlamalar, KKMM: Duygular, KKMM Uygulamaları: İhtiyalar, KKMM Uygulamaları: Faydalar, ve KKMM Uygulamaları: Sınırlamalar. Sonuç olarak, alıřmanın sonucundan ve pozitif teknoloji literatüründen beslenerek, tasarım boyutları belirlendi ve pozitif mobil KKMM uygulama deneyimini geliřtirmek için önerilerde bulunuldu.

Anahtar Kelimeler: Meme Saęlığı, Kendi Kendine Meme Muayenesi, Mobil Saęlık, İkna Teknolojileri, Pozitif Teknoloji

To all women

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LIST OF ABBREVIATIONS

ABBREVIATIONS

ACS	American Cancer Society
BSE	Breast Self-Examination
CBE	Clinical Breast Examination
CDC	Centers for Disease Control and Prevention
CT	Computed Tomography
FBM	Fogg Behavior Model
HCI	Human Computer Interaction
GLOBOCAN	Global Cancer Observatory
IARC	International Agency for Research on Cancer
ICT	Information and Communications Technology
NA	Negative Affect
NCD	Non-Communicable Disease
NHS	National Health Service
PA	Positive Affect
PANAS	Positive and Negative Affect Scale
PSD	Persuasive Systems Design
TRI	Technology Readiness Index
TSI	Turkey Statistical Institute
UICC	Union for International Cancer Control
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Research Opportunity

Cancer is a critical problem in healthcare since it is the second leading cause of death globally, and is responsible for an estimated 9.6 million deaths in 2020 (Bray et al., 2018; International Agency for Research on Cancer [IARC], 2020). According to the IARC (2020), breast cancer is one of the most common cancer types among women, accountable for approximately 2.2 million new cases and 684,996 deaths globally in 2020. Moreover, In Turkey, one in four women with a type of cancer is carrying breast cancer, and more than 24,000 women were diagnosed with breast cancer in 2020. Besides, Global Cancer Observatory (GLOBOCAN) estimates that almost 33,500 new cases of breast cancer may occur in 2040 in Turkey (IARC, 2020). The excessive increase in the number of breast cancer rates can be associated not only with genetics but also with health behavior (Houghton et al., 2019).

Although there is currently no method that prevents the occurrence of breast cancer, prolonging patients' life expectancy with breast cancer, and achieving full recovery is possible with early detection consisting of early diagnosis and screening methods. While early diagnosis generally focuses on individuals with symptoms, the screening is a system that targets the entire population, informs them, and invites them to test for identifying cancer before any symptoms appear (World Health Organization [WHO], 2021). Both methods are critical to survival, therefore, every woman should be aware of what to do for possible detection of cancer during earlier phases. Breast Self-Examination (BSE), Clinical Breast Examination (CBE), and mammography

are defined as the primary screening methods recommended for early detection (Anderson et al., 2003).

Even though CBE and mammography are the primary screening tools for breast cancer, BSE is recommended since it is an easy and economical method and empowers women to take responsibility for their own health. Besides, it is claimed that women who practice BSE monthly with accurate methods were probably able to detect changes earlier, thereby early diagnosis facilitated the process of treatment and increased the survival rate (Anderson et al., 2003). Although the advice might differ across different countries, the Turkish Ministry of Health recommends performing BSE monthly, attending CBE yearly, and having mammography every two years to women over 40 years old. It also emphasizes that BSE has a significant impact on increasing breast cancer awareness in women under the age of 40 and suggests performing BSE for breast awareness (Turkish Ministry of Health, 2017).

Despite the benefits associated with BSE, several studies demonstrated that women do not regularly or not at all perform BSE. According to the Turkish Statistical Institute (2016), approximately 60% of women aged 15 and over stated that they have never practiced BSE before. Several barriers and reasons are reported to prevent women from performing BSE including the following: not knowing how to perform, not believing in their ability to perform BSE correctly, fear of discovering symptoms, having low breast cancer risk perception, having low income, and being unable to access healthcare services (Alazmi et al., 2013; Özkan & Taylan, 2020; Yang et al., 2010).

Although people are willing to engage in healthy behavior, they usually lack motivation that is needed to be maintained as part of their daily routine (Kaptein et al., 2012). As Bolier and Abello (2014) stated, engagement and adaptation of healthy behavior into daily life could increase with technological interventions employing special advantages and features.

With the advancements in technology and the penetration of mobile phones, mobile health (mHealth) become one of the most widely used technological interventions, which it has potential to improve the healthcare system and provide valuable healthcare outcomes (Steinhubl et al., 2015). The term of mHealth was defined as the utilization of mobile and wireless communication technologies in order to enhance healthcare services and outcomes (Nacinovich, 2011). Among mHealth technologies, mHealth apps have come to prominence since mobile phones and apps are already parts of our daily lives. Several studies indicated that mobile healthcare apps can obtain comparable benefits in individuals' health by supporting them to manage their own health and providing critical health information. For example, they could assist women in maintaining their breast healthcare (Almeida et al., 2016; Cruz et al., 2019). In recent years, numerous mobile apps regarding breast healthcare have been developed to support BSE, to increase breast cancer awareness, to provide peer support, and to accompany women during their treatment (Bender et al., 2013; Ribeiro et al., 2017).

Even though there are studies that explored women's breast health behavior and barriers, as well as their effects of mobile apps on health behavior change (Kissal & Beşer, 2011; McKay et al., 2016; Özkan & Taylan, 2020; Yang et al., 2010), very little research has been carried out on the relation of breast health behavior and related mobile apps (Ribeiro et al., 2016; Ribeiro et al., 2017). Therefore, an in-depth investigation into women's experiences with BSE and mobile BSE apps, their needs, concerns, and expectations can give insights into their behavior.

On the other hand, mere technological interventions are not sufficient to meet individuals' health needs; critical topics, like women's health, can benefit from design research and practices. Design can contribute to develop/enhance existing BSE apps by putting women at the heart of a matter and considering women's needs and current experiences regarding health and mHealth apps. However, it is essential to keep in mind that BSE is an intimate experience, and it might differ from woman to woman. For that reason, it is necessary to identify design strategies based on women's needs, concerns, and expectations to enhance BSE experience and encourage behavior

change. Moreover, current approaches in design for healthcare can also support providing women a positive mobile BSE app experience and fostering behavior change. Persuasive Technology, which is the one of them, is one of the behavior change techniques that can be adopted in the healthcare domain and utilized to investigate the effectiveness of mHealth apps for behaviour change (Fogg, 2003; Milne-Ives et al., 2020). Another approach, Positive Technology, is based on the combination of positive psychology and technology like Information and communication technologies (ICT) to improve personal experiences (Downey, 2015). The aim of Positive Technologies is to find out how ICT can be employed for raising the quality of personal experience with both theoretical and applied studies (Serino et al., 2013). In order to understand how women's BSE experiences can be enhanced and their behavior can be changed with mobile BSE apps, these approaches could be obtained.

1.2 Research Aim and Research Questions

The main aim of this research to identify how a positive breast self-examination (BSE) experience can be delivered through the use of BSE apps, and how behavior change for BSE can be encouraged with the support of BSE apps. Additionally, this study intends to determine design dimensions and recommendations that can be adopted for BSE apps that better fulfill women's needs.

Following objectives are set for the research: i) to uncover motivations behind women to perform BSE; ii) to figure out women's needs to perform BSE, and iii) to recommend ways to enhance women's BSE experiences through the BSE apps.

The research seeks to answer the following main research question and related five sub-questions:

- **How can BSE apps promote women's BSE behavior and positively contribute to their BSE experience?**

- How do women feel about breast self-examination? What are their behavior and experiences regarding BSE?
- What are the limitations that prevent women from performing BSE according to them?
- What is current state of BSE apps in terms of providing a positive experience and encouraging behavior change?
- What are the effects of utilizing BSE apps on women's BSE behavior and BSE experiences?
- Which characteristics do BSE apps require to provide a positive BSE experience and encourage behavior change for BSE?

1.3 Research Audience

Ultimately, designers, researchers, technology developers, and healthcare stakeholders can consult this thesis as a source of summarized knowledge about breast healthcare, mHealth apps and current approaches in design for healthcare. Besides, they can benefit from the results of the study and the design recommendations toward women's BSE experience and mobile BSE app experience while enhancing BSE experience or designing a mobile BSE app.

1.4 Structure of the Thesis

The overall structure of the thesis takes the form of five chapters. The chapters and their contents are briefly described as follows (see Table 1.1).

Chapter 1, presents the research opportunity, the aim, objectives, research questions, and the structure of the thesis.

Chapter 2, provides the literature review on breast self-examination, mHealth technology and mHealth apps , and current approaches in design for healthcare. This

chapter starts with exploring breast healthcare and breast self-examination. The second part gives a brief review of the significant changes that have happened in healthcare, the situation in the mHealth apps, especially in mHealth apps for women and breast health. Subsequently, current approaches in design for healthcare such as persuasive technology and positive technology are investigated.

Chapter 3, includes the methodology employed for the research. It details the fieldwork set-up, data collection tools and methods, the study procedure, and data analysis stages.

Chapter 4, presents the results of the fieldwork and suggested design strategies. Then, the chapter demonstrates discussion on: i) the changes in participants' attitudes, knowledge level, emotions; ii) the analysis of characteristics of the mobile BSE apps through Persuasive Systems Design (PSD) model, and iii) design dimensions for positive BSE apps experience through Positive Technology.

Finally, Chapter 5 starts with the general conclusions of the research, specific answers are also provided by revisiting the research questions. Then, the researcher's reflections are presented. The chapter ends with explaining the limitations of research and suggestions for future studies.

Table 1.1 Structure of the Thesis

CHAPTER 1	Introduction: To introduce the research opportunity, to present the research aim, objectives, research questions, and the overall structure of this thesis.
CHAPTER 2	Literature Review: To review breast healthcare, mHealth technology and mHealth apps , and current approaches in design for healthcare.
CHAPTER 3	Methodology: To present a detailed explanation and justification about the methodology of this thesis, and data analysis overview.
CHAPTER 4	Fieldwork Results, Analysis and Discussion: To present the particular results and design strategies. To demonstrate the discussion regarding the results of fieldwork.
CHAPTER 5	Conclusions: To revisit research questions, to present researcher's reflections, and to explain limitations of research and suggestions for further studies.

CHAPTER 2

REVIEW OF BREAST SELF-EXAMINATION, MHEALTH APPS, AND CURRENT APPROACHES IN DESIGN FOR HEALTHCARE

The literature review is composed of three main topics, as can be seen from Figure 2.1. The chapter begins with a brief introduction to breast cancer and continues with breast self-examination (BSE) and approaches to the BSE to understand women's current state. Then, the chapter presents significant changes that have happened in healthcare, the current situation in the mHealth apps, especially in m-health apps for women and breast health. Finally, this chapter ends by demonstrating promising approaches in design for healthcare, such as persuasive technology, positive psychology, and positive technology.

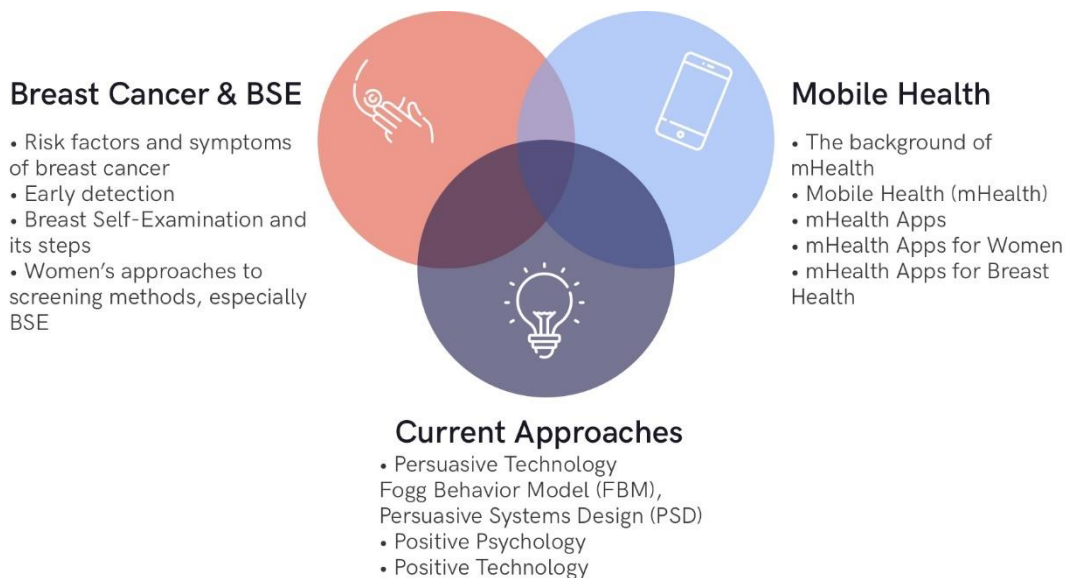


Figure 2.1 Summary of the literature review

2.1 Breast Cancer and Breast Self-Examination

This section begins by giving a brief summary about breast cancer, its risk factors and its symptoms. After emphasizing the importance of early detection on breast cancer, the screening methods (i.e., breast self-examination, clinical breast examination, and mammography) is presented, along with recommendations of countries and campaigns of some brands. Lastly, breast self-examination techniques and women's approaches to screening methods, especially BSE are described.

2.1.1 Breast Cancer

Breast cancer is a type of cancer that threatens women's health most, creates more than one variability in the body, causes the most deaths, and increases in frequency (Bray et al., 2018a). Breast cancer is the most critical obstacle to increasing life expectancy in developed and developing countries. It is the leading cause of morbidity and mortality in women (Bray et al., 2018b).

Addressing breast cancer, which poses the most extensive cancer burden among women, is particularly important not only for its potential health impact but also for confronting gender inequalities and recognizing the roles of women who are social and economic participants that affect the health of the whole family.

Breast cancer is a tumoral formation consisting of cells in the mammary glands of the breast and between the cells that line the ducts that carry the produced milk to the nipple, which have the potential to spread to other organs as a result of various factors (İlvan, 2006). If we describe breast cancer with medical terminology, it is an adenocarcinoma that mostly originates from the epithelium at the junction of the lobule and terminal duct. According to today's information, before breast cancer (invasive ductal cancer) develops, it goes through stages such as ductus epithelium, atypical ductal hyperplasia, ductal carcinoma in situ, and eventually, breast cancer develops. This transformation takes decades. Cancer cells, initially confined within the duct system that transfers milk (ductus), later progress through their basal

membranes and connective tissue. At this stage, tumor cells encounter blood vessels and lymphatics and have the ability to metastasize (i.e., spread to other parts in the body by metastasis) (Aydıntuğ, 2004).

In 2018, around 2.1 million new breast cancer cases were diagnosed in the world, and breast cancer accounted for 11.6% of all new cancer cases and 24.2% of all new cancer cases occurring in women. More than half of these cases occurred in economically developing countries representing approximately 80% of the world's population. While the breast cancer incidence in developed countries is above the world breast cancer incidence (46.3 / 100000), breast cancer incidence in developing countries is lower (Union for International Cancer Control [UICC], 2018). The cancer burden, which will increase in countries of all income levels due to population growth and aging, is expected to be more pronounced in low and middle-income countries where life expectancy is prolonged due to public health improvements such as control of communicable diseases (American Cancer Society, 2018). Additionally, based on the data of GLOBOCAN, among women, there are approximately 2.2 million new cases and 684,996 deaths worldwide in 2020 due to breast cancer (IARC, 2020). In Turkey, more than 24,000 women were diagnosed with breast cancer in 2020, and GLOBOCAN estimates that almost 33,500 new cases may occur in 2040 (IARC, 2020). The excessive increase in the number of breast cancer incident cases can be associated not only with genetics but also with health behaviors (Houghton et al., 2019).

2.1.1.1 Risk Factors for Breast Cancer

Although it is not known precisely why breast cancer occurs, the research suggests that the risk of breast cancer is higher in women with specific characteristics, and these characteristics are called risk factors (Campbell, 2002). These factors can be looked at within: i) age and gender, ii) family story, iii) genetic, iv) reproductive period, v) personal history of breast disease, vi) fertility history, vii) breast-feeding, viii) hormone replacement therapy ix) oral contraceptive use, and x) daily habits.

i) Age and Gender

Being female and having advanced age are risk factors for breast cancer. 99% of all breast cancers are seen in women and 1% in men (Fisher et al., 2005).

ii) Family History

Having a family history of breast cancer is the most widely known breast cancer risk factor. The risk increases much more with having relatives who are diagnosed with breast cancer before 50 years old. Having breast cancer in mother and sister increases lifetime risk four times more.

iii) Genetics

Hereditary breast cancers constitute 5-10% of all breast cancers. The most common cause of hereditary breast cancers is an inherited mutation in the BRCA1 and BRCA2 genes (Schwartz et al., 2009). Moreover, the lifetime risk of developing breast cancer in people with the BRCA1 or BRCA2 mutation ranges from 40-80% (Lakhani et al., 1998).

iv) Reproductive Period

Prolonged exposure to the estrogen hormone increases the risk of breast cancer. Therefore, the risk of developing breast cancer increases in women who menstruate at an early age and who enter menopause at a late age (Page, 2004).

v) Personal History of Breast Disease

A history of a positive breast biopsy has been associated with a slight (1.5 to 2-fold) increase in breast cancer risk. Having a history of breast cancer 3-4 times increases the risk of a second primary cancer in the other breast (Ashbeck et al., 2007).

vi) Fertility History

Women who do not give birth and give first birth at a late age have more incidence of breast cancer. The incidence of breast cancer in women who gave birth to their

first child after 30 years old is two times higher than those who gave birth before the age of 20 (Veronesi et al., 2005).

vii) Breast-feeding

Breast tissue undergoes a transformation with pregnancy. The pregnancy and lactation cycle causes a permanent molecular and histological change in the breast and affects breast cancer risk. Most studies show that breastfeeding for a year or more slightly reduces breast cancer risk in women (Faupel-Badger et al., 2013).

viii) Hormone Replacement Therapy

Hormone replacement therapy is given to control symptoms in the perimenopausal and postmenopausal period, which during this period, drugs containing only estrogen or progesterone combined with estrogen can be used. Considering the effect of estrogen replacement therapy on breast cancer development alone, it was found that long-term use (more than ten years) increased the risk of developing breast cancer (Seçginli, 2005).

ix) Oral Contraceptive Use

The risk of developing breast cancer increases slightly in women using oral contraceptives. However, oral contraceptive content has changed significantly over the years. Most of the studies conducted are related to oral contraceptive forms containing high doses of estrogen and progesterone. The relationship between newer forms with lower doses and breast cancer is unknown (Casey et al., 2008).

x) Daily Habits

Daily habits significantly impact cancer risk factors, such as eating habits, tobacco use, and alcohol consumption, which people could eliminate risk factors by controlling these habits. There is some evidence to suggest that long-term consumption of high-fat foods increases risk of breast cancer. Moreover, according to Kawai and colleagues, the rate of developing one type of breast cancer in young women who smoke is approximately 30% higher than in women who never smoke

(Kawai et al., 2014). Also, studies suggest that the amount and duration of alcohol consumption increase the risk of breast cancer (Tuch et al., 2013). To sum up, having obesity and consuming cigarettes and alcohol increase the risk of breast cancer.

2.1.1.2 Breast Cancer Symptoms

There is reliable evidence that diagnosis and treatment at a pre-symptomatic phase for some cancers like breast and cervical cancers are connected with survival rates (Bish et al., 2005). Hence, women should be aware of the symptoms of breast cancer to detect at an earlier phase.

Even though every individual has different symptoms of breast cancer, a firm lump or mass in the breast tissue is the most common symptom (Cancer Treatment Centers of America, 2020). However, every lump is not cancer. The lump should be tracked; if the size of the lump does not reduce or is present except for menstruation, individuals should consider seeing a specialist (Canadian Cancer Society, n.d.).

Moreover, there are several other signs and symptoms for breast cancer, as follows (Canadian Cancer Society, n.d.; Cancer Research UK, 2019; Cancer Treatment Centers of America, 2020; Centers for Disease Control and Prevention [CDC], 2020; National Health Service [NHS], 2019):

- a lump or swelling in either of your armpits or breasts,
- changes in shape or size of breasts,
- skin alterations in the breast such as puckering, dimpling, a rash or redness of the skin,
- nipple discharge,
- pain in any area of breasts,
- changes in the feel of breasts (feel hard, tender or warm).

Furthermore, several symptoms appear after cancer grows and spreads throughout the body. Some of these symptoms are weight loss, nausea, jaundice, shortness of

breath, cough, headache, double vision, weakness in muscles (Canadian Cancer Society, n.d.).

2.1.1.3 Early Detection of Breast Cancer

Since the risk of developing breast cancer throughout a woman's life is 11-12.57%, protection from breast cancer becomes essential. Although there is currently no method that prevents the occurrence of breast cancer, cancer development should be prevented through attitudes and behaviors that will reduce or minimize the risk. In the case of disease, life expectancy and quality should be increased with early detection and effective treatment (Gençtürk, 2007).

The WHO (2021) describes two different yet associated strategies to promote early detection of breast cancer: early diagnosis, which generally focuses on identifying symptomatic cancer at an early stage, and screening, which targets the entire population consisting of apparently healthy individuals, informs them, and encourages them to test for identifying cancer before any symptoms appear.

Early detection can be achieved with primary, secondary, and tertiary prevention methods. Primary prevention aims to hinder cancer development and take all kinds of precautions for risk factors. Risk factors that can be controlled in primary prevention; weight control according to age, physical exercise, healthy diet, alcohol and cigarette consumption, minimum pregnancy after 30, and breastfeeding can be listed (Howard et al., 2008). Besides, bilateral mastectomy, which is the primary preventive surgical method, is also used in very high-risk women with a familial history, genetic predisposition, and a history of previous breast cancer. In secondary prevention it is aimed to reduce the morbidity and mortality rate, detect cancer with early diagnosis methods before developing any symptoms or at an early stage, slow the progression of the disease, enhance the lifespan and quality by increasing the chances of recovery of the individual. Early diagnosis of breast cancer increases the success of treatment. BSE, Clinical Breast Examination (CBE), and mammography

are defined as the primary screening methods recommended for early diagnosis of breast cancer. Lastly, the purpose of tertiary prevention is to decrease the impact of an ongoing disease or minimize long-term disability and suffering. However, primary and secondary prevention are more common to prevent cancer (Henderson & Feigelson, 2000).

Furthermore, early diagnosis is essential to prevent breast cancer, and women can be cautious against breast cancer by regularly screening. Primary methods accepted in breast cancer screening are: i) breast self-examination, ii) clinical breast examination, and iii) imaging methods like mammography (Amadou et al., 2013).

i) Breast Self-Examination (BSE)

In Breast Self-Examination, the individuals themselves play an essential role in the detection of breast diseases. BSE is a cheap, straightforward type of examination that protects individuals' privacy and can easily be performed at home alone. The American Cancer Association recommends that women regularly take the 5th-7th week from the start of menstruation each month. It recommends that they do breast self-examination on a specific day of each month on days or post-menopausal periods (ACS, 2018).

ii) Clinical Breast Examination (CBE)

Clinical Breast Examination (CBE), is a physical examination for women that should be done by healthcare professionals; thus, the effectiveness of CBE depends on the skills of the health professionals and the facilities available. It is stated that CBE should be done once in three years for women between the ages of 20-39 and once a year for women over 40. Besides, its combination with mammography increases the chance of detecting breast cancer (Smith et al., 2010).

iii) Mammography

Mammography is a particular radiography method widely used in the early diagnosis of breast cancer formation by utilizing low-energy x-rays and compression. It is used to examine the muscle, fat, and glandular structures of the breast. It has an important

place in the early diagnosis of breast cancer. Ultrasonography, computed tomography (CT), and magnetic resonance imaging (MRI) are the additional breast imaging techniques (Seçginli, 2011).

Recommendations for the screening methods may show differences between countries. The American Cancer Society recommends that every woman fitting into following descriptions should go for the screening (Berner et al., 2003):

- over the age of 20 should do BSE once a month,
- between the ages of 20 and 40 should have CBE every three years,
- over the age of 40 should have CBE every year,
- between the ages of 35-39 should have their first mammogram,
- aged 40-50 should have a mammogram every two years,
- over the age of 50 should have mammograms every year.

The recommendations of the Turkish Ministry of Health for the screening program suggest that (Turkish Ministry of Health, 2017) every woman should:

- perform breast self-exam (BSE) monthly,
- attend clinical breast exams (CBE) yearly,
- have a mammography screening every two years after the age of 40 years old.

In England, the NHS (2019) suggests that the main screening method is mammography. Therefore, women between the ages of 50 and 70 are acceptable for breast cancer screening and are regularly summoned to be screened every three years. Women over the age of 70 can demand a mammogram at their local unit every three years.

In order to raise attention and awareness regarding breast cancer, every October was recognized as Breast Cancer Awareness Month in countries. In accordance with the increase in awareness, it is considered that early detection and treatment will increase (WHO, 2012). Also, some events like races are organized. To give an example,

Cancer Research UK arranges the Race for Life events to raise awareness (Cancer Research UK, n.d.)

In addition, numerous brands related to fashion and cosmetics which are more appealing to women support Breast Cancer Awareness Month through their advertisements, campaigns, and projects (see Figure 2.2). The pink ribbon, which was created by Evelyn H. Lauder (see Figure 2.3), has been the universal symbol since the late 1990s as the symbolic representation of support and awareness of breast cancer (Pink Ribbon International, n.d.).



Figure 2.2 Beauty products for breast cancer awareness (Retrieved from <https://weekender.com.sg/w/style/shop-for-these-limited-edition-beauty-products-and-do-your-part-for-breast-cancer-awareness>)

To give an example, Estée Lauder is one of the most supportive brands for breast cancer, and the brand inspires people with "The Estée Lauder Companies' Breast Cancer Campaign" to build a cancer-free world. Also, the brand's mission for 2020 was hash-tagged as "#TimeToEndBreastCancer" and they declared that:

"The Pink Ribbon is a globally recognized symbol for breast cancer, however, what it represents goes so much further. That's why this year, The Campaign's creative features a single, bold Pink Ribbon. It's what unites us, what brings us hope, and what symbolizes our fight for a cure. It's a movement, it's a representation of our

diverse global community, and it honors each, and every one of us touched by this disease: patients, loved ones, caregivers, doctors, thrivers, advocates, and more."
(The Estée Lauder Companies, n.d).



Figure 2.3 The image of the Pink Ribbon for Breast Cancer Awareness (Retrieved from <https://www.esteelauder.co.nz/estee-stories-article-history-of-the-pink-ribbon-breast-cancer-awareness>)

2.1.2 Breast Self-Examination

The most critical role in the early diagnosis of breast cancer falls to the individuals themselves. The only application that can be done on its own for early diagnosis is BSE. BSE is the process of systematically examining the breasts of individuals once a month and through determined methods. Although there are no studies confirming that BSE reduces breast cancer mortality, it makes a significant contribution to raising awareness about breast cancer in developing countries such as in Turkey. BSE is a method that gains an advantage in countries with insufficient resources because it is simple, easy to learn, can be applied alone, and inexpensive. Also, it does not require any special equipment or intervention and does not require regular hospital visits. In addition, performing BSE at regular intervals creates reference information about the breast tissue and enables women to get used to their regular breast appearance and normal breast tissues, so it becomes inevitable for them to notice any abnormal changes if they occur (ACS, 2018; Gonzales et al., 2018).

The first symptom of breast cancer is usually a palpable mass, and 80-90% of the breast mass is noticed by women themselves. This situation reveals the importance of BSE in finding the mass in the breast. As BSE regularly increases breast cancer awareness every month, it is thought that it will make women more sensitive to mammography and clinical breast examination, which are definitive diagnostic methods. In this respect, it is vital that women perform BSE regularly.

2.1.2.1 Breast Self-Examination Steps

There are two main steps that are suggested to be followed during BSE: i) visual, and ii) manual.

i) Visual Breast Self-Examination

Visual evaluation is the first step of BSE. For this, breasts should be observed in a bright room by removing the clothes above the waist in front of the mirror, with the hands-on both sides, in the air, with both hands on the hips, and leaning forward (see Figure 2.4). The breast, nipple, and surrounding tissues are checked for breast cancer symptoms such as swelling, redness, nipple discharge, discoloration, pre-existing prominence in superficial veins, withdrawal, asymmetry in breasts, orange peel appearance, wound, drying, and scaling. The purpose of visual examination in different positions; is to make possible malignant formations in the breast tissue become visible by causing the muscles behind the breast tissue to contract.

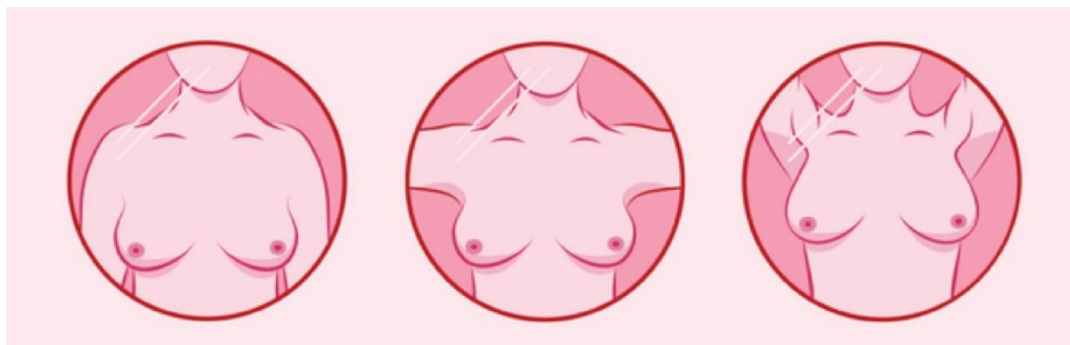


Figure 2.4 Observation of breasts in the hands free, in the air and on the hips in BS (Retrieved from <https://adobe.ly/3dMIH3B>)

ii) Manual Breast Self-Examination

It is stated that the area to be examined is horizontally from the middle of the breastbone to the armpit and vertically between the collarbone and a few cm below the breast. In palpation, the inner parts of the middle three fingers of the hand should be used, circular, vertical, or by scanning from the center outward (see Figure 2.5). Scanning on each breast should be repeated a total of three times by pressing lightly, moderately, and severely (Oliver-Vázquez et al., 2002).

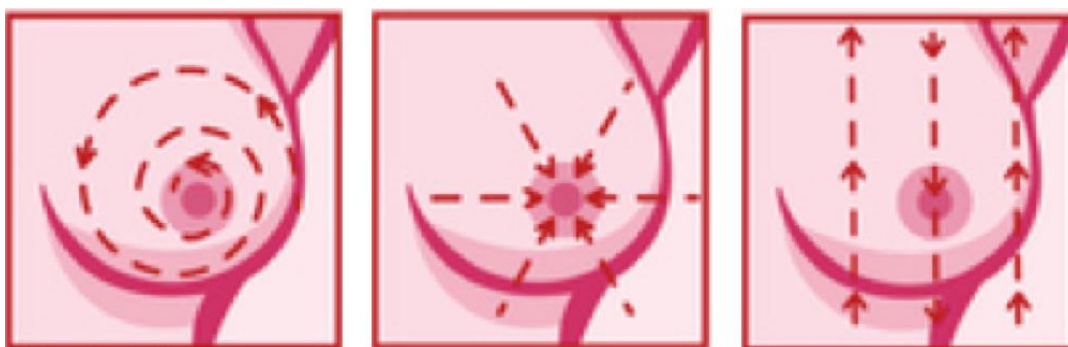


Figure 2.5 Top down, bottom-up, circular, or radial inception (Retrieved from <https://adobe.ly/3dMIH3B>)

The manual examination should be done both in the lying down and standing (see Figure 2.6). If the right breast is to be examined in the lying position, a thin pillow should be placed under the right shoulder, and the right arm should be placed under the head. Then, the right breast is examined with the left-hand fingers as described above, and the same procedures should be repeated on the left breast by switching to the left breast. If the right breast is to be examined in the outpatient examination, the right hand is placed on the neck, and manual procedures are performed in the lying position. For the left breast, the left arm is placed on the neck, and the same procedures are repeated for the left breast. Providing slipperiness is more comfortable during the outpatient examination; thus, it could be done with soapy hands in the shower (Mahfouz et al., 2013).

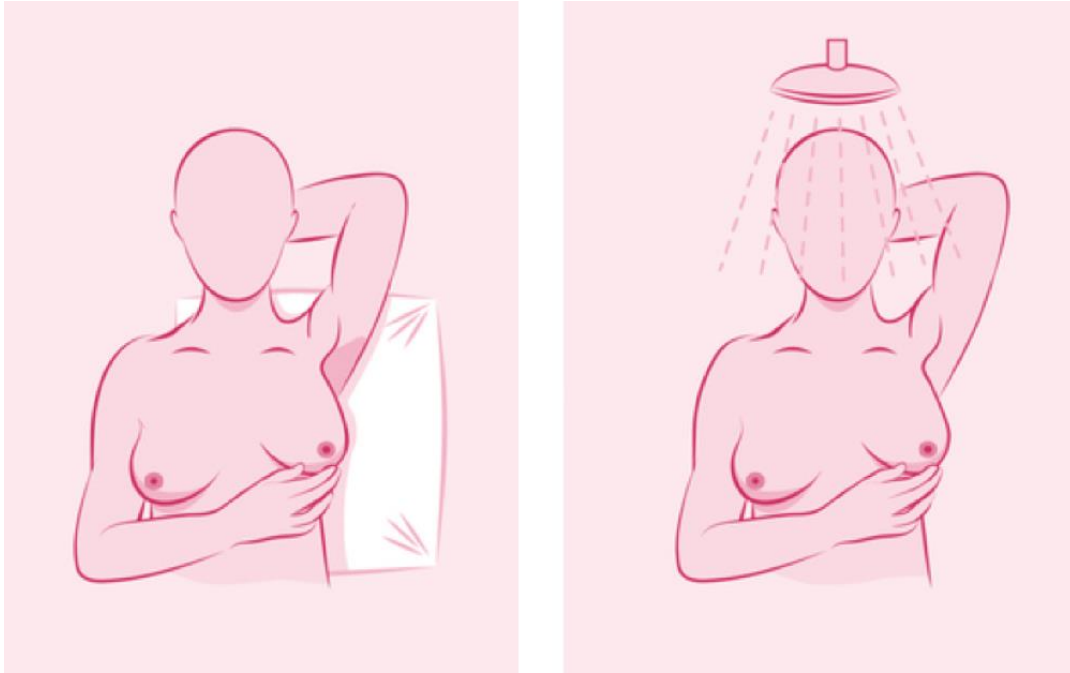


Figure 2.6 Manual examination while lying down and standing (Retrieved from <https://adobe.ly/3dMIH3B>)

Although BSE is known to be necessary, the level of knowledge and application rates of women in our country is very low. The population of women who know and apply for the BSE examination is one-fifth of the total female population. According to the TSI (2016), the rate of performing regular BSE for women over the age of 15 is 19.7%, and the proportion of women who never perform BSE was found to be 60.6%.

2.1.2.2 Women's approaches to screening methods, especially BSE

It is stated that 80% of breast masses can be detected in the early stage without excessive growth by BSE. Although breast cancer could be diagnosed at an early stage with screening methods, the BSE performing rate across the world and in Turkey are very low. In the study of Lamyian et al. (2007), women stated that the most important factor affecting BSE behaviors was fear to find something bad.

In a study conducted with African American women, it was stated that fear of breast cancer was high in 31% of women, medium in 55.6%, and low in 13.4% (Lee, 2015). In another study, it was found that there was a statistically significant relationship between women's fear of breast cancer and the status of having mammography (Miller et al., 2011). In the study conducted, it was stated that the concept of fear affecting the mammography of women had a negative effect on early diagnosis of breast cancer by 21%, and they also experienced pain and fear of exposure to radiation during mammography. It was also stated that they experienced more fear because of the thought of having breast cancer, exposure to radiation, suffering, and being fatal. In the study conducted by Donnelly et al. (2013) in Qatar, it was stated that women did not have CBE and mammography due to fear of breast cancer. In another study conducted, it was stated that the thought of the participants having breast cancer themselves, pain, and fear of the unknown was the fear that prevented them from having mammography (Lyttle & Stadelman, 2006). Miles et al. (2008) found a statistically significant relationship between the participants' desire to have knowledge about breast cancer and their fear of breast cancer in their study. It was also stated that women with a high level of breast cancer fear do not want to have information regarding cancer and are not open to innovations in screening programs.

In relation to 'fear' of breast cancer in Turkey, the effects of early diagnosis and behavioral research studies are limited. A study stated that most of the women in the research group had a fear of breast cancer because they saw breast cancer as a fatal disease (Gürsoy et al., 2011). In another study conducted; it was stated that women were afraid of finding a mass when they performed BSE, and the thought of having a bad result when they had BSE and mammography, and it was determined that they postponed their early diagnosis behaviors because of the fear that breast cancer will (Aker et al., 2015). In their study, Rızalar and Altay (2010) stated that 51.9% of women did not perform BSE, and 5.2% of these women were afraid of finding a mass. While some people with a fear of breast cancer do not practice early diagnosis behavior practices, others do early diagnosis behavior practices as a coping method.

Although mammograms are among the effective techniques for detecting breast cancer in the early-stage, BSE is also considered necessary at the point of detection. However, breast cancer is a severe public health problem due to low participation in breast cancer screening programs. Therefore, it is vital to identify the obstacles to screening participation.

There is an important fight against breast cancer worldwide. Implementing regular screening behaviors to reduce the mortality and morbidity that may occur in the advanced stages of breast cancer is one of the most effective methods of combating this issue. Experts on this subject recommend that individuals be included in participation programs at a rate of at least 70% in order to minimize breast cancer (Bever et al., 2018). Moreover, many countries have national screening programs for breast cancer, but participation in breast cancer screening programs has never reached the desired level. There are severe differences in participation in screening programs between countries or even among various ethnic groups living in the same country. In order for women to be encouraged for medical examinations or screening tests, it is necessary to make positive changes in women's behaviors by understanding the reasons for breast health behaviors. The barriers that people perceive are maintained directly or indirectly. Therefore, it is necessary to examine the factors affecting health behaviors in-depth.

In literature, the factors that prevent women's breast cancer screening behavior have been collected under three headings: i) personal barriers, ii) social barriers, and iii) system barriers. Although the barriers that prevent women from participating in breast cancer screenings differ from country to country or from culture to culture, it has been found that these barriers are generally very similar. The differences and similarities in these barriers are considered valuable by healthcare professionals in both national and international strategies to increase participation in breast cancer.

i) Personal barriers

Fear and shame that prevent women from participating in breast cancer screenings are considered the most critical personal obstacles. Emotions play an essential role

in health behavior. Therefore, these emotions are also effective in the decision-making process of patients. Emotions sometimes pose a barrier to health behaviors (Lerner et al., 2015).

Causes of fear as the obstacles to women's participation in screening programs can be summarized as (VanDyke & Shell, 2017), fear of:

- being diagnosed with a cancer,
- receiving radiation,
- pain,
- spreading the potential lumps to their whole body by touching,
- losing their femininity,
- eating a cancer stamp,
- thinking their spouse will break up,
- not going to be able to be a mother,
- and, dying.

It can be seen that these fears are usually caused by wrong or incomplete information (Akuoko et al., 2017; Al-Zalabani et al., 2018). In this direction, it is necessary to carry out studies to improve women's breast cancer literacy to be able to eliminate the wrong and incomplete information, hence their fears.

Male healthcare workers are also seen as an important factor that prevent women from participating in breast cancer screenings, due to the feeling of shame. In this direction, increasing the number of female health workers in screening teams will significantly increase participation in breast cancer screening.

Fatalism is among the variables that negatively affect women's participation in breast cancer screening (Molaei-Zardanjani et al., 2019). Some of the obstacles mentioned by women are socio-economic status, negative experiences, and lack of motivation (Whitaker et al., 2016). Although there is little investigation on lack of motivation, it was found that women who participate in mammography screenings have a much

higher health motivation than those who do not (Kawar, 2013; Khazae-Pool et al., 2014; Wells et al., 2017)

ii) Social barriers

Social barriers affecting breast cancer screening behaviors are beliefs, values and experiences adopted by the culture in which women live. The beliefs and attitudes of cultures have a versatile and comprehensive structure that is effective on health behaviors. For example, racial and ethnic groups play an essential role in cancer screening participation (Lee, 2015; Lee et al., 2014). Determining societies' dominant cultural factors is an important point for increasing women's participation in breast cancer screening and their behavior. It is recommended to develop community-specific health promotion strategies and programs (Lee, 2015).

Women may not participate in breast cancer screenings due to stigmatization. Breast cancer is equated to death in some ethnic groups. Therefore, such groups do not see women with breast cancer as a wife or mother. Therefore, even though women know that they have breast cancer, they do not have a screening and avoid learning about it (Agustina et al., 2017; Quaife et al., 2015). Accordingly, the precaution to be taken will be the development of culturally sensitive interventions for stigmatizing ethnic minorities. This situation can be considered as one of the critical strategies to increase participation in breast cancer screenings.

iii) System barriers

System barriers to participation in breast cancer screening are defined as the lack of health insurance or sufficient health insurance coverage, healthcare professionals' negative attitudes, and inaccessibility to screening services. In a study conducted (Bowser et al., 2017) on this issue, systematic obstacles are stated as lack of: health insurance coverage, doctor's advice, regular caregivers, and information; fear of systems and procedures; and, the healthcare personnel's gender.

When women's participation in breast cancer screening rates with and without health insurance is compared, it can be seen that the screening rate of women with insurance

is 79%, and 52% of those without insurance (Ross et al., 2006). Also, it is observed that women mostly prefer female doctors for their participation in breast cancer screening rather than male doctors (Vahabi et al., 2017). Accordingly, it is recommended to implement policies aimed at developing health services. It is predicted that the motivation needed by women in terms of screening behavior can be achieved by the following factors (Bowser et al., 2017):

- free scanning programs,
- increasing the number of female healthcare staff to perform the screening,
- using reminders for scanning,
- regular mobile screening programs in rural areas,
- providing transfers for scanning,
- and, more frequent use of the media to raise breast cancer awareness.

In summary, women may not participate in breast cancer screening programs due to social, systematic, and personal barriers. These obstacles are fear, breast cancer perceptions, lack of motivation, socio-economic status, shame, belief, lack of knowledge, cultural context, access to health services, stigma, health insurance coverage, healthcare professionals' attitudes, and access to health systems.

To eliminate these barriers, healthcare professionals need to be aware of the fears, cultural background, and beliefs (e.g., fatalism and stigmatization concerns) of women. At the same time, healthcare professionals are required to carry out personal barriers intervention programs in this direction. Strengthening countries' health policies can be considered as another factor that will increase participation in breast cancer screening. After all, suggestions can be made to provide mobile screening services for the strategies that countries should implement, performing free screenings, providing transfer services, increasing the number of female health workers, using social media frequently, and developing new screening programs.

2.2 An Emerging Technology: Mobile Health (mHealth)

Globally, healthcare systems have been dealing with a variety of challenges and handling a great burden for decades (see Figure 2.7). There are several underlying causes of this situation, and the most significant ones are: growth of aging population; and increase in chronic, communicable and non-communicable diseases (Chiarini et al., 2013; Llorens-Vernet, & Miró, 2020; Moghaddam & Lowe, 2019; Tseklevs & Cooper, 2017; Yi et al., 2018).

The human lifespan has extended with advances in medicine, improvements in environmental and social conditions such as hygiene, nutrition and housing, and declining fertility; therefore, the population has increasingly aged (Paré et al., 2007). According to the address-based population registration system data of the Turkey Statistical Institute (TSI), 9.1% of the population is the elderly people (2019). Based on the TSI's population projections for Turkey, the elderly population frequency is predicted to be 10.2% in 2023, 16.3% in 2040, 22.6% in 2060, and 25.6% in 2080 (TSI, 2019). On the other hand, global changes such as urbanization and modernization have negative influences on human lifespan.

With urbanization and modernization, people's daily habits such as their diet and physical activeness have been influenced negatively, and this has affected the prevalence of chronic diseases (Moghaddam & Lowe, 2019). To illustrate, every year 41 million people die due to chronic diseases globally, which corresponds to 71% of total deaths (WHO, 2021)

In accordance, as Afferni et al. (2018, p.1) declared, "healthcare organizations have been facing several critical issues, such as patient safety, quality of service, aging populations, the rapid evolution of diagnostic and therapeutic technologies, financial constraints, and budget reductions." As a result, chronic diseases and age-related diseases cause an increase in healthcare costs and morbidity, and the burden on healthcare continues to gradually increase (Moghaddam & Lowe, 2019; Stroetmann et al., 2010).

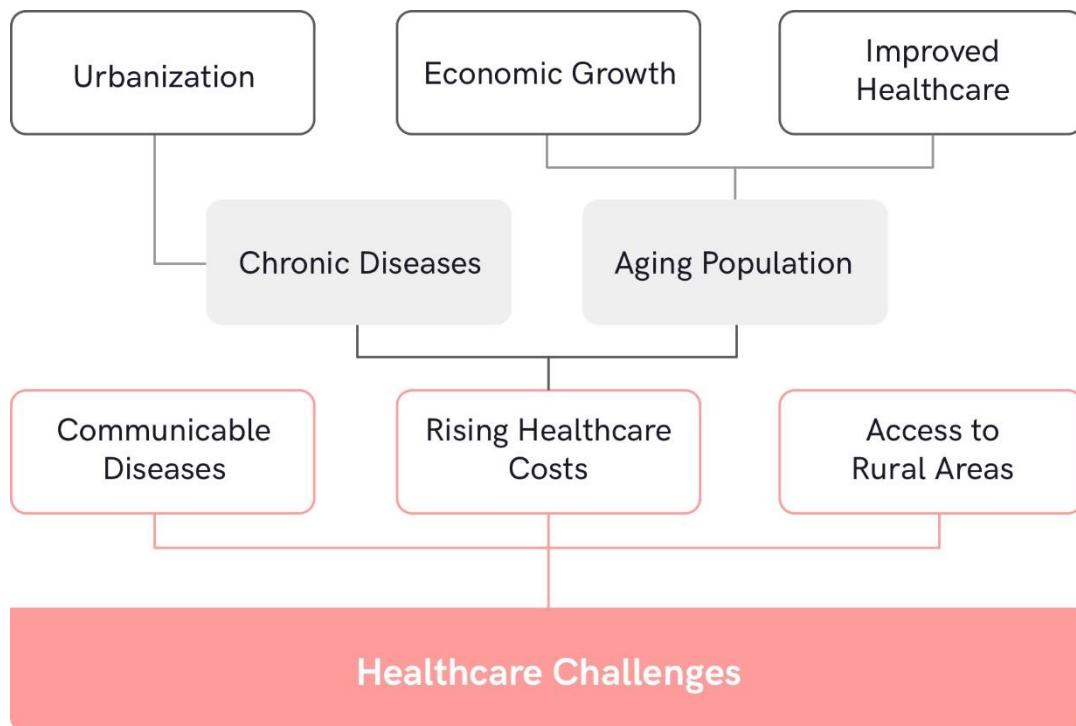


Figure 2.7 The challenges that healthcare system deals with for last decades (Moghaddam & Lowe, 2019)

There is a need that new approaches and solutions are focused on by healthcare stakeholders to address and figure out health system problems (Bause et.al, 2019). One of the approaches is that the healthcare system concentrates on the person instead of the disease (Mirzaei et.al., 2013). Moreover, according to Tseklevs & Cooper (2017), “person-centered healthcare” is also one of the emerging trends as a promising approach. Following the person-centered healthcare, other emerging trends are respectively self-management healthcare, community healthcare, holistic healthcare, and preventative/health-promoting care. Tseklevs & Cooper (2007) described these emerging trends (see Figure 2.8) as follows.

- *Person-centric healthcare*: This approach makes the person the center of the system and enables people to take an active role in their healthcare from the diagnosis of the disease to its treatment. Different from the traditional approach, this approach includes not only patients but also people who want to improve their quality of life by being healthier.

- *Self-management healthcare*: Owing to technological advancements, people are able to monitor their symptoms, treatment, and maintain or enhance their health easily and efficiently. This approach motivates and empowers people to be responsible for their own health, especially people with long-term conditions and chronic diseases.
- *Community healthcare*: Due to the adoption of the self-management healthcare approach, healthcare services will shift from healthcare facilities to community and individuals' homes. In this approach, personal health is considered in the social context.
- *Holistic healthcare*: Instead of focusing only on individuals' health, this approach considers individuals' emotional and social well-being, their physical functioning, and professional aspects of their lives.
- *Preventative/health-promoting care*: Healthcare system and the delivery of its services were influenced by all these trends and shifted from focusing on illness to enhancing the wellbeing of individuals and communities.

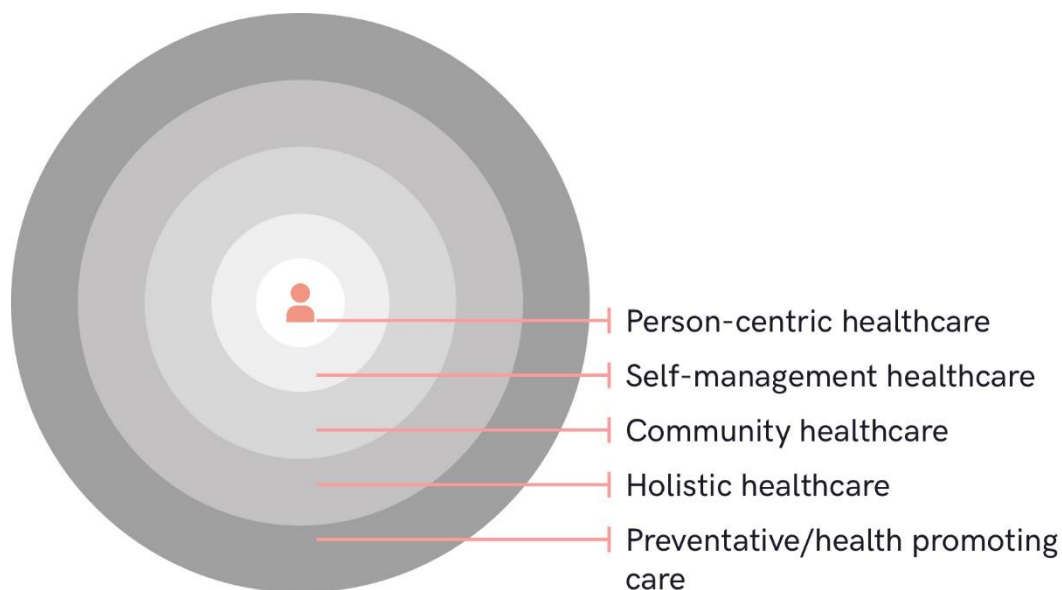


Figure 2.8 Circle of emerging trends in design in healthcare: hierarchical depiction of emerging trends with a focus placed on the individual person (Tseklevs & Cooper, 2007)

Apart from such new approaches, technological advancements can be a solution to tackle healthcare problems. The applications of technological advancements in the field of health are explained under “Health 4.0” by Afferni et al. (2018). The term is inspired from the concept of Industry 4.0 which focuses on enabling industries to transform from manufacturers to service providers by providing an advance personalization as a service (Afferni et al., 2018).

Accordingly, “Health 4.0” can be described as “A strategic concept for the health domain derived from the Industry 4.0 concept.” (Bause et al., 2019, p. 888). Health 4.0, aims to increase the connectedness between patients and other healthcare stakeholders (e.g., doctors), and to enhance healthcare services benefiting from technology (Bause et al., 2019; Thuemmler & Bai, 2017).

Health 4.0 utilizes three technologies: mHealth, Internet of Things (IoT), and big data. Briefly, mHealth empowers the communication between patients and healthcare professionals, whereas IoT enables to gather data from patients and transmits it to healthcare professionals. With big data, healthcare professionals can detect trends and better monitor public health, which facilitates the process of diagnosis and disease prevention (Bause et al., 2019).

Due to the common usage of mobile phones and the potential to reach the overall population, mHealth is particularly appropriate to change the way individuals reach to healthcare services, and it has a remarkable potential of facilitating the process of the change. Therefore, mHealth becomes prominent among these technologies. The prevalence of mHealth is rapidly advancing day by day (Olla & Shimskey, 2015). To illustrate, in 2016, the mobile health market was 21 billion dollars. It is predicted that the mobile health market will reach approximately 99 billion dollars in 2021, and nearly 333 billion dollars in 2025 (Statista, 2018).

2.2.1 Mobile Health(mHealth)

Technological developments can also be used to adopt new approaches like the self-management healthcare, in addition to considering technological advancements as a source for the solution. mHealth is a promising opportunity and it has great significance to tackle healthcare problems (Chiarini et.al., 2013; WHO, 2011).

It is a growing field that adopts wireless technologies and utilizes mobile technologies such as mobile devices like phones, software applications, and other wireless devices in healthcare (Olla & Shimskey, 2015). The term of mHealth is described by WHO Global Observatory for eHealth (2011) as:

"Medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices. mHealth involves the use and capitalization of a mobile phone's core utility of voice and short messaging service (SMS) as well as more complex functionalities."

With the adoption of m-Health, healthcare could be more person-centered, affordable, accessible, participatory, and preventive (Llorens-Vernet, & Miró, 2020; Malvey & Slovensky, 2014). Therefore, healthcare stakeholders believe that mHealth enhances the value proposition of the healthcare system (Moghaddam & Lowe, 2019). The adoption of mHealth as current healthcare systems can also bring other advantages (Moghaddam & Lowe, 2019) such as mHealth can:

- increase the capacity and quality of health services by improving accountability and sharing responsibility among health stakeholders,
- enable self-management healthcare of individuals and community by fostering healthy behavior,
- decrease the number of outpatients and the number of visits to healthcare facilities by monitoring individuals remotely,
- increase efficiency of treatment by monitoring individuals remotely,
- enable healthcare system and services to reach everywhere.

Finally, with all these advantages listed above, mHealth can reduce the expenditure on healthcare services and systems (Moghaddam & Lowe, 2019).

The surge in technological advancements has influenced and increased the number and types of mHealth and mHealth implementations. This creates chaos for individuals and healthcare professionals because of the concerns about uncertainties in regulations, privacy, security, and finance (Olla & Shimskey, 2015; Steinhubl et al., 2015). In order to facilitate and understand mHealth and its implementations, Olla and Shimskey (2015) prepared a mHealth taxonomy. This mHealth taxonomy has three main dimensions: i) medical use cases, ii) technical modalities, and iii) policy consideration (see Figure 2.9).

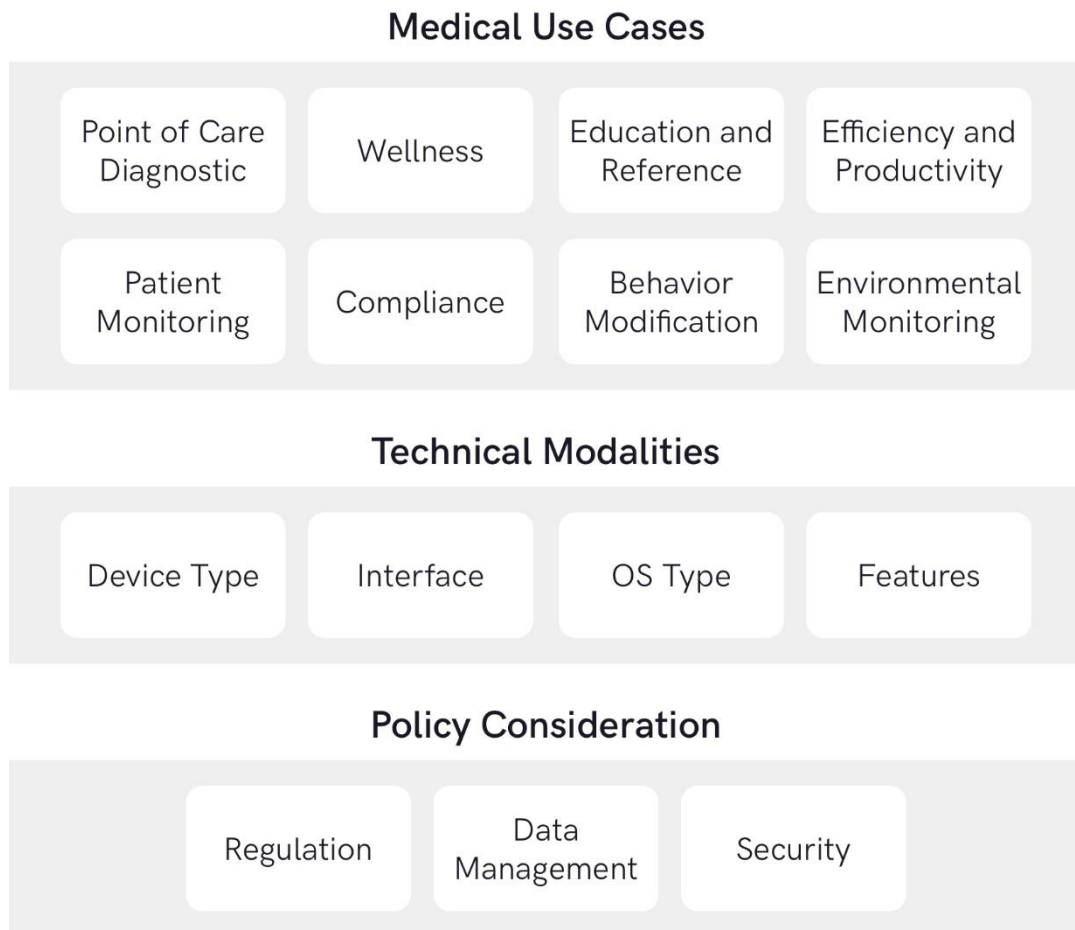


Figure 2.9 mHealth taxonomy (Olla & Shimskey, 2015)

The purpose of the taxonomy is, first, to clarify the connection of mHealth implementations between usage purpose, technological and policy aspects. Then, another purpose is enabling individuals and other stakeholders such as researchers, healthcare professionals to evaluate mHealth implementations based on their strengths and weaknesses. Eventually, this will increase the prevalence of mHealth (Olla & Shimskey, 2015).

One on hand, the prevalence of mHealth that supports individuals in enhancing their health is increasingly available day-to-day. On the other hand, individuals become more active in their health decisions, and therefore their need for technological support is growing continually (Lupton, 2013; UK National Clinical Guideline Centre, 2012). Considering the prevalence of mobile phone use, mHealth apps are a very good beginning to meet the needs of individuals due to in familiarity with mobile apps and technology (Bhavnani et al., 2016).

2.2.2 mHealth Apps

The emergence of mobile technology and mobile computing has influenced the life of millions of people and the way they live. New mobile technologies provide various solutions and innovative approaches for several needs in daily life (Becker et.al., 2014). Mobile technologies enable users to have mobility and utilize a computing device such as smartphones, laptops, tablets, and cameras without being linked to any fixed location; and one of the most preferred mobile technology is smartphones (Jusoh, 2017). 3.6 billion people were using smartphones worldwide in 2020; and the estimated number of smartphone users will be 4.3 billion in 2023 (Statista, 2020).

As the use of smartphones has become accessible and prevalent, the number of mobile apps increases day by day, and mobile apps become a significant part of daily lives. 140.68 billion mobile apps were downloaded in 2016, whereas the number of downloaded mobile apps was 218 billion in 2020 (Statista, 2021a). In the market,

there are several app categories used by a large mass of people such as gaming apps, business apps, lifestyle apps, and so on. One of the promising categories is healthcare and wellness. The adoption of smartphones and apps in healthcare has been steadily increasing for more than a decade (Smith, 2017). According to the market statistics, there were 51,476 healthcare apps available at App Store and 49,890 healthcare apps available at Google Play in 2020 (Statista, 2021c; Statista, 2021d)

Besides individuals, healthcare professionals have also commonly embraced these mHealth apps to access patients and caregivers (Plaza Roncero et al., 2020). Given the interest in mHealth apps, mHealth apps have enormous potential to improve the healthcare system and provide valuable healthcare outcomes.

mHealth apps can be beneficial tools for all stakeholders such as individuals, patients, caregivers, healthcare professionals, and healthcare institutions by enabling individuals to maintain their own health, promoting healthy living on a community basis, and providing better healthcare outcomes for all stakeholders (Jusoh, 2017; Zhang et al., 2014). As a consequence of appropriately designed mHealth apps, the communication between healthcare professionals and patients could be enhanced and the tasks of healthcare professionals could be facilitated. Eventually, mHealth apps enable to improve quality of health services and outcomes (Gatara & Cohen, 2014). Despite the benefit of mHealth apps, many mHealth apps in the market are not theoretically studied. Likewise, some of the mHealth apps do not focus on the users' needs and do not consider whether individuals have the technological knowledge to use the apps or whether individuals want to use the apps (Jusoh, 2017).

However, there has been an increasing amount of literature on mHealth apps over the past decade in order to understand the promise of mHealth apps. In the next sections, the prior works related mHealth apps and the examples of mHealth apps will be presented.

2.2.2.1 Prior Studies Related to the mHealth Apps

The mHealth apps have been used for some time now, and there are numerous studies that present analysis about mHealth apps on the market and systematic literature review. In the review of literature conducted for the thesis, it was observed that mHealth researchers have approached mHealth and its implementations with diverse perspectives. For example, some studies were related to the users of mHealth apps and their needs. Also, a number of studies focused on the purpose of the mHealth apps while several studies investigated the association between health factors and mHealth apps. In addition, based on the findings of the study carried by Chib and Lin (2018), mHealth studies generally covered health areas, the aim and the target audience of mHealth apps.

Owing to the several opportunities of mHealth apps like mobility, mHealth apps are becoming popular for other users rather than only patients such as caregivers, doctors, nurses, students, and healthcare workers. Therefore, a considerable amount of literature has been published on the target audience of mHealth apps and their needs on mHealth apps. In their study, Mosa et al. (2012) analyzed literature reviews on mHealth apps and classified the apps by the users into three main groups: i) healthcare professionals, ii) medical or nursing students, and iii) patients.

Although numerous studies focused on mHealth apps for patients, studies on mHealth apps to target healthcare professionals have only increased recently. In a study that set out to investigate literature for addressing mHealth intervention for healthcare professionals, White et al. (2016) defined four categories of mHealth apps based on their intervention objectives: i) data collection during patient visits, ii) communication between healthcare professionals and patient, iii) communication between healthcare professionals doing outreach in the community and those located at clinics or hospitals, and iv) population surveillance.

As the popularity of mHealth apps rises, the apps become a fundamental platform for addressing health interventions from promoting physical activities to supporting

cancer patients (Klasnja & Pratt, 2014). Consequently, mHealth apps have been used for a range of purposes, and there are several studies focused on the evidence of the health impacts of mHealth apps.

Ali et al. (2016), categorized the aim of the mHealth interventions into five groups: health promotion and disease prevention; diagnosis; treatment; monitoring; and support for health services. Jusoh (2017) evaluated the state of mHealth apps covering mHealth apps on Google Play and an academic literature, and defines the aim of mHealth apps as: giving treatment; making the diagnosis; illness monitoring; self-management; and promoting healthy lifestyle behaviors. Sama et al. (2014) examine the mHealth apps in App Store to define the characteristics of the apps and understand their approaches in terms of patient engagement. They analyze nearly 400 mHealth apps to describe engagement methods offered by mHealth apps, since patient engagement, hence behavior change, is a significant factor for enhanced health outcomes. Consequently, Sama et al. (2014, p.2) identified nine categories of engagement: “i) changing personal environment, ii) facilitating social support, iii) goal setting, iv) progress tracking, v) reinforcement tracking, vi) self-monitoring, vii) social presentation or announcement, viii) social referencing, and ix) others”. They found that the self-monitoring approach was the most commonly used engagement method, used in 299 of the 400 mHealth apps chosen for the review.

Other prior work centered on mHealth apps address specific types of health concerns. A survey was carried out between August 2012 and September 2012 by Pew Research Center in order to demonstrate the number of mHealth apps users among US adults, as well as why and how these people use mHealth apps. According to the findings, 85% of US adults have a mobile phone, while 53% of those own smartphones. While half of the smartphone owners use their phones to maintain and monitor their health, 19% of the smartphone owners use mHealth apps for that. Additionally, the types of mHealth apps were identified based on health concerns. The health concerns mostly covered by the mHealth apps are fitness, diet, weight, menstrual cycle, blood pressure, pregnancy, diabetes, medication management, mood, and sleep (Fox & Duggan, 2012).

Debon et al. (2019) reviewed the literature to identify mHealth apps with features for enhancing patients' life quality with chronic diseases. The authors examined the studies related to mHealth apps for diabetes mellitus, hypertension, cardiovascular diseases, lung diseases, cancer, and chronic conditions reveal similar features. They found that most mHealth apps concentrated on the behavior changes of individuals' poor nutrition and physical inactivity since these behaviors are the main causes for chronic disease development. They also emphasized that the use of mHealth apps had a remarkable influence on lifestyle changes. They added there is a need for mHealth apps focused on not only the treatment of diseases but also the prevention of diseases.

Similarly, in order to identify common features of mHealth apps and possible opportunities for mHealth apps, Martínez-Pérez et al. (2013) carried two separate reviews: a review for mHealth apps in published articles and a review for mHealth apps on the commercial app stores. The researchers included the most common health conditions defined by WHO's Global Burden Disease, which are iron-deficiency anemia, hearing loss, migraine, low vision, asthma, diabetes mellitus, osteoarthritis, and unipolar depressive disorder. They observed that the prevalence of mHealth apps related to health conditions differ in literature and commercial reviews. For example, there were more studies related to asthma compared to depression in the literature. In contrast, the number of mHealth apps on the commercial market for depression is higher than the number of mHealth apps for asthma. They also found that the aims of the apps were generally related to monitoring, assisting, or informing the users about their health condition. Additionally, mHealth apps focused on monitoring and assisting have a more prevalent and frequent use rather than mHealth apps focused on informing. Combining mHealth apps focused on monitoring and informing might be advantageous for mHealth apps in terms of improving the frequency of use, increasing the number of users, and enhancing the apps' content.

2.2.2.2 Examples of mHealth Apps

In 2019, ten diseases inducing the highest mortality rate were accountable for 55.4 million deaths globally, and 7 out of 10 diseases were non-communicable diseases (NCDs), such as cardiovascular diseases, cancer, diabetes, Alzheimer's disease, and kidney diseases (WHO, 2020b). Non-communicable diseases are caused by genetic, physiological, environmental factors, and mostly by unhealthy behaviors such as having an unhealthy diet, using tobacco and alcohol, and being physically inactive. The unhealthy behaviors induce obesity, increased blood pressure, increased cholesterol, and eventually disease (WHO, 2021; WHO, 2020b). 74% of all deaths are induced by NCDs in 2019 and the rate is rising continually. Evidently, NCDs cause a large burden on the healthcare system because of the levels of mortality, morbidity, and cost. Therefore, there is a need for accessible, affordable, and effective interventions to decrease the influence of NCDs on healthcare. mHealth apps have the potential decrease the impact of NCDs (van Olmen, 2020).

Based on the mobile apps usage in 2018 which surveyed by Deep Knowledge Group, apps related to health, productivity, and sport are the most preferred among mHealth apps. The category of health, productivity, and sport are followed by geo-tracking, meditation, quantified-self, sleep, brain training, period tracking, and nutrition (Deep Knowledge Group, 2018).

Platt et al. conducted a review of literature and user survey, to determine the most popular features sought by users on the mHealth apps and the probability of user acceptance for these features. They identified that users were most likely to use the apps for fitness, weight control, general wellness, mental diseases, asthma, high blood pressure, and women's health (Platt et al., 2016).

In the light of this information related to health conditions and the mHealth apps, several mHealth apps on the commercial market will now be presented. In order to select the examples, the most downloaded mHealth apps were determined by researcher through examining the lists prepared by Koetsier (2020) and Statista

(2021b). The leading mHealth apps from five categories that will be presented are: i) Myfitnesspal for weight management, ii) FitBit and WalkFit for fitness, iii) Headspace, and Calm for meditation and sleep, iv) Flo for period tracking, and v) Hayat Eve Sığar for general health tracking.

i) ‘Myfitnesspal’ for weight management

MyFitnessPal, developed by Under Armour Inc., is an app to track diet and exercise. It is the world’s second popular app in Google Play and the third popular app in App Store among the health and fitness category (42matter AG., 2019). MyFitnessPal is a calorie counter that enables users to lose weight, get stronger, be healthy, and change their habits. With over 6 million foods in its databases, it allows users to automatically calculate calories in their food, their meals, and their recipes. It provides a personalized experience by enabling users to log the meals they eat during the day and create their own recipes.

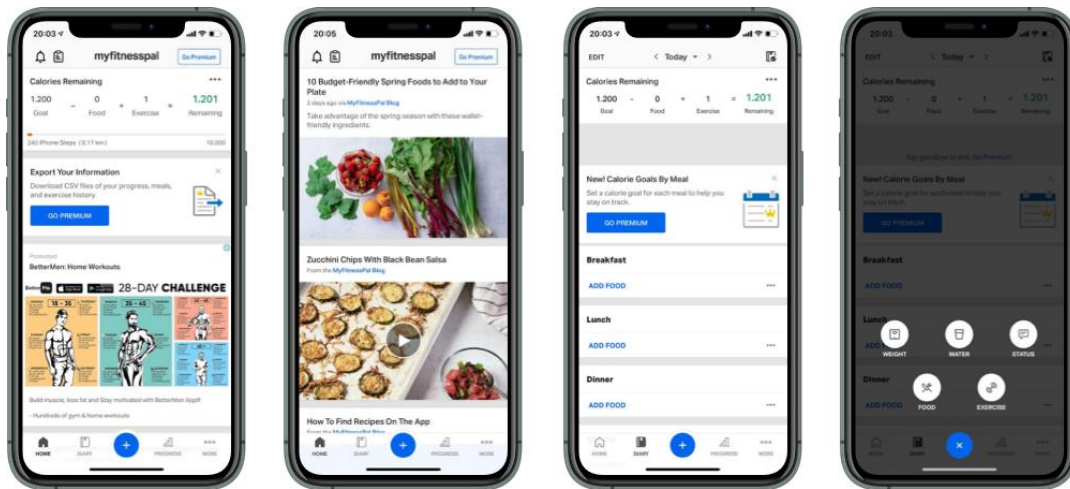


Figure 2.10 Example screenshots of Myfitnesspal

ii) ‘FitBit’ and ‘WalkFit’ for fitness

Fitbit, developed by Fitbit Inc., is a connected app to a fitness tracker or smartwatch. Through the app, users can track their activity, workouts, sleep, nutrition, and stress. Also, the app enables users to connect with their friends and offers activity challenges. Fitbit provides a community that users can find the support and

encouragement they need. The app is the seventh most rated app among the health and fitness category in the App Store.

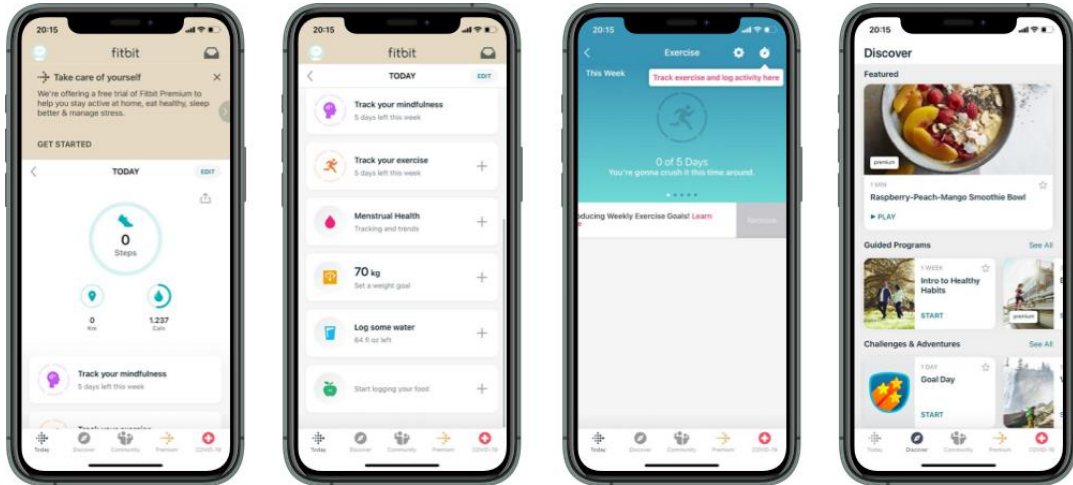


Figure 2.11 Example screenshots of Fitbit

Walkfit: Walking, Fitness Coach & Distance Tracker, developed by Mobilious Ltd., provides numerous walking exercises to help users achieve more healthy lives. Users can set a goal, follow their training schedule, track their progress, remain motivated with the help of daily notifications, and attend to challenges given by the app. Walkfit is the eighth-most popular app with approximately 2.21 million downloads from global users.



Figure 2.12 Example screenshots of Walkfit

iii) 'Headspace' and 'Calm' for meditation and sleep

Headspace, developed by Headspace Inc., is an app that guides users to mindfulness in daily life. With 3.8 million installs in the first half of 2020 in the U.S., it was the fourth most popular apps in the health and fitness category (Koetsier, 2020; Statista, 2021b). It helps users to learn simple meditation techniques and achieve mindfulness abilities by learning from well-known specialists. Besides mindfulness, users can find sleep meditation, restful sleep music, and sleep casts for a more comfortable night and sleep. Also, there are several 'SOS' courses to help users to relieve their panic, anxiety, and stress levels.

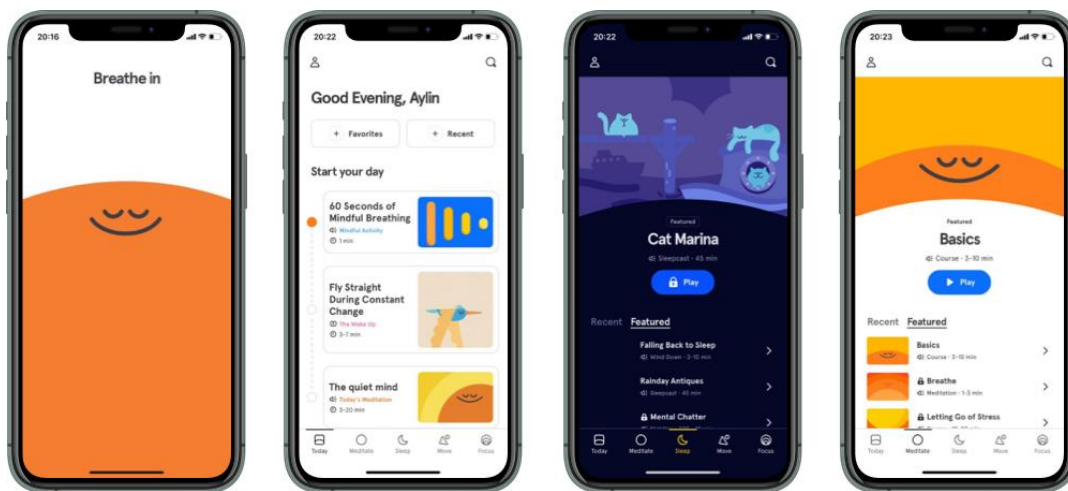


Figure 2.13 Example screenshots of Headspace

Calm, developed by Calm.com Inc., is a leading meditation and sleep app. According to Statista (2021b), the platform generated 1.6 million U.S. dollars in revenues from global users in 2020. While Calm aims to reduce stress and anxiety of the users, it also provides a restful sleep with several sessions. The app includes many features such as breathing exercises, meditations in different durations, exclusive music to support users relax, masterclasses with mindfulness experts, and lastly Sleep Stories vocalized by the celebrities.



Figure 2.14 Example screenshots of Calm

iv) 'Flo' for period tracking

Flo Period Tracker & Calendar, developed by Flo Health Inc., allows users to accurately track their period, fertility, or pregnancy. The app was the fifth most popular app in the health and fitness category with 3.6 million installs in the first half of 2020 in the U.S.; and still is in the App Store (Koetsier, 2020). Flo adopts Artificial Intelligence (AI) to provide a personalized experience. With Flo, users are able to track their period start date and length, PMS symptoms, fertile window, peak ovulation days, flow intensity, and birth control.

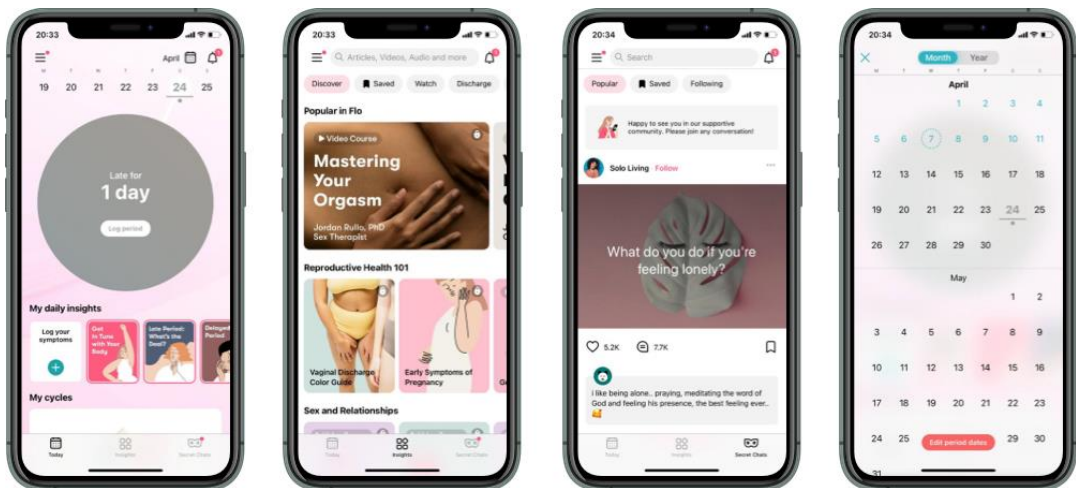


Figure 2.15 Example screenshots of Flo

v) ‘Hayat Eve Sığar’ for general health tracker

‘Hayat Eve Sığar’ (Life Fits Into Home) is developed by the Turkish Ministry of Health specifically for the Covid-19 pandemic to inform, track and guide citizens about Covid-19, to minimize the risks related to the epidemic, and to prevent its spread. After creating an account, users can obtain a personal health tracking code (called HES code), examine Covid dense/safe areas, by accessing daily virus-spread data on the GPS based map, and can track family members. It was the ninth-most downloaded app by approximately 1.17 million global users.



Figure 2.16 Example screenshots of Hayat Eve Sığar

Consequently, the examples of mHealth apps given above use for weight management, fitness, meditation and sleep, period tracker, and general health tracking. These examples have a wide range of use with various kinds of users. Fundamentally, these mHealth apps are used to support and enhance health and well-being. For that, all of them have several common features that promote individuals for performing healthy behavior such as sending notifications and enabling personalization. These mHealth apps and their features might be examined for the design of BSE apps, and it might give inspiration to foster behavior change for BSE and provide a positive experience.

2.2.3 mHealth Apps for Women

Although the health status of women and men is equally important, women's health is of growing concern due to many socio-cultural and economic obstacles. There are several obstacles preventing women from getting qualified health services, such as gender inequality, reduced opportunity for education and income, and exclusive attention for women's fertility roles (WHO, 2020a). Besides, women have some unique health concerns such as menstruation, pregnancy, birth control, and menopause. To give an example, about 810 women passed away due to avoidable reasons related to pregnancy and childbirth in 2017 (WHO, 2019). In spite of this, women health studies predominantly concentrate on enhancing women's sexual and reproductive health (Peters et al., 2016). Nevertheless, the mortality levels among women and the burden of women's health on healthcare systems have shifted from women's sexual and reproductive health to NCDs over the last decades (Peters et al., 2016). Some of the most common NCDs among women are cardiovascular diseases, cancer, respiratory diseases, diabetes, dementia, depression, and musculoskeletal disorders (Derbyshire & Dancey, 2013; Peters et al., 2016). In the light of this shift, the perspective on women's health should be redefined, the healthcare interventions and policies should be designed to prevent and treat such diseases (Peters et al., 2016).

The utilization of mHealth interventions for women has increased significantly in the past decade, likewise for many health issues. Based on Statista estimations, the market segment of mHealth apps related to women's health was 523 million in 2018, and it will be 4.9 billion U.S. dollars in 2025 (Statista, 2020). It was also reported that downloads from women users and the use of mHealth apps by women significantly more than men (Derbyshire, & Dancey, 2013; Reporter, 2012). There is an evidence that mHealth apps have a positive impact on obtaining desired health behaviors, and managing and preventing NCDs (Vlahu-Gjorgievska et al., 2018; Zangger et al., 2021).

The most common modifiable health behaviors can be said the ones that are related to physical activity, weight management, mental health, tobacco use, and alcohol use. A considerable amount of literature has been published on mHealth apps and the abovementioned health behaviors among women, including women and physical activity (Ainscough et al., 2020; Fukuoka et al., 2019; Joseph et al., 2019; Nielsen et al., 2019; Lindgren et al., 2019); nutrition, diet, and weight management (Griffin et al., 2020; James & Harville, 2017; van Dijk et al., 2020); mental health (Baumel et al., 2018; Coelho et al., 2019); tobacco use (Armin et al., 2017; Gordon et al., 2017); and alcohol use (Hai et al., 2019).

The two leading reasons of death in women were related to heart diseases and cancer in 2017 (CDC, 2021). These two reasons were also the top two diseases that women fear from and think as the most critical health issues (Statista, 2019). Several systematic reviews have been undertaken related to heart disease (Sengupta et al., 2020) and cancer (Fogel et al., 2002; Chow et al., 2020; Soto et al., 2018; Zhu et al., 2018) among women. As mentioned previously, cancer, especially breast cancer, is one of the most common disease types among women. BSE is one of the primary screening methods recommended for the early detection of breast cancer. Despite the fact that BSE is an easy, accessible, affordable method amongst primary screening mHealth apps have a potential to facilitate behavior change in the context of breast cancer, likewise other health behaviors such as physical activity, and diet (Kalke et al., 2020). The subsequent section will provide an overview of mHealth apps and their utilization for breast health.

2.2.4 mHealth Apps for Breast Health

Breast cancer rates have been increasing worldwide, particularly among women. Such rapid changes in the incidence of early-onset breast cancer cannot be attributed solely to genetics, but rather to interactions between health behaviors and genes (Johnson et al., 2013; IARC, 2020). However, the post cancer treatment 5-year survival rate approaches to 88% when breast cancer is treated appropriately, and the

rate of breast cancer survivorship is on a constant rise thanks to improvements in treatments (Weingart et al., 2008).

Breast cancer is now recognized as a chronic disease rather than an acute illness. This indicates that breast cancer should be treated with a focus on long-term goals and wellbeing promotion (Bodai & Tusso, 2015). In addition, the ever-increasing number of breast cancer requires new models of care. These models should include a personalized needs assessment; a self-management care approach as well as individualized follow-up and support (Pagani & Eicher, 2014). Self-management is “the ability of the individual, in conjunction with family, community, and health care professionals, to manage symptoms, treatments, lifestyle changes, and psychosocial, cultural, and spiritual consequences of health conditions” (Richard & Shea, 2011, p.256). Evidence suggests that self-management interventions improve the quality of life of women with breast cancer by enabling self-care, mindfulness-based stress reduction, and improved management of medical, emotional, and role-based tasks (Van Dijck et al., 2016; Eyles et al., 2015).

In parallel to this, mHealth technologies have emerged as new tools for delivering healthcare and health-related services in the field of cancer, particularly breast cancer (Houghton et al., 2019). As the usage of mobile apps has become widespread and essential part of our daily lives, mHealth apps also come into prominence (Aitken et al., 2017). In a search carried out by Giunti et al. in 2018, there were a total of 1473 apps matched the search terms of “breast cancer”, of which 692 apps were from the iTunes App Store and 781 apps were from the Google Play Store.

Research indicates that using mHealth apps to support patients with breast cancer can offer several advantages including enhanced knowledge, increased physical activity, eliciting short-term reductions in weight, decreased anxiety, improved self-confidence, emotional well-being, and improved quality of life (Zhu et al., 2018; Pope et al., 2019). Several studies address mobile apps for breast health and breast cancer. According to the study conducted by Houghton et al. (2019), an effort was made to determine the extent of mHealth apps included in breast cancer prevention.

The study was carried out using the Preferred Reporting Elements for Systematic Reviews and Meta-Analysis (PRISMA) guides, searches were made in PubMed and Web of Science Core Collection databases, based on the keywords of breast cancer, smartphone, mobile application, and phone application. At the end, it was revealed that early diagnosis app usage rate was very low. It was stated that people with an average risk of breast cancer are not particularly active in using apps.

In another study conducted by Ribeiro et al. (2017), it was assumed that smartphones can be used to prevent cancer. In this direction, a smartphone app called "Happy" was developed to encourage people's cancer prevention behaviors with its special message contents. Then, a fieldwork was carried out to test the app, and as a result, it was evident that the app was effective in improving people's cancer prevention behavior.

Kapoor et al.'s (2020) study was aiming to evaluate the free mobile apps for breast cancer survivors on Android and iOS in terms of their usability and the identification for self-management features. For this aim, six main self-management features for mHealth apps were determined based on the Chronic Care Model as follows symptom tracking; survivorship education; information-sharing with family and/or caregivers; scheduling, follow-up visits; personal alerts and reminders; and social networking. First, they reviewed 424 apps on Google Play and App Store. The app number was reduced to 67 with initial selection that include criteria such as having English description, not having requirement of payment, and having user rating on app stores. Then, 9 out of 67 apps were selected by evaluating the apps based on whether include self-management features. The study revealed the frequencies of adoption of each determined self-management features on the apps. According the study, the most common self-management feature among the apps examined was determined as survivorship education, followed by social networking. Lastly, Kapoor and colleagues emphasized the lack of mHealth apps that met the need of people who have survived breast cancer, and they stated that further studies could include breast cancer survivors to better understand their needs for mHealth apps. (Kapoor et al., 2020).

This section has demonstrated that the prevalence of mHealth apps has been increasing and mHealth apps are utilized for several health-related purposes. According to literature review, mHealth apps have a positive impact on monitoring and managing breast health. Therefore, they have a potential to encourage women in performing BSE and support their healthy behaviors. In the next section, current approaches in design for healthcare, especially approaches related to enhancing healthy behaviors, with the help of technology will be presented.

2.3 Current Approaches in Design for Healthcare

The shift in healthcare system, the advancements in technology, and the prevalent utilization of mHealth and mHealth apps in healthcare domain have changed the perspective on health. Current approaches in design for healthcare are necessary to understand individuals' needs in managing their own health, to support their healthy behavior, and to facilitate their use of technology. Following section will present persuasive technology, positive psychology, and positive technology as prevalent current approaches.

2.3.1 Persuasive Technology

It is essential to adopt new approaches and a paradigm shift in healthcare to prevent the expansion of NCDs and chronic diseases that cause a great burden on the healthcare systems (Moghaddam & Lowe, 2019). As previously stated, the two most prevalent approaches that can be adopted are person-centered healthcare, and self-management healthcare (Bause et.al, 2019; Tseklevs & Cooper, 2017). The common aspects of the two approaches are to empower individuals to be responsible for their own health, and to enable individuals to self-manage or enhance their own health (Tseklevs & Cooper, 2017). With the growth of smartphone usage, mHealth apps have become a promising opportunity to support the self-management healthcare approach (Moghaddam & Lowe, 2019). Additionally, mHealth apps can

help to monitor individuals' health data and help to diminish the healthcare problems. Therefore, they are essential tools to foster change in health-oriented behaviors to support individuals for healthy living (Boudreaux et al., 2014; Guo et al., 2015). Briefly, behavior in this context can broadly be defined as: "*... anything an individual does in response to internal or external events. Overt action (motor or verbal) which is directly measurable; behaviors are physical events that occur in the body and are controlled by the brain*" (Kwasnicka et al., 2016).

The number of mHealth apps on the app market has been rising rapidly, especially mHealth apps related to health-oriented behaviors such as physical activity, tobacco use, alcohol use, nutrition, and mental health (Fox & Duggan, 2012). Nevertheless, most of these apps developed and released without comprehensively reviewed by an expert, and their effectiveness for behavior change has not been precisely investigated (Han & Lee, 2018; Torning & Oinas-Kukkonen, 2009). For that reason, it is essential to investigate the effectiveness of mHealth apps for behavior change as well as behavioral change techniques that best foster positive behavior change (Milne-Ives et al., 2020).

Persuasive technology is one of the behavior change techniques that can be adopted in the healthcare domain (Fogg, 2003). A definition provided by Fogg (2003, p.24) suggests that persuasive technology is "computerised software or information system designed to reinforce, change or shape attitudes or behavior or both without using coercion or deception". Persuasive technology supports and prompts individuals to adopt beneficial behavior for themselves and for their communities (Orji & Moffatt, 2018). Persuasive technology in healthcare serves as a mechanism for individuals to monitor and maintain their health, thereby enhancing individuals' quality of life and promoting health among community (Qasim et al., 2018).

In accordance with this, the use of persuasive technology that aims to positively affect health and wellness via mHealth apps has been growing over the past decade (Kegel & Wieringa, 2014). Persuasive technologies in health and wellness domain concentrate on physical activity (Al Ayubi et al., 2014; Aldenaini et al., 2020; Haque

et al., 2020), diet and weight management (Aydin et al., 2017; Asbjørnsen et al., 2019; Fabri et al., 2013), smoking (Ham & Langrial, 2020; Karim et al., 2017), and sexual behavior (Schnall et al., 2015).

On the other hand, behavior change can be difficult to accomplish despite of the utilization of persuasive technology (Oinas-Kukkonen & Harjumaa, 2009). Over time, numerous studies suggested theories that offer persuasion strategies to achieve behavior change with persuasive technology. The following section will introduce some of the most prevalent persuasive models.

2.3.1.1 Persuasive Models

This section introduces i) Fogg Behavior Model (FBM) and ii) Persuasive Systems Design (PSD) within the field of persuasive technology.

i) Fogg Behavior Model (FBM)

In Fogg Behavior Model (FBM), there are three essential factors for individuals to perform a target behavior including motivation, ability, and trigger (Fogg, 2009). The FBM enables understanding the connections between these three factors. According to Fogg (2009), these factors must be met at the same time in order to achieve the desired behavior.

As can be seen in Figure 2.17, in FBM, there are two axes: vertical axis for motivation and horizontal axis for ability. The desired behavior occurs with sufficient motivation and sufficient ability. Nevertheless, in individuals with low ability, increasing motivations might be a solution for crossing the behavior activation threshold. Fogg (2009) stated that the FBM framework included three core motivators: pleasure/pain, hope/fear, and social acceptance/rejection. Based on the model, increased pleasure, hope, and social acceptance or decreased pain, hope, and rejection enable increasing motivation. In addition, in individuals with low motivation, an increase in ability might be also a solution to achieve the desired behavior. In order to increase individuals' ability, the desired behavior should be

made easier to do instead of teaching individuals new things or training them. That is, simplicity is required to increase ability, and simplicity consists of six elements: time, money, physical effort, brain cycles, social deviance, and non-routine.

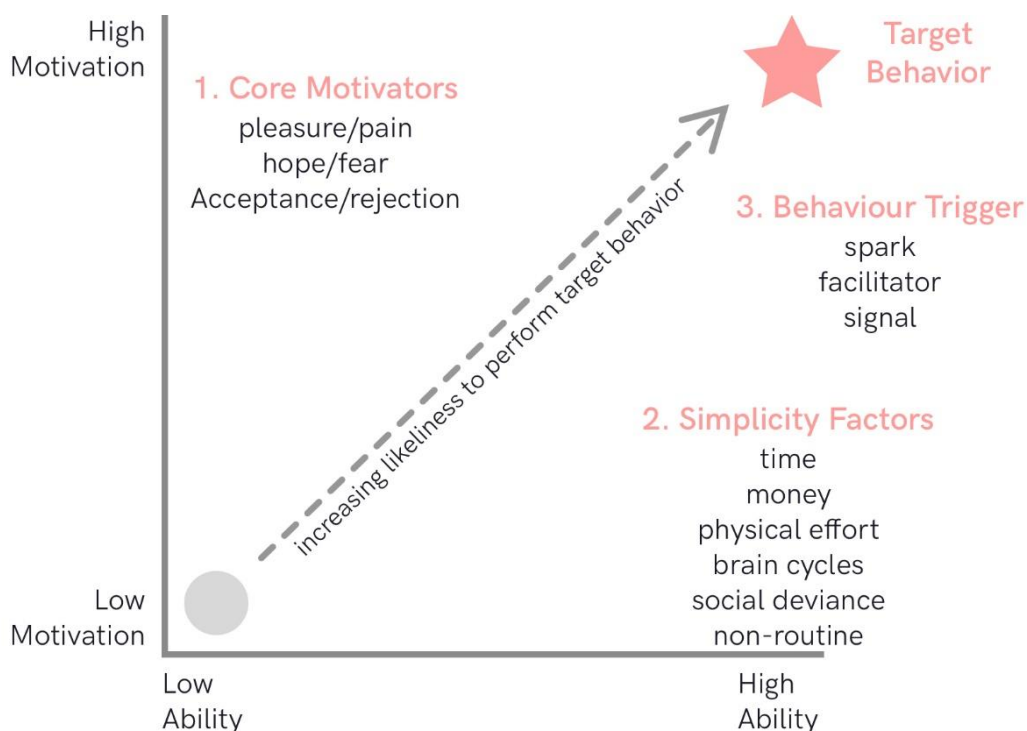


Figure 2.17 All three factors in the Fogg Behavior Model have subcomponents (Fogg, 2009)

Although individuals have high motivation and high ability, it is not possible to achieve target behavior without a trigger. There are three types of triggers 1) facilitator that makes behavior easier, 2) spark that motivates behavior, and 3) signal that reminds behavior (see Figure 2.18).

To summarize, the FMB declares that as individuals are tried to be persuaded with technologies to achieve the desired behavior, but the desired behavior will only be achieved with sufficient motivation, ability, and right trigger (Kouroupetroglou et al., 2015). The FBM facilitates understanding the fundamental determinants in behavior change for designers and researchers. Lastly, it is asserted that FBM can be adopted for the design and implementation of behavior change systems with persuasive strategies (Kouroupetroglou et al., 2015).

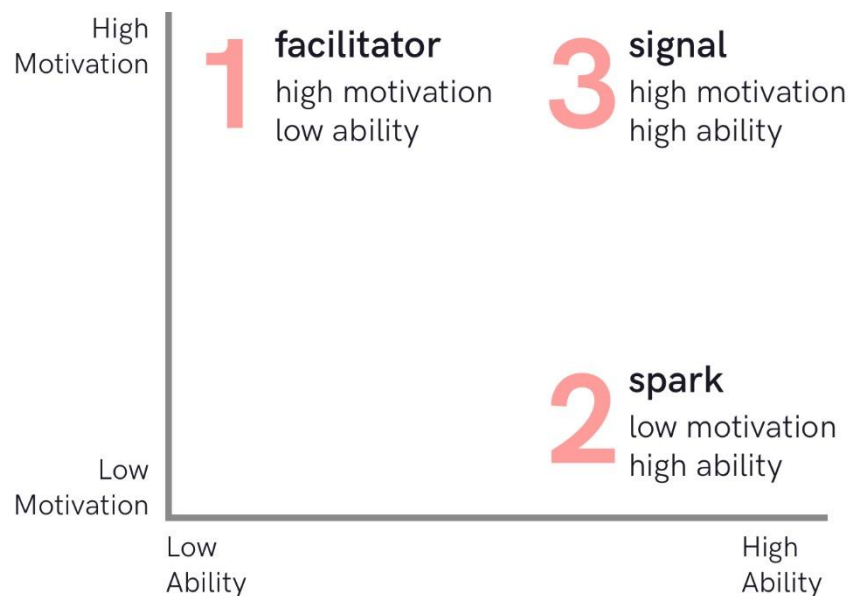


Figure 2.18 Three types of triggers based on Fogg Behavior Model (<https://behaviormodel.org/>)

ii) Persuasive Systems Design (PSD)

Despite the framework suggested by Fogg provides an understanding of persuasive technology, it was found insufficient to be utilized in the development or assessment of persuasive technology (Harjumaa & Oinas-Kukkonen 2007). Therefore, Persuasive System Design (PSD) model conceptualized by Oinas-Kukkonen and Harjumaa, was developed to be utilized for designing and assessing persuasive systems that affect individuals' behavior (Matthews et al., 2016). In this model, there are three main phases (see Figure 2.19): understanding the fundamental issues behind persuasive systems, analyzing the persuasion context, and designing system qualities (Oinas-Kukkonen & Harjumaa, 2009).

In the first phase, in order to understand the fundamental issues behind persuasive systems, seven postulates that require to be considered while designing or assessing persuasive systems are determined. These seven postulates are: 1) information technology is never neutral, 2) people like their views about the world to be organized and consistent, 3) direct and indirect routes are key persuasion strategies,

4) persuasion is often incremental, 5) persuasion through persuasive systems should always be open, 6) persuasive systems should aim at unobtrusiveness, and 7) persuasive systems should aim at being both useful and easy to use (Oinas-Kukkonen & Harjumaa, 2009, p.487).



Figure 2.19 Phases in Persuasive Systems Development (Oinas-Kukkonen & Harjumaa, 2009)

In the second phase, the aim is to analyze the persuasion context, which requires to understand of what occurs in the information processing event, in other words understanding the roles of persuader, persuadee, message, channel, and the larger context. For context analysis, the intent of the persuasion, understanding the persuasion event, and defining and/or recognizing the strategies in use are need to be included (Oinas-Kukkonen & Harjumaa, 2009). Briefly, the model promotes a comprehensive analysis of the use and user context whereas designing persuasive software features (Langrial et al., 2012; Torning & Oinas-Kukkonen, 2009).

In the last phase, the model proposes four categories for system qualities as follows: primary task support, dialogue support, system credibility support, and social

support. Besides these four categories, the model includes 28 design strategies, 7 from each category, for persuasive system content and functionality (Oinas-Kukkonen & Harjumaa, 2009).

*Primary task support*_ The category is related to intended behavior and performing this behavior, and includes 7 design strategies as follows: reduction, tunneling, tailoring, personalization, self-monitoring, simulation, rehearsal (see Table 2.1).

*Dialogue Support*_ The category involves the system feedback that leads the user to achieve the intended behavior, and the design strategies in this category are praise, rewards, reminders, suggestion, similarity, liking, and social role (see Table 2.2).

*Credibility support*_ The category emphasizes that credibility is a persuasive component, and includes trustworthiness, expertise, surface credibility, real-world feel, authority, third-party endorsements, and verifiability as design strategies (see Table 2.3).

*Social support*_ It illustrates the methods to drive users for intended behavior by benefiting from social impact. It consists of 7 design strategies which are social facilitation, social comparison, normative influence, social learning, cooperation, competition, and recognition (see Table 2.4).

Table 2.1 Design Strategies of the PSD model: Dialog Support (Oinas-Kukkonen & Harjumaa, 2009)

PSD model strategies: Primary task support	
Reduction	The system has to decrease effort and strain that users consume when doing their target behavior. The reduction principle can be achieved by reducing a complex behavior into simple and easy tasks for users.
Tunneling	The system has to guide users in the attitude change process or experience by providing opportunities for action performance that makes user nearer to the target behavior.
Tailoring	The system has to offer tailored information for its user group according to their interests, needs, personality, or other factors related to the user group.
Personalization	The system has to provide personalized content and customized services for users.
Self-monitoring	The system has to give means for users to track and monitor their performance, progress, or status in accomplishing their goals.
Simulation	The system needs to give means for observing and noticing the connection between the cause and effect of users' behavior.
Rehearsal	The system must deliver means for rehearsing a target behavior.

Table 2.2 Design Strategies of the PSD model: Dialog Support (Oinas-Kukkonen & Harjumaa, 2009)

PSD model strategies: Dialog support	
Praise	The system has to deliver praise through images, symbols, words, videos, or sounds as an approach to give user feedback information regarding his/her behavior.
Rewards	The system should offer virtual rewards for users to provide credit for doing the target behavior. The virtual rewards come in different forms such as collecting points or trophies, and changing media elements (e.g., background, sounds, or avatar), etc.
Reminders	The system has to remind users to perform their target behavior while using the system.
Suggestion	The system has to suggest ways that users can achieve the target behavior and maintain performing behavior during the use of the system.
Similarity	The system must imitate its users in some particular manner, so the system should remind the users of themselves in a meaningful way.
Liking	The system should be visually attractive and contain a look and feel that meets its users' desires and appealing.
Social role	The system has to adopt a social role by supporting the communication between users and the system's specialists.

Table 2.3 Design Strategies of the PSD model: System Credibility Support (Oinas-Kukkonen & Harjumaa, 2009)

PSD model strategies: System credibility support	
Trustworthiness	The system has to give truthful, fair, reasonable, and unbiased information.
Expertise	The system has to offer information displaying experience, knowledge, and competence.
Surface credibility	The system must have a competent look and feel that portrays system credibility based on an initial assessment.
Real-world feel	The system must give information of the organization and/or the real individuals behind its content and services.
Authority	The system should refer to people in the role of authority.
Third-party endorsements	The system should deliver endorsements from well-known and respected sources.
Verifiability	The system has to give means to investigate the accuracy of the system content through external sources.

Table 2.4 Design Strategies of the PSD model: Social Support (Oinas-Kukkonen & Harjumaa, 2009)

PSD model strategies: Social support	
Social learning	The system has to give a user the ability to observe other users and their performance outcomes while they are doing their target behavior.
Social comparison	The system should enable users to compare their performance with other users' performance.
Normative influence	The system has to have a feature for gathering together individuals that have identical objectives and let them feel norms.
Social facilitation	The system should enable a user to discern other users who are performing the target behavior along with him/her.
Cooperation	The system should offer the opportunity for a user to cooperate with other users to achieve the target behavior goal.
Competition	The system should allow a user to compete with other users. In the competition principle, there is a chance for winning or losing a race.
Recognition	The system has to offer public recognition (e.g., ranking) for users who do their target behavior.

There are several studies investigated the effectiveness of persuasive technology within mHealth apps and/or identified the usage frequency of persuasive strategies integrated in mHealth apps. For example, Langrial et al. (2012) conducted an expert review to identify persuasive features by evaluating twelve mHealth apps with PSD model. They identified which of the 28 design strategies were in each mHealth app that evaluated in the study. As a result, they found that ‘self-monitoring’ (12 out of 12 apps), ‘reduction’ (11/12), and ‘personalization’ (4/12) among primary task support category were the most utilized strategies, while ‘tailoring’ was not observed among the evaluated apps. From dialog support category, the most common strategy integrated was the use of ‘reminder’s (5/12). Even though ‘trustworthiness’ (8/12) and ‘real-world feel’ (7/12) strategies were found to be most employed, the other strategies among credibility support category were hardly used. Lastly, the utilization of strategies from social support category were limited, the only features related social support were blogs, forums and discussion boards (Langrial et.al, 2012).

Even though the PSD model might be employed to motivate and persuade individuals to achieve the intended behavior, the creators of the model did not explain why some of the strategies chosen particularly and describe how to select and utilize the design strategies (Kegel & Wieringa, 2014). Moreover, the model has a great potential to lead the development of persuasive systems for achieving behavior change; yet, the model has not been tested in detail and proved in terms of effectiveness (Oinas-Kukkonen & Harjumaa, 2009). Therefore, the PSD model is not sufficient to cover all strategies for persuasive technology despite its usefulness in coordinating the strategies (Aldenaini et al., 2020).

2.3.2 Positive Psychology

In the previous section (see Section 2.2), it was mentioned that healthcare systems have been dealing with a variety of challenges and a great burden for decades. Therefore, to tackle the problems in healthcare systems, there has been a shift in

healthcare from the traditional approach focusing on treating diseases towards a new approach that focuses on enhancing individuals' well-being.

In the psychology domain, the situation was similar, in which the focus of psychology had often been on the pathological conditions and the diagnosis-treatment of people with mental health problems (Grossi et al., 2020; Kauffman, 2006). Because of this, psychologists had very little knowledge about how people flourish in better conditions (Seligman & Csikszentmihalyi, 2000). At the beginning of the millennium, psychologists started realizing that they only focused on helping people with mental health problems due to the diagnostic-treatment model and left other people outside of their scope (Grossi et al., 2020; Riva & Gaggioli, 2015).

This approach continued until the shift in focus of psychology from treating disease to enhancing well-being and "making normal life more fulfilling" with the study of psychologists such as Seligman and Csikszentmihalyi (Kumar & Vohra, 2017; Seligman & Csikszentmihalyi, 2000). The term "positive psychology" was introduced by Maslow in 1954; however, it was popularized with Martin Seligman's study in American Psychological Association in 1988 (Kumar & Vohra, 2017). As Seligman (2002, p.4) mentioned:

"The message of the Positive Psychology movement is to remind our field that it has been deformed. Psychology is not just the study of disease, weakness, and damage; it also is the study of strength and virtue. Treatment is not just fixing what is wrong; it also is building what is right. Psychology is not just about illness or health; it is about work, education, insight, love, growth, and play. And in this quest for what is best, Positive Psychology does not rely on wishful thinking, self-deception, or hand-waving; instead, it tries to adapt what is best in the scientific method to the unique problems that human behavior presents in all its complexity."

Positive psychology aims to explore human strengths and virtues, and hereby promote the strengths to flourish individuals, communities, and societies (Seligman & Csikszentmihalyi, 2000). The positive psychology approach is focused on the positive emotions and the improvements in emotional states rather than trying to fix

negative aspects in human life. In other words, positive psychology tries “to make normal life more fulfilling” (Compton, 2005). However, the purpose of positive psychology is not to deny the unpleasant and negative aspects of human life, but to address the entire scope of people’s experiences by studying "the ways that people feel joy, show altruism, and create healthy families and institutions" (Gable and Haidt, 2005, p.105).

The field of positive psychology can be explored at three levels: subjective, individual, and group level (Hefferon & Boniwell, 2011; Seligman & Csikszentmihalyi, 2000).

‘The subjective level’ includes the positive experiences and states across past, present, and future; for example, well-being, contentment, and satisfaction (past), flow and happiness (present), and hope and optimism (future). ‘The individual-level’ focuses on defining the characteristics of a ‘good person’, such as talent, wisdom, love, courage, creativity, resilience, and determination. ‘The group level’, which is also recognized as community-level, is about enhancing the progress of institutions, citizenship, and communities. Some of the issues of group-level include being a good citizen, having work ethics, being selfless, and having tolerance. Consequently, the mission of positive psychology can be explained as a focus on the enhancement of life quality and well-being through these three levels like positive subjective experience, positive characteristics of individuals, and positive communities (Seligman & Csikszentmihalyi, 2000).

In accordance with the fact that positive psychology concentrates on positive emotions, with the contribution of positive psychology, the interest in a good life has increased in the psychology field (Lopez & Snyder, 2011). As Seligman (2002) mentions in his book titled “Authentic Happiness”, there are ‘three pillars’ of a good life: i) the pleasant life, ii) the engaged life, and iii) the meaningful life (Seligman, 2002).

i) The pleasant life

Pleasant life can be achieved through the presence of pleasure and encouraged by activities that increase positive emotions. As stated by positive psychologists, pleasure occurs with experiences that make us feel good (Peterson et al., 2005). Fredrickson says "Certainly moments in people's lives defined by experiences of positive emotions such as joy, interest, contentment, love and the like—are moments in which they are not plagued by negative emotions—such as anxiety, sadness, anger, and despair." (2001, p.1) He also states that positive emotions could have positive contribution to the psychological and physical well-being of individuals not simply in the present, but also in the long term, hence people should foster positive emotions in themselves and in those around them to achieve a pleasant life (Fredrickson, 2004).

ii) The engaged life

Engaged life can be achieved through participating in empowering activities and by utilizing an individual's strengths and virtues. The concept of engaged life is based on Aristotle's ethical doctrine, that is, on the eudaimonic definition of well-being (Ryff & Keyes, 1995). According to the eudaimonic view, which is one of the basic approaches of positive psychology, the concept of well-being includes much more than the satisfaction of pure pleasure (Ryan & Deci, 2001). Ryff and Keyes define psychological well-being as consisting of six aspects of human experience: autonomy, self-acceptance, mastery, personal growth, positive relationship, and mastery (Ryff & Keyes, 1995).

iii) The meaningful life

Meaningful life can be achieved by making an effort for a purpose more significant than oneself. In other words, it can be defined as complex well-being that depends on both hedonic and eudaimonic well-being. The aim of a meaningful life is to serve a great purpose to promote cohesion among individuals, communities, and groups by mixing individual wellbeing and social well-being (Keyes & Haidt, 2003).

Consequently, emotional, psychological, and social wellbeing ought to be encouraged to achieve the pleasant, engaged, and meaningful life (Keyes and Lopez, 2002).

While studies on positive psychology and its dissemination to a broad audience continued, it was argued that technology and its innovative utilization could help to enhance well-being as well (Desmet & Sääksjärvi, 2016). Riva et al. (2012) proposed that to enhance well-being the objectives of positive psychology can be combined with technology towards a new paradigm: Positive Technology.

2.3.3 Positive Technology

Positive Technology combines the objectives of positive psychology with the advancements in information and communication technologies (ICT) to improve the quality of personal and collective life, and to enhance emotional, psychological, and social well-being (Serino et al., 2013; Downey, 2015). In other words, positive technologies can be described as *“the scientific and applied approach to the use of advanced technology for improving the quality of personal experience.”* (Riva et al., 2012, p.1).

Positive technologies aim to utilize technology to manage and improve the characteristics of personal experiences for advancing wellness in individuals, organizations, and society (Wiederhold & Riva, 2012). As mentioned in the Positive Psychology section, there were three pillars of good life: the pleasant, engaged, and meaningful life. Serino et al. (2013) discuss levels of integrating positive psychology into positive technology for supporting the pleasant, engaged, and meaningful life (see Figure 2.20).

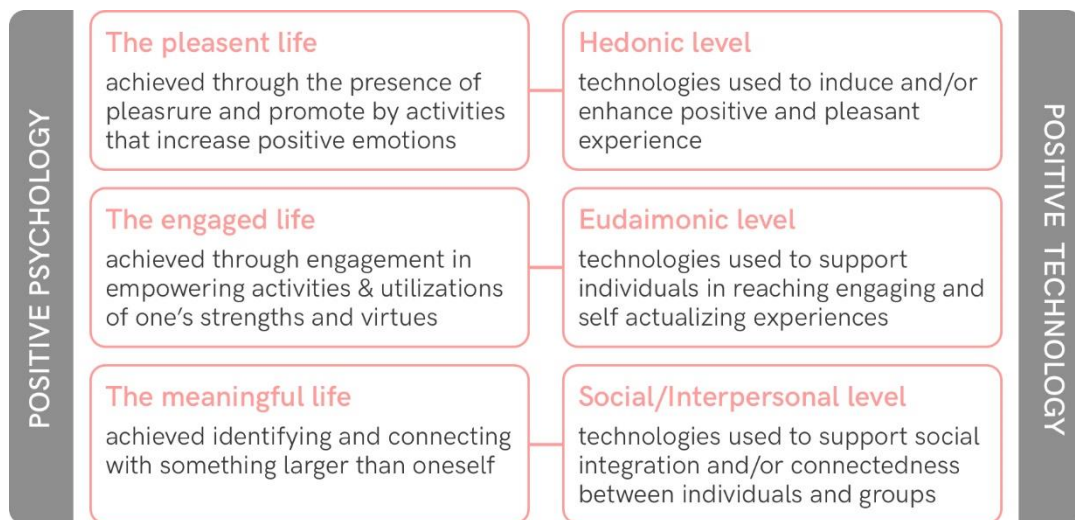


Figure 2.20 The three level for supporting the pleasant, engaged and meaningful life with Technologies (Serino et al., 2013)

In accordance, to enhance well-being, positive psychology determines three components of personal experience: emotional quality; engagement/actualization; and connectedness (Botella et al., 2012; Riva & Gaggioli, 2015). Botella et al. (2012) classified positive technologies into levels based on their impacts on the personal experience, which are hedonic level, eudaimonic level, and social and interpersonal level. Riva et al. (2012) demonstrated the relation between three components of personal experience and three levels of positive technologies; and also illustrated their link with well-being and gave examples of related ICT topics (see Figure 2.21).

Accordingly, ‘the hedonic level’ represents the technologies that produce positive and pleasant experiences. ‘The eudaimonic level’ represents technologies that encourage individuals to reach engaging and actualizing experiences. Lastly, ‘the social/interpersonal level’ represents technologies improving connectedness and supporting socialization.

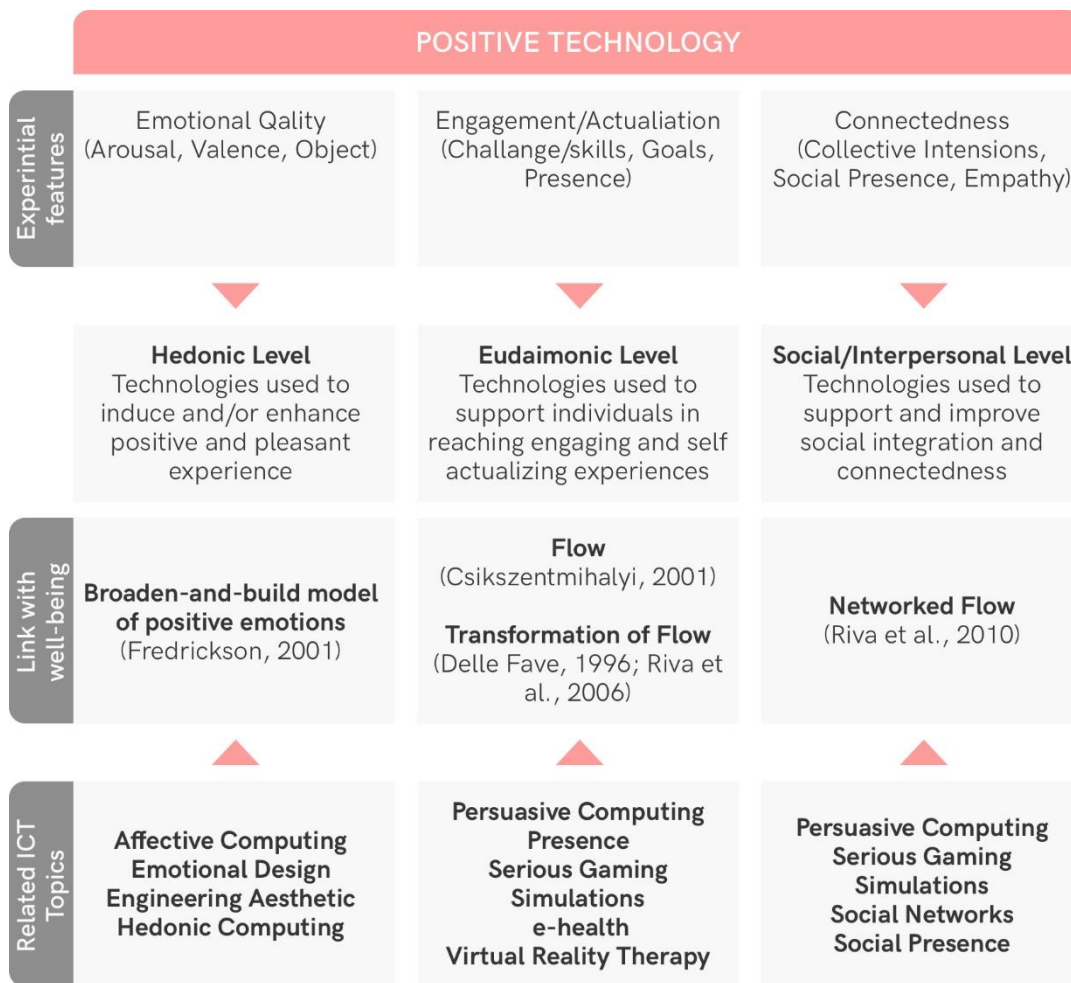


Figure 2.21 Positive Technology domain (Riva et al., 2012)

2.3.3.1 Hedonic Level

One of the levels of Positive Technology is the hedonic level which concerns how technology is used to foster positive emotional states such as joy and relaxation. Recently, the role of emotions in the human-computer interaction domain has been increasingly discussed, which this discussion reveals the trends such as engineering aesthetics and hedonic computing. A common aspect of these trends is that they highlight the significance of understanding how user interfaces should be designed to promote positive emotional experiences for users (Riva et al., 2012). Moreover,

there are several studies concentrating on how to stimulate positive emotional states in experimental and clinical settings.

In line with the model of emotions proposed by Russell it is achievable to change the affective quality of an experience through the manipulation of “core affect”, a neurophysiological category corresponding to the combination of valence and arousal levels that endow the subjects with a “core knowledge” about the emotional features of their experience (Russell, 2003; Riva et al., 2020). Russell gives an example of a change in "core affect": "Alice is calmly strolling through the woods. A wild bear steps into her path. She is startled, utters a quick yell, freezes, and then flees." (2003, p.146). In this example, if the core emotion was 'calm' due to doing a relaxing activity then, the core emotion would be 'fear' because of encountering a bear.

Another model that presents main arguments for the benefit of positive emotions in increasing well-being was provided by Fredrickson (Fredrickson, 2001; Fredrickson, 2004), which is called the “broaden-and-build model” of positive emotions. The broaden-and-build theory defines the forms of positive emotions, such as joy, interest, contentment, and love (Fredrickson, 2001). Based on the model, a fundamental proposition is that these positive emotions provide a complementary influence, positive emotions increase an individual’s momentary thought-action repertoires and extend the order of the thoughts and actions that come to mind (Fredrickson, 2004). According to Fredrickson (2004, p.1367), for instance, "joy sparks the urge to play, interest sparks the urge to explore, contentment sparks the urge to savor and integrate, and love sparks a recurring cycle of each of these urges within safe, close relationships". The second fundamental proposition is related to the outcomes of these broadened mindsets. By increasing an individual’s thought-action repertoire and awareness, the resultant learning to produce future physical, psychological, and social resources is focused.

2.3.3.2 Eudaimonic Level

Another level of Positive Technology is the eudaimonic level, which is about how technology can be used to enable individuals to reach engaging and self-actualizing experiences. Similar to the discussions related to the hedonic level, researchers from the human-computer interaction domain recently have tried to address this challenge. According to Rogers' study, for instance, there is a need for a shift from “proactive computing” to “proactive people,” where “technologies are designed not to do things for people but to engage them more actively in what they currently do.” (Rogers, 2006, p.406).

Based on Figure 2.21, there are two main theories linking well-being: Flow (Csikszentmihalyi, 1990) and Transformation of flow (Delle Fave, 1996; Riva et al., 2006).

The theory of flow, suggested by Positive Psychology pioneer Mihaly Csikszentmihalyi (1990), presents a valuable framework for dealing with this challenge. According to Riva et al. (2019), flow is a positive and complex state of consciousness that is present when individuals act with total involvement. The perceived balance and positive consciousness between personal skills that offer environmental opportunities for action and enable them to be faced with these opportunities can be defined as the state of total participation flow or optimal experience (Riva & Gaggioli, 2015). The features of the Flow theory are indicated as: "clear rules, accurate feedback, control of an individual's actions and environment, loss of self-consciousness, deep concentration, positive effects, and intrinsic motivation" (Skadberg & Kimmel, 2004; Hedman & Sharafi, 2004; Pace, 2004). The flow theory has been broadly used to study user experience in Information and Communication Technologies. For instance, it is used for topics related to ICT such as persuasive computing, presence, serious gaming, simulations, e-health, and virtual reality therapy, as can be seen in Figure 2.21.

Another theory related to the eudaimonic level of Positive Technology is the Transformation of Flow. The theory of "Transformation of Flow" is the ability of an individual to utilize flow for identifying and employing new and unexpected sources as sources of involvement. Individuals might adopt this approach in order to deal with radical alteration in day-to-day life and obtain new environmental opportunities for action.

2.3.3.3 Social and Interpersonal Level

The last level of Positive Technology is the social/ interpersonal level, which is about the use of technology to support and enhance the connectedness between individuals, groups, and organizations, and to form a common sense of awareness (Argenton et al, 2014; Riva & Gaggioli, 2015). The critical point here is to figure out how technology can be used to create a collective sense of awareness, and a powerful sense of community at a distance (Riva & Gaggioli, 2015).

Social presence is described as *“degree of salience of the other person in a mediated communication and the consequent salience of their interpersonal interactions”* by Short et al. (1976, p.65). It is considered that communication with e-mail and sms chat have lower social presence in comparison to face-to-face communication (Riva et al., 2012); however, there are different approaches. For example, ICT can be regarded as a mediator for forming and enhancing social presence in a community with online learning (Joyce & Brown, 2009) and e-health (Kamel Boulos & Wheeler, 2007).

According to Riva et al. (2004), to be present within a group, the person should present his or her purposes (presence) and understand the intentions of other group members (social presence). In relation to these, technology needs to provide virtual groups with the ability to express themselves and understand what each member is doing.

Subsequently, virtual groups ensure that individuals' collective actions are combined and the groups to whom their intentions are directed to behave autonomously and provide social optimal experiences (networked flow) (Gaggioli et al., 2011). For example, Morris (2005) developed a technological platform that measures phone calls and visits to obtain a public view of social interactions with relatives and friends to reduce the social isolation and feelings of depression of the elderly. Ambient screens, which reflect the data of distant and face-to-face interaction collected by wireless sensor networks, aim to increase the existing awareness of social connectedness as a dynamic and controllable aspect of well-being. Based on his study's results, this strategy was useful in decreasing the elderly's feeling of social isolation. Similarly, The Nostalgia Bits (NoBits) project which is the study of Mortangi et al. (2013) intended to promote interaction between the elderly and children through collecting memories. Mortangi et al. (2013) stated that uploading and using concrete works such as photographs, personal documents, and stories belonging to the lives of elderly individuals is an essential resource and the right way for the elderly to meet their own generations. The social interaction between the elderly and their families is tried to be encouraged by NoBits, and it is also aimed to increase the interactions and guidance between generations.

In conclusion, Botella et al. (2012) demonstrated the three levels of positive technologies, their objectives, the ways to accomplish them, along with examples, and their connections, as can be seen in Figure 2.22.



Figure 2.22 Levels of Positive Technology (Botella et al.,2012)

To conclude the literature review chapter, while previous studies on breast health, breast cancer, and breast self-examinations have illustrated that women did not perform BSE, these studies also provided numerous insights into why they do not it. Moreover, the review on mHealth apps has demonstrated that the prevalence of mHealth app use for fitness, weight management, mental disease as well as non-communicable diseases such as cancer has increased. Also, the effects of mHealth apps on individuals' health have been investigated through several current approaches such as Persuasive Technology and Positive Technology, and mHealth apps found to be promising to enhance individuals' health and support their healthy behavior. On the other hand, very little research has been carried out on the relation

between breast health behavior and mobile apps, despite the fact that numerous mobile apps regarding breast healthcare have been developed. In view of all that has been mentioned so far, this study will investigate how to provide a positive BSE experience and to encourage behavior change for BSE with the utilization of mobile BSE apps. During this investigation, Persuasive Technology and Positive Technology approaches will be considered.

CHAPTER 3

FIELDWORK SET-UP

Literature review chapter indicated the requirement for a new perspective towards mobile BSE apps that positively support women in maintaining breast health and performing BSE. This chapter concentrates on the fieldwork methodology investigating BSE and how the mobile apps affects women performing BSE. Consequently, the chapter describes the phases of the fieldwork, selection of participants, and mobile BSE apps, along with data collection tools and methods.

3.1 Fieldwork Set-up

The aim of the fieldwork was to find out the current state of BSE experience according to women, and to understand their emotions, attitudes, needs regarding BSE. Also, it is aimed to figure out how mobile BSE apps positively contribute to the BSE experience of women and encourage behavior change for BSE. Since user behavior, needs, and concerns occur as a result of a holistic experience, the pre-usage experiences value significantly, as well as experiences of post-usage (Karapanos et al., 2009). Thus, the fieldwork is divided into three phases: pre-usage phase, during-usage phase, and post-usage phase.

The three phases of the study were visualized in Figure 3.1. Pre-usage Phase aims to gain insights into how women maintain their breast healthcare, their opinions on BSE, and their BSE apps needs. In During-usage Phase, participants will be asked to use a given apps at least four times during a month. Post-usage Phase investigates women's behavior, needs, and emotions while performing BSE, and also their general assessment of the mobile BSE apps. Details of each of the three phases will be revealed in the subsequent sections.

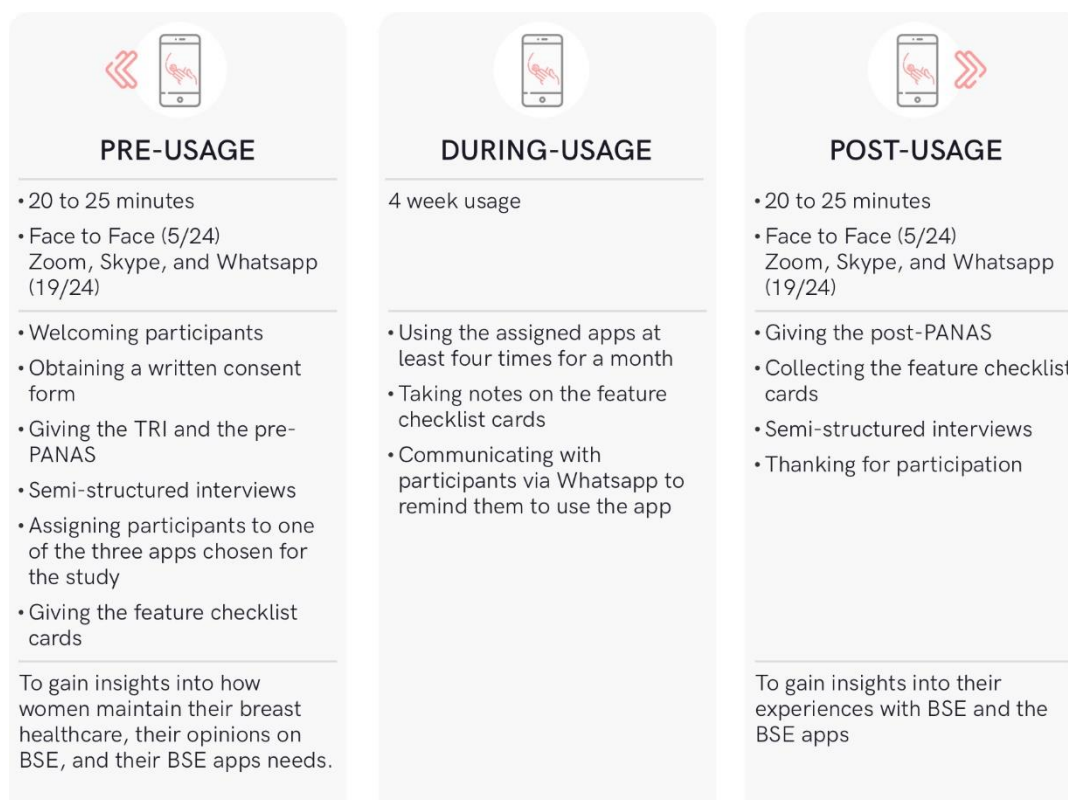


Figure 3.1 The three phases of the fieldwork set-up

3.2 Data Collection Tools and Methods

In the literature chapter (see Chapter 2), previous studies were reviewed in terms of mHealth apps in general and specific to breast health and BSE, and BSE apps. This review gave several insights for research approaches that can also be adopted in the current study. First, previous studies into mHealth apps were generally focused on the users of mHealth apps and their needs, the purpose of the mHealth apps, and the association between health factors and mHealth apps. These studies were explained in detail and can be seen in Section 2.2.2.1. In addition, the PhD research of Günay (2017) that conceptualized the pregnancy experience with utilization of mHealth apps, and the MSc research of Tuna (2014) that explored mobile technologies for diet control body-monitoring were found to be specifically useful as they were both carried out in the context of design for health domain. The present research inspired

from their fieldwork set-up, data collection and analysis methods, and where necessary their work will be references in the thesis.

Subsequently, studies related to breast healthcare or mobile BSE apps are often based on one of the two approaches: reviewing mobile breast apps and exploring women's breast self-examination behavior. Studies related to BSE apps aim to search for major stores to identify the number of BSE apps and their categories. These studies have employed a quantitative approach in general. On the other hand, studies related to BSE experiences commonly use qualitative analysis to gain insights into women's behavior.

Up to now, very few studies have investigated the association between breast self-examination behavior and mobile BSE apps, and questionnaires are utilized in these studies (Ribeiro et al., 2016; Ribeiro et al., 2017). Therefore, within the framework of women's mobile BSE apps experience, gathering qualitative and quantitative data seems necessary. Moreover, in order to collect various data of users' interaction with a product or system, it is more critical to examine their long-term experience than to explore the momentary user experience because how users' experiences change in time affects their behavior and decisions (Kujala et al., 2011). Also, it was pointed out that user experiences include the users' prior experiences, their early interactions, and experiences over prolonged use, so user experiences are comprehensive and evolve in the course of time (Karapanos et al., 2009). After all, several methods were examined to understand women's BSE experiences accurately. The chosen methods are scales PANAS and TRI as measurement instruments, semi-structured interviews, and the feature checklist cards, these methods were described below.

3.2.1 Measurement Instruments

3.2.1.1 Positive and Negative Affect Scale (PANAS)

It is aimed at observing women's subjective well-being about their breast healthcare in this research. Hefferon and Boniwell (2011) suggest two measurement tools for understanding the emotions of individuals in their books that explain positive psychology and research methods used in positive psychology. These tools are the Positive and Negative Affect Scale (PANAS), Scale of Positive and Negative Experience (SPANE). In order to determine the changes in participants' moods regarding their breast healthcare before-and-after using the selected mobile BSE apps, it is decided that adopting the Positive and Negative Affect Scale (PANAS) was more appropriate, which was also adopted in the MSc research of Tuna (2014). (see Appendix A for the Turkish and English versions).

The PANAS, widely used in studies, deals with mood status (Watson et al.,1988). The term “affect” would be adopted instead of the terms describing a person's subjective well-being like mood and feeling. There are two main categorizations of “affect,” which are “Positive Affect” and “Negative Affect”. While “Positive Affect” refers to enthusiasm, alertness, activity, and engagement, “Negative Affect” refers to distress, anger, guilt, fear, and nervousness (Mcdowell, 2006). In this study, The PANAS is composed of 10 of each “affect”. Participants are asked to fill in the scale by assigning scores on a 5-point Likert scale (1-strongly disagree | 2-disagree | 3-Neither agree nor disagree | 4-agree | 5-strongly agree).

3.2.1.2 Technology Readiness Index (TRI)

An abridged version of the Technology Readiness Index (TRI) was decided to be employed to determine the women’s tendency to embrace and use new technologies, which was adopted by Günay (2017) based on the Technology Readiness Index (TRI) 2.0 of Parasuraman and Colby (2001). According to Parasuraman and Colby

(2001), individuals' path to embracing cutting-edge technologies depends on their technology readiness. The TRI aims to describe a gestalt of mental enablers and prohibitors that collectively determine the participants' tendency to use new technologies (Parasuraman, 2000). Although there were 36 items under four themes: optimism, innovativeness, discomfort, and insecurity in previous studies, Parasuman and Colby (2001) composed the TRI into ten items that include a 1-5 Likert scale (1-strongly disagree | 2-disagree | 3-Neither agree nor disagree | 4-agree | 5-strongly agree). The TRI was prepared in English; then it was translated into Turkish as the study will be conducted in Turkish (see Appendix B for the Turkish and English version).

3.2.2 Interviews

Interviewing is one of the most critical and commonly used qualitative data collection methods; also, it enables researchers to gain insight into the world of participants (Qu & Dumay, 2011). Qualitative interviewing can be employed if learning about participants' motivations, feelings, and experiences are critical (Milena et al.,2008). In this thesis, it was vital to gather data about the participants' assessments about breast self-examination and mobile BSE apps. Accordingly, semi-structured interviews with open-ended questions were utilized before and after the use of apps.

There are four main behaviors related to breast self-examination: (a) performing BSE, (b) learning about BSE, (c) discussing BSE with friends, and (d) having someone remind one to perform BSE (Misovich et al., 2003). In the light of this knowledge, the questions about what participants know about BSE, how they practice, and what they need for an app were asked in Pre-usage Phase. Moreover, their experiences with performing BSE and using the given apps were questioned in the Post-usage Phase.

3.2.3 The Feature Checklist Card

In order to assist the participants to check across and make a note of the app features they use, the feature checklist cards are prepared, the layout and content is inspired from Günay's similar study (2017). The feature checklist cards consist of several features of three BSE apps such as reminder, BSE training videos, and steps for performing BSE. The card also included space for making note for the participants' interaction time and interaction frequency.

Uygulama kullanım tarihi: Uygulama kullanım zamanı: Lütfen aşağıda bulunan özelliklerden kullandıklarınızı işaretleyiniz.			
Özellik/Çerik	✓	Özellik/Çerik	✓
Kendi Kendine Meme Muayenesi Video		Yönelimlerle Kendi Kendine Meme Muayenesi Yap	
Kendi Kendine Meme Muayenesi Semptomları		Kendi Kendine Meme Muayenesi kaydet	
Kendi Kendine Meme Muayenesi kayıtlarını incele		Hatırlatma kur	
Kişisel meme soğluğu görüntüleme planı		Paylaşım (Facebook, Instagram, Twitter vb.)	
Risk profillerini inceleme		Eğitim araçları	
Mamografi randevusu al		Mağaza	
Bağış Yap		Sıkça Sorulan Sorular	
Uygulama Hakkında		Kuruluş hakkında	
Notlar:			

Uygulama kullanım tarihi: 27.01.2020 Uygulama kullanım zamanı: 23.20 Lütfen aşağıda bulunan özelliklerden kullandıklarınızı işaretleyiniz.			
Özellik/Çerik	✓	Özellik/Çerik	✓
Kendi Kendine Meme Muayenesi Video	✓	Yönelimlerle Kendi Kendine Meme Muayenesi Yap	✓
Kendi Kendine Meme Muayenesi Semptomları	✓	Kendi Kendine Meme Muayenesi kaydet	
Kendi Kendine Meme Muayenesi kayıtlarını incele		Hatırlatma kur	✓
Kişisel meme soğluğu görüntüleme planı		Paylaşım (Facebook, Instagram, Twitter vb.)	
Risk profillerini inceleme	✓	Eğitim araçları	
Mamografi randevusu al		Mağaza	
Bağış Yap		Sıkça Sorulan Sorular	
Uygulama Hakkında		Kuruluş hakkında	
Notlar:			

1) ilk meme muayenesi dereyimden çok fazla belirsizlik vardı. Materyalleri inceledim, dinledim ve başladım. Ama hastalık belirtisi oluyunca da insan kendinde onu aramaya başlıyor ya biraz o yüzden negatif bir dereceye dönüştü. Bir de hissettiğim şeylerin tam olarak neye karşılık geldiğini anlayamadım sanırım. Bir sonraki kontrolde sanırım daha iyi olacak.

2) App'in tek silvntüsü anlatımın çok kişisel olması. Tam doğru yapıyor mu-yum diye tedirgin oldim. Görsel bir rehber de aradım. (Mona Lisa'dan daha belirgin bir şey)

Figure 3.2 The feature checklist card

3.3 Selection of Mobile BSE Apps

In order to decide which mobile apps should be included in the study, a thorough evaluation is made. To include different operating platforms, two major app stores (Apple App Store for the iOS operating system and Google Play Store for Android operating system) were searched using the keyword 'breast cancer' in July 2019, the matching apps were ordered by downloads. Only the apps available in both stores were included (approx. 50 apps). Then, they were divided into categories based on data classifications proposed by Bender et al. (2013) and Giunti et al. (2018). Criteria for the exclusion of the apps were: (1) having non-English description, (2) having requirement of payment, (3) aiming at a physician-oriented target audience, and (4)

having purpose except early detection such as fundraising or disease management. Among these, the app number was reduced to nine, and the remaining nine apps were on the list studied based on their features in detail to determine final apps (see Appendix C). As explained earlier, four main behaviors are essential for BSE (Misovich et al., 2003), including ‘performing BSE’, ‘learning more about BSE’, ‘discussing BSE with friends’, and ‘having someone remind one to perform BSE’. Therefore, the apps with features that are believed to support the four behavior are kept. The final list of apps includes ‘Know Your Lemons’ (Know Your Lemons Foundation, Inc.), ‘Breast Check Now’, and ‘CheckYourself!’.

The user interface and user interactions of the “Know Your Lemons” app changed at the end of the study. Since the fieldwork of the thesis concluded, the findings of the study were not affected.






Features	Know Your Lemons	Breast Check Now	Check Yourself!
 LEARN	<ul style="list-style-type: none"> • BSE Video • The 12 symptoms of breast cancer • Risk factors 	<ul style="list-style-type: none"> • BSE video • Touch-Look-Check steps • More info with FAQs 	<ul style="list-style-type: none"> • General info with visuals
 PERFORM	<ul style="list-style-type: none"> • Examing coach, Mona Lisa • Video • Visuals 	<ul style="list-style-type: none"> • Touch-Look-Check steps • Video • Illustrations 	<ul style="list-style-type: none"> • BSE steps with GIFs
 REMIND	<ul style="list-style-type: none"> • Once a month 	<ul style="list-style-type: none"> • Once a week • Every other week • Every month • Every 3 months 	<ul style="list-style-type: none"> • Specific date
 DISCUSS	<ul style="list-style-type: none"> • Sharing the app 	<ul style="list-style-type: none"> • Sharing the app 	<ul style="list-style-type: none"> • Sharing the app
 TRACK		<ul style="list-style-type: none"> • Recording BSEs • Creating personal plans • Taking notes 	

Figure 3.3 Selection of the mobile BSE apps

3.3.1 Know Your Lemons

The app's primary purpose is to enable users to learn how to perform BSE with your virtual coach. It supports users to learn about breast healthcare through its training video and detailed descriptions of breast cancer's 12 symptoms. The app customizes users' breast self-examination plan according to their risks and reminds them to perform BSE at a suitable time based upon their menstruation. It also assists users with summarized information about breast cancer and its risks.

3.3.2 Breast Check Now

The app allows users to regularly check their breasts by setting up a plan that's easy to remember and fits their lives. It offers three essential features: recording a check, creating a plan, reviewing records of past checkings. Once the TLC method containing Touch-Look-Check steps is analyzed, users record their exams by answering three questions. Breast self-examination log, which allows users to track their breast healthcare, consists of examination dates, states, and findings.

3.3.3 Check Yourself!

Check Yourself! App has two main features, which are learning how and scheduling a monthly reminder. The app provides a step by step explanation of the BSE by using GIFs and summarized information about breast healthcare. In the reminder section, users are able to set an automatic monthly reminder.

3.4 Selection of the Participants

In order to reach potential candidates to participate in the study, a web-based questionnaire was published through several social media channels (e.g., Facebook, Twitter, LinkedIn, and Instagram). The 12-item questionnaire aims to gather general

information about women's approach to BSE (e.g., their breast healthcare conditions, BSE knowledge) and to invite them to take part in the fieldwork. Since the user's active involvement has a significant impact on design for well-being (Desmet & Pohlmeier, 2013), their willingness to participate in the study was asked.

In total, 116 women completed the questionnaire, 68 of them indicated their willingness to participate. Consequently, 24 participants were selected amongst the ones who had a smart mobile phone and an adequate level of English to be able to follow the instructions on the three selected apps. Having a pre-usage experience for BSE apps was not included as a selection criteria because only 2 out of 118 women who completed the questionnaire had used BSE apps before. Hereby, the study was conducted with 24 women, and they were divided into three groups of eight to evaluate each of the three apps. Women aged between 20 and 60 were included in the study with an average age of 35. As much as possible, it is aimed to get homogeneous distribution between different age groups (i.e., 20-30, 30-40, and over 40 years old).

Additionally, 16 participants had bachelor's degrees, 1 participant had master's degrees, and 7 participants had doctoral degrees. Appendix D includes detailed information of participants such as ages, educational background, given BSE apps.

3.5 Venue and Equipment

Since face-to-face interviews with participants were decided, women living in Istanbul were preferred to recruit in the study in the beginning. Nonetheless, most of the interviews decided to be conducted via Skype and Zoom due to COVID-19 restrictions. In the usage phase, WhatsApp will be used as communication tool to track participants. All interviews will be recorded by voice-recording and note-taking.

3.6 Pilot Study

A pilot study containing semi-structured interviews and usage of an apps was conducted with a 28-year-old woman. Similar to the fieldwork, the pilot study consists of three phases: pre-usage phase, usage phase, and post-usage phase. At the beginning of the study, the usage period of the BSE app was two weeks and an interview through a phone call was designed to check participants. It has been discussed that performing BSE and remembering to perform BSE are two primary behaviors related to Breast Self-Examination; however, it was observed that participants did not have adequate time to use the given apps (Misovich et al., 2003). Therefore, the fieldwork duration was increased to 4 weeks, and the participants were asked to practice BSE at least four times within these weeks after the pilot study.

3.7 The Study Procedure

As all participants were Turkish, the study was conducted in their native language, Turkish. The study's question guide in Turkish which includes a consent form and semi-structured interview questions, can be found in Appendix E.

3.7.1 Pre-Usage Phase

This phase aimed to find out women's attitudes toward BSE and learn about their expectations for mobile BSE apps with the pre-usage PANAS, TRI, and semi-structured interviews.

The researcher planned face-to-face meetings with the participants. However, due to the coronavirus pandemic, only 5 of the interviews were carried out face-to-face, the remaining 19 interviews were carried out online via Zoom, Skype, and Whatsapp (10 Zoom, 6 Skype, 3 Whatsapp). Foremost, participants were welcomed and informed about the research aim and the fieldwork's procedure. Then, five participants who were interviewed face-to-face signed the consent form; also, audio

permissions were obtained from 19 participants who were interviewed online, and they were asked to sign and submit the consent form via mail.

On informing participants about the research and obtaining a written consent form, the PANAS scale was administered to the participants to identify their emotions related to breast healthcare. The PANAS scale required the participants to indicate on a 5-point Likert-scale (1-strongly disagree | 2-disagree | 3-Neither agree nor disagree | 4-agree | 5-strongly agree), they were also asked to fill in the Technology Readiness Index (see Appendix B for the Turkish and English version) to determine the level of their tendency to embrace and use new technologies.

Following this, a two-part semi-structured interview was carried out with each participant. The first part covered questions about participants' breast healthcare, their BSE experiences, and mobile healthcare apps. The questions also aimed to learn about whether they performed BSE before (and, if yes, their reflections). The second part of the interview concentrated on BSE apps. The participants were asked about the kinds of features they would like to/need to have in mobile BSE apps.

Subsequently, each participant was assigned one of the three apps chosen for the study (see Appendix D). The app was introduced to the participants by using information cards describing its usage and features through a series of visuals that is prepared by the researcher (Figure 3.4).

Then the participants were asked to download the app, and after quick navigation, their questions (if there was) were answered. The participants were then given information about the following stages of the study. The app-feature checklist cards were also given to the participants to note which feature they used, write the app usage date, and their thoughts about the entire experience, and their feelings. At this stage, each session with a participant took between 20 to 25 minutes.

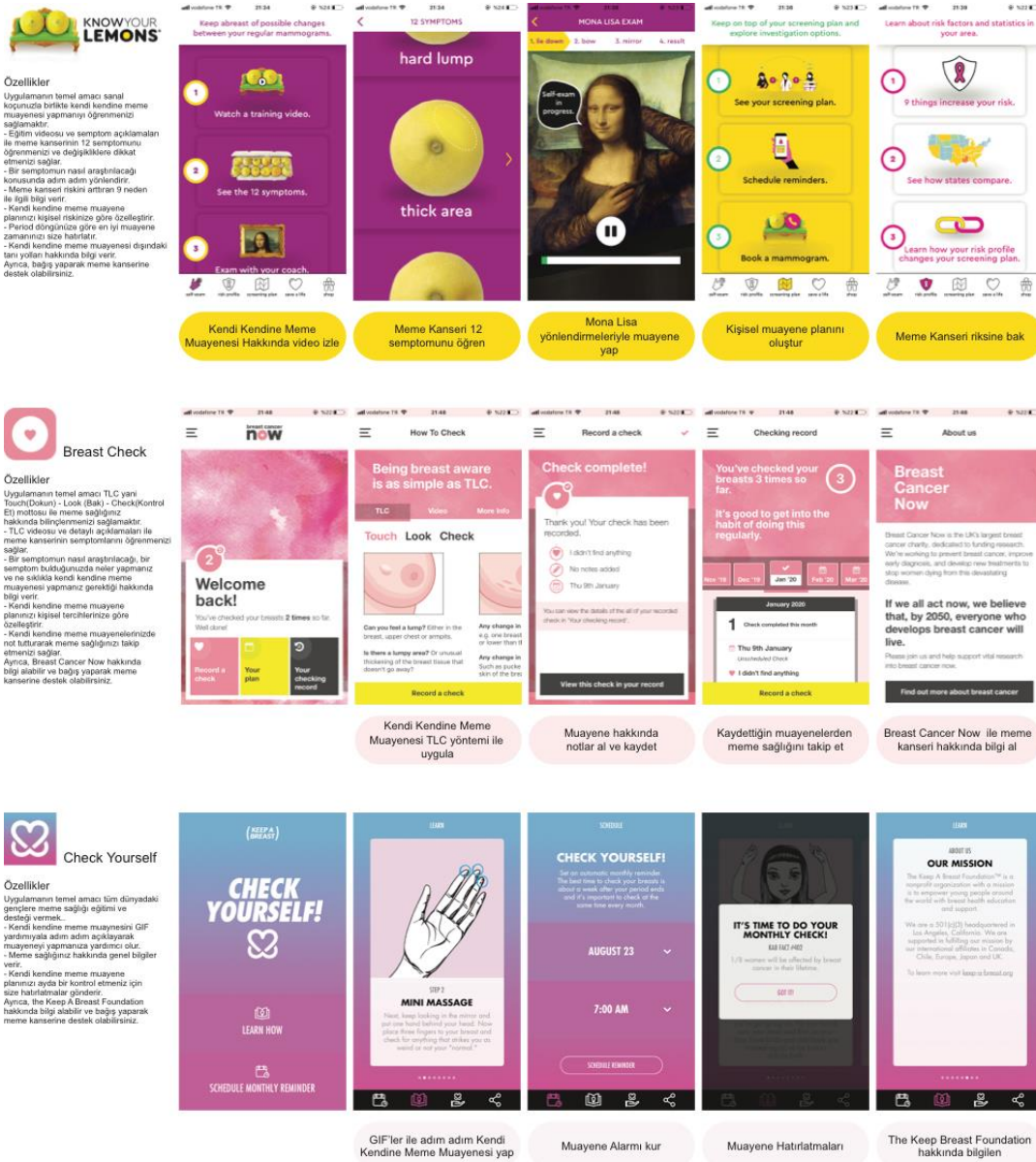


Figure 3.4 Mobile BSE app cards: Know Your Lemons, Breast Check Now, Check Yourself!

3.7.2 During-Usage Phase

In this phase, each of the eight participants was asked to use their assigned apps at least four times for a month. The researcher communicated with participants via Whatsapp to remind them to use the app and check on their experiences up to date. A few participants used the given app more than four times, and most participants

used it four times. Some participants who already used the app four times before completing a month were invited to an interview.

3.7.3 Post-Usage Phase

In this phase, the participants were interviewed to reflect on their experiences with the app that they used.

First, the post-usage PANAS was administered to identify the mood differences between before and after using the selected mobile BSE apps.

Then, semi-structured interview sessions were conducted individually with each of the 24 participants. As in the pre-usage phase, the interviews with 5 participants were conducted face-to-face, other participants were interviewed via online mediums such as Zoom, Skype and Whatsapp.

The interview contained questions about BSE experiences whilst using the app, whether the participants would like to continue performing BSE and use the given app, how the BSE apps make them feel, and their recommendations for apps.

The feature checklists and their notes were also collected. Each session took between 20 to 25 minutes.

3.8 Data Analysis Overview

This section describes the steps to be followed for the analysis of the study. First of all, quantitative analysis will be carried out to evaluate 'affect' changes with the pre-PANAS and post-PANAS scales and determine user habits and changes in these habits by using mobile BSE apps. Moreover, qualitative data analysis considering Grounded Theory will form the basis of the analysis since understanding user experiences thoroughly is critical to the study.

Grounded Theory is a methodology related to qualitative research proposed for social sciences by Barney Glaser and Anselm Strauss in 1967. As Glaser and Strauss (1967, p.1) indicated, grounded theory creates an innovative methodology and assists in the 'discovery of theory from data'. In traditional approaches, the research's departure point is based on an existing theoretical framework, and often the goal is collecting data to test and illustrate how the original theory is applied to the study. Conversely, grounded theory focuses on developing a new 'theory' based on empirical data collected in the field (Glaser & Strauss, 1967; Strauss & Corbin, 1998). While analyzing the data, first, the processes of data abstraction and categorization are employed. Then, codes for repetitive opinions and statements are determined. Since Grounded Theory requires that data collection and analysis be carried out simultaneously instead of in a linear sequence, the collected data and the assigned codes are reviewed several times. Thus, headings and categories emerge from codes (Dunne, 2011; Strauss & Corbin, 1998). Subsequently, the grounding of a new theory occurs from these categories, which are based on collected data. Grounded theory research consists of the following three coding types: open, axial, and selective (Strauss & Corbin, 1998).

In qualitative data analysis considering Grounded Theory, the first step will be transcribing recordings of interviews into Microsoft Word documents. Then, raw data obtained from interviews will be transferred to Microsoft Excel sheets regarding interview questions and read several times to discover repeated patterns and assign codes to these patterns, as recommended by Bogdan and Biklen (2007). Once obtaining initial codes, the process of thematizing will be adopted to create headings. Then, the codes listed under these headings will be examined separately and divided into categories in accordance with the repeated patterns of them by applying axial coding. Finally, conducted pre-categorization through axial coding will be re-examined and combined under relevant sub-categories. Besides, the study has an inductive nature since there were no specific predetermined codes received from a current theory and literature about experiences of breast self-examination and mobile

BSE apps. Nevertheless, several codes are commonly used in general user experience literature.

Moreover, one of the research questions in this study seeks to understand the current state of BSE apps in terms of providing a positive experience and encouraging behavior change. In order to respond to this question, the three apps chosen for the study will be evaluated through the Persuasive Systems Design (PSD) model. Briefly, the PSD model enables to design and assess persuasive systems that affect individuals' behavior. The model has four dimensions (i.e., primary task support, dialogue support, system credibility support, and social support) and 28 strategies (see Chapter 2 for full detail).

3.9 Ethical Considerations

Participants' opinions and behavior on breast self-examination, as well as their experiences with the given BSE apps, were required for the study. Due to containing personal data in the study, Ethics Committee approval was obtained as recommended by the Middle East Technical University Graduate School of Social Sciences (See Appendix F).

CHAPTER 4

FIELDWORK RESULTS, ANALYSIS AND DISCUSSION

This chapter is divided into two parts. The first part presents the results and analysis of the fieldwork including the PANAS and interviews, and design strategies that emerged through data analysis with Grounded Theory. Then, the second part covers the discussion on changes in the participants' attitudes, knowledge level, and emotions between phases of the study, the analysis of the three BSE apps chosen for the study (i.e. Know Your Lemons, Breast Check Now, Check Yourself!) through Persuasive System Design (PSD) Model, and lastly discussion on the design strategies through Positive Technology.

4.1 Data Analysis Stages

The fieldwork included two sessions (pre- and post-interviews) with each of the 24 participants. The researcher's notes and voice-recordings of 48 interview sessions were transcribed into Microsoft Word documents. Raw data from interviews were transferred to a Microsoft Sheet, which contains rows according to the participant numbers and questions.

Data analysis was carried out in several stages. First, an analysis carried out to evaluate pre-PANAS and post-PANAS scales administered before and after the usage of mobile BSE apps to see the possible changes in the participants' attitudes. Additionally, Grounded Theory formed the basis of the analysis since understanding the participants' experiences thoroughly was critical to the study. Accordingly, Grounded Theory's three coding types, which are open, axial, and selective coding were applied to transcribed data. As suggested by Bogdan and Biklen (2007), repetitive patterns were identified and relevant codes were assigned (e.g., examining underarm areas of the body, having concerns about performing BSE accurately,

being unable to give user motivation, being unable to track menstruation, and giving essential information about breast health and BSE). It is important to note that participants were asked open-ended questions, and thus, not every participant may have an answer regarding the assigned code. After the completion of open coding, six headings emerged (i.e., BSE: Strategies, BSE: Limitations, BSE: Emotions, Mobile BSE Apps: Needs, Mobile BSE Apps: Benefits, and Mobile BSE Apps: Limitations). The codes were listed under these headings and examined separately and divided into categories in accordance with the repeated patterns by applying axial coding. Then pre-categorization through axial coding was re-examined and combined under relevant sub-categories. The study had an inductive nature since there were no specific predetermined codes about women's experiences of BSE and mobile BSE apps. Data analysis was carried out using Airtable, a publicly online platform used for creating and sharing relational data to group the participants' answers more efficiently. Each participant was assigned a number to keep their identities anonymous, and the numbers were utilized during the entire analysis process.

4.1.1 Pre-Usage Phase

4.1.1.1 The Pre-PANAS Results

As mentioned in the Methodology Chapter (see Chapter 3), it was argued that the PANAS scale provides an objective state of 'positive affect (PA)' and 'negative affect (NA)' (Clark and Watson, 1991). The mixed positive and negative feelings were presented to the participants on the scale. Since the aim was to understand the participants' mood changes between before (i.e., Pre-usage phase) and after (i.e., Post-usage phase) using mobile BSE apps; the Pre-PANAS results will be presented with The Post-PANAS results, in Section 4.1.3.1.

4.1.1.2 The Pre-Usage Interview Results

In the pre-usage phase of the study, the same set of open-ended questions were asked to the participants to understand their participants' preferences and attitudes regarding BSE (see Appendices E and F). Thus, information about 24 participants was gathered under the following headings: i) breast health history, ii) preferences regarding BSE, iii) frequency of performing BSE, iv) knowledge level of BSE, v) previously used mHealth apps, and vi) previously used mobile BSE apps (see Table 4.1).

i) Breast Health History

According to pre-usage interviews, 7 participants out of 24 declared to have a disease related to their breasts. When the types of diseases were asked participants, they answered that they all had fibrocystic breast disease.

ii) Preferences regarding BSE

The participants were asked whether they perform BSE, half of the participants (17 of 24) answered as 'yes': 12 participants said they do perform BSE; 5 participants stated that they previously performed BSE, however, it was a long time ago as they were unsure about whether they were performing accurately; remaining 7 participants said that they had never performed BSE before.

iii) The Frequency of Performing BSE

When 17 participants among the ones that performed BSE were asked how often they perform BSE, the answers given were as follows: occasionally (8/17), frequently (5/17), and regularly (4/17).

iv) Knowledge Level for BSE

All 24 participants were asked their knowledge about BSE. The answers are: 'I do not have any information related to BSE' (5/24), 'I have little knowledge about BSE and performing techniques' (12/24), and 'I do know about BSE' (7/24).

v) Previously Used Mobile Healthcare Apps

All participants were asked about their experiences with mHealth apps. Moreover, the participants who previously used these apps were asked to indicate which apps they used. Accordingly, the answers are: ‘I have never used a mobile healthcare app (6/24), and ‘ I use mobile healthcare apps such as apps for step counting, water reminding, period tracking, pregnancy tracking, and personal health information management’ (18/24).

vi) Previously Used Mobile BSE Apps

When participants were asked whether they used mobile BSE apps before, only one participant expressed that she used mobile BSE apps including Brexa, Breast Check Now, and Breast Health, due to having fibrocystic breast disease.

4.1.2 During-Usage Phase

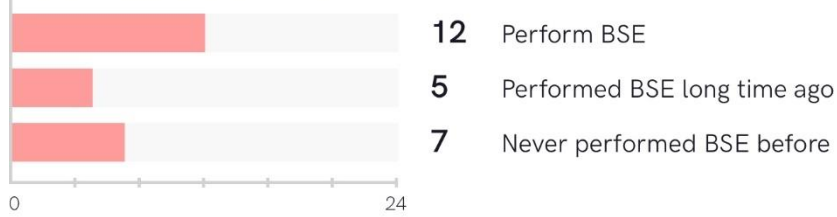
In During-usage Phase, each of the chosen three apps (i.e. Know Your Lemons, Breast Check Now, Check Yourself!) was used by eight participants. In total, 24 participants used the mobile BSE apps for a month. Data associated with During-usage Phase was collected through interviews at Post-usage Phase and will be presented in Section 4.3.1.

Table 4.1 Summary of the pre-usage interview results

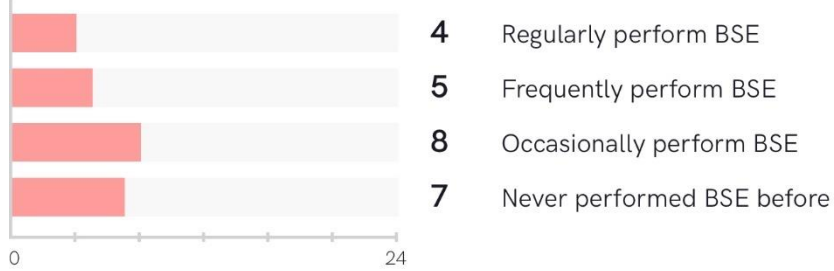
Breast Health History



Preferences regarding BSE



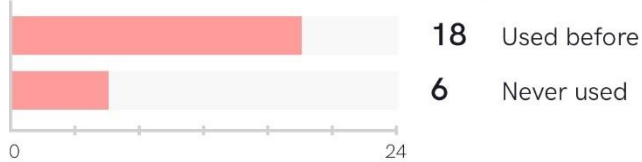
The Frequency of Performing BSE



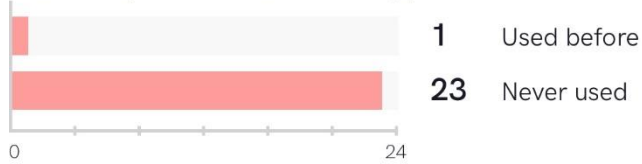
Knowledge Level for BSE



Previously Used Mobile Healthcare Apps



Previously Used Mobile BSE Apps



4.1.3 Post-Usage Phase

4.1.3.1 The Post-PANAS Results

Similar to the Pre-PANAS, the mixed positive and negative feelings were presented to the participants in the scale. Answers from all participants for the Pre-PANAS and Post-PANAS can be found in Appendix G. While analyzing the Pre-PANAS scale and Post-PANAS scale, the answers were transferred to Microsoft Excel spreadsheets and grouped regarding positive and negative affect. Moreover, the scores provided by all participants to each emotion for PA and NA were averaged to analyze scales. In Table 4.2 the mean values of each emotion's scores; in other words, 'affect' were demonstrated.

Table 4.2 The mean value of the PANAS answers in relation to 'before' and 'after' the app usage by 24 participants

Positive Affect: NA	'Before'	'After'	Negative Affect: NA	'Before'	'After'
Interested	2,83	3,79	Distressed	2,16	2,50
Excited	2,08	2,87	Upset	1,79	1,37
Strong	2,33	4,04	Guilty	2,29	1,70
Enthusiastic	2,04	3,54	Scared	2,20	2,29
Proud	1,66	4,20	Hostile	2,16	1,62
Alert	2,79	2,79	Irritable	2,41	1,75
Inspired	1,37	3,58	Ashamed	2,50	1,46
Determined	2,37	3,54	Nervous	2,54	2,33
Attentive	1,50	1,58	Jittery	2,58	2,25
Active	2,37	3,62	Afraid	2,75	2,37
Total Mean	2,13	3,35	Total Mean	2,33	1,96

From the PANAS ‘before’ and ‘after’ data, all positive affect measures (except ‘alert’) increased, whilst all negative measures (except ‘distressed’ and ‘scared’) decreased. A paired t-test ($\alpha=0.05$) was performed on the PANAS data to check for significant differences. To perform paired t-test, t-Test calculator from GraphPad was utilized (GraphPad Software, Inc., 2021). For positive affect, comparison of the ‘before’ data (M=2.14, SD=0.50) and ‘after’ data (M=3.36, SD=0.77) shows a highly significant increase in positive affect, $t(9)=4.70$, $p=.001$. Similarly, for negative affect, comparison of the ‘before’ data (M=2.34, SD=0.27) and ‘after’ data (M=1.97, SD=0.42) shows a significant reduction in negative affect, $t(9)=3.07$, $p=.013$. In combination, these results confirm that the apps were successful in their task of supporting positive affect and alleviating negative affect (see Table 4.3).

Table 4.3 Summary of paired t-test

Positive Affect: NA	‘Before’	‘After’	Negative Affect: NA	‘Before’	‘After’
Mean	2.14	3.36	Mean	2.34	1.97
SD	0.50	0.77	SD	0.27	0.42
t	4.70		t	3.07	
P	0.001		P	0.013	
Result	a highly significant increase		Result	a significant reduction	

4.1.3.2 The Post-Usage Interview Results

In the Post-usage Phase of the study, the participants’ experiences related to BSE and BSE apps were questioned. Having completed the post-usage phase (i.e. the usage of BSE apps assigned to them), the participants were asked whether they would continue: i) to perform BSE, and/or ii) to use mobile BSE apps or not (see Table 4.4).

i) Continue to Perform BSE

The participants were asked whether they would continue performing BSE, and the answers are as follows: 'I would maintain performing regular BSE after the study' (13/24), 'I would perform BSE, but probably not on such a regular basis as I did during the study' (7/24), and 'I would not perform BSE in the hereafter due to some physical and psychological conditions such as suffering from fibrocystic breast disease, having fear of occurring breast cancer, and being afraid of advancing existing disease.' (4/24).

ii) Continue to Use Mobile BSE Apps

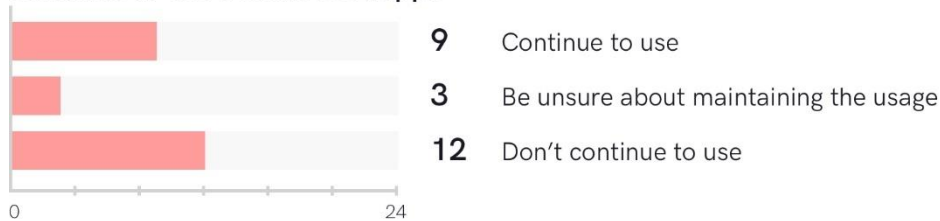
The participants were asked whether they would continue to use the given mobile BSE apps whilst performing BSE, and the answers are as follows: 'I would continue to use the given apps' (9/24), 'I am unsure about maintaining the usage this app' (3/24), and 'I would not use the given apps after the study' (12/24). Although the participants, who stated that they would continue to use these apps, they also explained that their needs were not fully met.

Table 4.4 Summary of the post-usage interview results

Continue to Perform BSE



Continue to Use Mobile BSE Apps



Subsequently, additional questions posed to understand women's thoughts, needs and experiences, related to BSE and BSE apps, then the answers were analyzed with grounded theory which will be explained in the following sections.

4.1.4 Grounded Theory

Grounded Theory, a qualitative research methodology offered for social sciences by Barney Glaser and Anselm Strauss in 1967, builds an innovative approach and helps to "explore theory from data". It focuses on developing a new 'theory' based on empirical data collected in the field by utilizing the categorization of raw data (Glaser & Strauss, 1967; Strauss & Corbin, 1998).

It can be seen in literature that several studies related to mHealth apps adopted this qualitative research methodology for data analysis (e.g., Alshawmar et al., 2021; Leung et al., 2016; Marent et al., 2018; Vaghefi & Tulu, 2019). It is stated that grounded theory was one of the appropriate research methodologies to identify e.g., user needs, user preferences, and to evaluate the effectiveness of mHealth apps (Sigler, 2017). Therefore, grounded theory was adopted in order to analyze the collected data and identify necessary design strategies needed to be included in BSE apps. This analysis stage involved Grounded theory's three coding types: open, axial, and selective. And this stage ended up with defining design strategies.

4.1.4.1 Open Coding

Open coding was the first phase of the grounded theory procedure aiming to analyze transcribed raw data. According to Strauss and Corbin (1998, p.101), open coding is an "analytic process through which concepts are identified, and their properties and dimensions are discovered in data".

To comply with this suggestion, initially, raw data collected from the 5 participants were analyzed while the fieldwork was ongoing. After the completion of open

coding, two themes emerged: 'Breast Self-Examination' and 'Mobile BSE Apps'. For the remaining participants, the analysis included these two themes with related headings under each. Codes were classified under the 'Breast Self-Examination' theme, and consisted of three headings: i) strategies, ii) limitations, and iii) emotions. The headings named as i) needs, ii) benefits, and iii) limitations were classified under the 'Mobile BSE Apps' theme.

As the study has an inductive nature, the themes and related headings were obtained from raw data by the researcher. All statements by all 24 participants were placed in a coding table according to interview questions, and phrases obtained by initial coding were transferred to the related table column. Strauss and Corbin (1998, p.223) expressed the importance of writing memos of the researcher since "initial thoughts and ideas without concern for what others think or whether the analysis is correct" were significant for the analysis process as well as the study. Therefore, the researcher noted her initial thoughts about the codes into the last column of the table.

At the end of the open coding stage, the initial codes related to the headings were listed separately to analyze in the next procedure of grounded theory, as in Table 4.5.

4.1.4.2 Axial Coding

Axial coding can be defined as "the act of relating categories to subcategories along the line of their properties and dimensions" (Strauss & Corbin, 1998, p. 124). Each code listed under six headings obtained with open coding was examined in detail and merged with other relevant codes. The categories under headings were determined by applying axial coding. To give an example, four categories were defined under the heading 'Mobile BSE Apps: Needs': i) feature-related needs, ii) content-related needs, iii) support-related needs, and iv) experience-related needs, as in Table 4.6.

Table 4.5 The code list of the Mobile BSE Apps: Needs generated with ‘open coding’

MOBILE BSE APPS: NEEDS- Codes
- Creating a plan
- Having a reminder
- Having background music
- Having checklist for steps
- Recording breast self-examinations
- Taking notes about their practices and findings
- Chatting with doctors via mobile BSE apps
- Communicating with other users
- Having a reminder for doctor appointments
- Making an appointment with doctors
- Reviewing the symptoms by doctors
- Tracking breast healthcare
- Taking notes about emotions
- Having a comprehensive mobile app to monitor women’s health
- Tracking menstruation
- Seeing information like the number of people performing now
- Seeing information like techniques people adopt for performing BSE
- Socializing with other users
- Getting summarized information about BSE
- Learning how to perform BSE
- Learning symptoms
- Providing video related to performing BSE
- Providing the right and reliable information
- Seeing other users’ information
- Seeing other users’ comments
- Getting summarized information about awareness month
- Getting summarized information about breast health
- Getting summarized information about breastfeeding
- Getting summarized information focused on men
- Receiving suggestions about health clinics
- Reading user stories
- Sharing new and informative content
- Helping users understand the findings
- Helping users to get familiar with own breasts
- Providing analysis and explanation of the process by doctor with a psychological approach
- Providing personalized information about breast health and BSE
- Keeping users positive
- Motivating users
- Making users feel relaxed
- Guiding users with a physical comparison
- Providing physical resource
- Sending a kit to help performing BSE
- Guiding users to follow BSE moves step by step
- Providing voice command for steps
- Leveling up according to their knowledge about BSE
- Seeing progress
- Keeping users involved
- Keeping users active with interactive features

Table 4.6 The categories of Mobile BSE Apps: Needs generated with ‘axial coding’

MOBILE BSE APPS: NEEDS- Categories and Codes	
<p>Feature</p> <ul style="list-style-type: none"> - Creating a plan - Having a reminder - Having background music - Having checklist for steps - Recording breast self-examinations - Taking notes about their practices and findings - Chatting with doctors via mobile BSE apps - Communicating with other users - Having a reminder for doctor appointments - Making an appointment with doctors - Reviewing the symptoms by doctors - Tracking breast healthcare - Taking notes about emotions - Having a comprehensive mobile app to monitor women’s health - Tracking menstruation - Seeing information like the number of people performing now - Seeing information like techniques people adopt for performing BSE - Socializing with other users 	<p>Content</p> <ul style="list-style-type: none"> - Getting summarized information about BSE - Learning how to perform BSE - Learning symptoms - Providing video related to performing BSE - Providing the right and reliable information - Seeing other users’ information - Seeing other users’ comments - Getting summarized information about awareness month - Getting summarized information about breast health - Getting summarized information about breastfeeding - Getting summarized information focused on men - Receiving suggestions about health clinics - Reading user stories - Sharing new and informative content
<p>Support</p> <ul style="list-style-type: none"> - Helping users understand the findings - Helping users to get familiar with own breasts - Providing analysis and explanation of the process by doctor with a psychological approach - Providing personalized information about breast health and BSE - Keeping users positive - Motivating users - Making users feel relaxed - Guiding users with a physical comparison - Providing physical resource - Sending a kit to help performing BSE 	<p>Experience</p> <ul style="list-style-type: none"> - Guiding users to follow BSE moves step by step - Providing voice command for steps - Leveling up according to their knowledge about BSE - Seeing progress - Keeping users involved - Keeping users active with interactive features

4.1.4.3 Selective Coding

The pre-categorization through axial coding was re-examined, and codes were combined under relevant sub-categories with selective coding. For example, the category ‘Experience-related needs’ under the heading ‘Mobile BSE Apps:Needs’ had five subcategories of i) active involvement, ii) being facilitative, iii) creating self-awareness, iv) user interface, and v) personalization, as in Table 4.7.

Table 4.7 The categories and sub-categories of Mobile BSE Apps: Needs generated with ‘selective coding’

MOBILE BSE APPS: NEEDS- Categories, Sub-categories, and Codes	
Feature	
Feature related to BSE	Feature related to breast health
<ul style="list-style-type: none">- Creating a plan- Having a reminder- Having background music- Having checklist for steps- Recording breast self-examinations- Taking notes about their practices and findings	<ul style="list-style-type: none">- Chatting with doctors via mobile BSE apps- Communicating with other users- Having a reminder for doctor appointments- Making an appointment with doctors- Reviewing the symptoms by doctors- Tracking breast healthcare- Taking notes about emotions
Feature related to women health	Feature related to community
<ul style="list-style-type: none">- Having a comprehensive mobile app to monitor women’s health- Tracking menstruation	<ul style="list-style-type: none">- Seeing information like the number of people performing now- Seeing information like techniques people adopt for performing BSE- Socializing with other users

4.1.5 Categories, Sub-Categories and Codes as Design Strategies

The grouping stage of codes enabled determining the categories, sub-categories, and codes as design strategies under six headings which were BSE: Strategies, BSE: Limitations, BSE: Emotions, Mobile BSE Apps: Needs, Mobile BSE Apps: Benefits, and Mobile BSE Apps: Limitations. These design strategies provided a holistic

understanding of the research subject. It is important to note that participants were asked open-ended questions, and thus, not every participant may have had an answer regarding the assigned code.

4.1.5.1 Breast Self-Examination: Strategies

‘BSE: Strategies’ covered the strategies developed to learn about BSE and to overcome difficulties related to performing BSE. It is divided into three categories: i) Performing BSE, ii) Learning about BSE, and iii) Getting help for BSE, as can be seen in Table 4.8.

i) Performing BSE

‘Performing BSE’ included sub-categories related to comments about techniques that women generally implemented in relation to How, Why, When, and Where to practice BSE. Accordingly:

How_ 9 (out of 24) participants stated that they ‘perform quick manual breast check’, which means they did not follow any specific BSE procedure or techniques.

Why_ 11 participants said that they ‘remember performing BSE because of sensitivity on their breasts’.

"I do breast self-examinations unconsciously; they are more like a quick check. Also, my breasts become tender, especially during menstruation, and it makes me afraid usually. That's why I remember performing BSE." (P09)

When _ Several participants mentioned when they prefer to perform: five of them usually during menstruation, one of them except menstruation, and the remaining whenever they need.

Where_ 7 participants declared that they generally practice BSE in the bathroom.

"I usually perform BSE before or in the shower. Also, my breasts swell up during my period, I need to check them because of an unusual feeling." (P03)

ii) Learning about BSE

‘Learning about BSE’ consisted of two sub-categories: ‘Learn by Yourself’ and ‘Learn from the Environment’. Accordingly:

*Learn by Yourself*_9 participants indicated that they searched on the web, while 7 participants mentioned that getting informed about BSE from articles or videos was beneficial for learning about BSE.

“While searching the internet in detail to understand what problem I had, I also researched breast self-examination. Then, I also discussed these findings with my doctor.” (P16)

*Learn from the Environment*_ 7 participants explained that they learned BSE from a doctor since they had a breast disease. 4 participants mentioned that they would prefer to see a doctor to get information.

ii) Getting Help for BSE

7 participants stated that they never talked with anybody about BSE. 17 participants mentioned that they discussed it with their social network such as their mother, family, and friends.

Table 4.8 Categories and sub-categories under ‘Breast Self-Examination: Strategies’

BSE: STRATEGIES	
Performing about	<p>How?</p> <ul style="list-style-type: none"> - Examining underarm areas of the body - Feeling breasts - Following BSE techniques and steps - Learning symptoms - Looking for changes and symptoms - Performing quick manual breast check - Practicing it clockwise - Thinking positively
	<p>Why?</p> <ul style="list-style-type: none"> - Having family history - Paying more attention to perform BSE thanks to social media - Paying more attention to perform BSE thanks to awareness month - Paying more attention to perform BSE thanks to commercials - Remembering performing BSE because of sensitivity on their breasts’ - Tracking breasts for changes
Learning about	<p>When?</p> <ul style="list-style-type: none"> - Performing BSE during menstruating - Performing BSE regularly - Performing BSE during not menstruating
	<p>Where?</p> <ul style="list-style-type: none"> - Performing BSE at bathroom
Get Help	<p>Learn by Yourself</p> <ul style="list-style-type: none"> - Getting informed about BSE from articles - Getting informed about BSE from videos - Getting informed about BSE from external source - Searching on web
	<p>Learn from the Environment</p> <ul style="list-style-type: none"> - Getting informed about BSE from brochures at the health clinics - Getting informed about BSE from ads of some brands - Getting informed about BSE from magazines - Getting informed about BSE from visuals on the toilet - Learning at university - Learning BSE from a doctor - Learning from a friend - Learning from mother - Preferring to see a doctor to get information - Preferring to see a doctor to learn how to perform BSE
<p>- Preferring to see a doctor when they find changes and symptoms on breasts</p> <ul style="list-style-type: none"> - Talking never - Talking with family/mother/friends - Getting advice from social network to perform BSE 	

4.1.5.2 Breast Self-Examination: Limitations

The restrictive situations that the participants dealt with were grouped under ‘Breast Self-Examination: Limitations’ with the following categories: i) ‘Practical Barriers to understanding process and findings’, ii) ‘Psychological Barriers’, and iii) ‘Informational Barriers’, as can be seen in Table 4.9.

i) Practical Barriers to Understanding Process and Findings

The participants’ concerns about performing BSE accurately, misunderstanding of the findings, and confusion between the symptoms and normal breast tissue shaped the Practical Barriers. Accordingly, 13 participants expressed concerns about being unsure of what they found. In addition, 6 participants were doubtful whether they performed BSE accurately or not.

“I searched about how to perform a breast self-examination on the web, and it was explained how to check myself in front of a mirror. I just thought that ‘Am I doing it right?’ This feeling was similar to the feelings that occurred during sport. I constantly asked myself, ‘Can I detect something and understand if I find something?’. I was afraid of confusing the mammary gland with cysts.” (P24)

ii) Physiological Barriers

Psychological barriers arose from two sub-categories: ‘Negligence of BSE’, and ‘Personal Excuses’.

Negligence of BSE _ the sub-category was derived from what women consider BSE unimportant. 10 participants think that breast cancer will not happen to them, so they do not need to perform BSE.

*Personal Excuses*_ the sub-category was derived from the reasons for lack of BSE according to women. 12 participants expressed concerns such as fear of finding something in their breasts. Furthermore, 5 participants stated that they have some difficulties in adapting BSE in their daily lives.

“For example, this is not only about breast health, but it can be scary to detect a general health symptom. On the other hand, it can be relieving when you go to the doctor and find out that everything is okay. However, the process is still scary!”
(P04)

iii) Informational Barriers

Some limitations arising from practical, individual, and social restrictions related to knowledge were formed ‘Informational Barriers’.

Practical_ 13 participants stated that they are not familiar with performing BSE; 6 of them emphasized that they did not know in detail.

“I am trying to perform breast self-examination, but I am worried, because I do not know how to do it. So, I avoid doing it.” (P11)

Individualistic_ 9 participants indicated that they do not recognize their breasts since they did not perform regularly.

Social_ 1 participant commented: ‘sharing experiences between women’ is critical to be familiar with BSE.

Table 4.9 Categories and sub-categories under ‘Breast Self-Examination: Limitations’

BSE: LIMITATIONS	
Practical	<ul style="list-style-type: none"> - Being unsure about what to find - Having concerns about performing BSE accurately - Having confusion between the symptoms and normal breast tissue - Misunderstanding of the findings - Not knowing what to face
Psychological	<p>Negligence of BSE</p> <ul style="list-style-type: none"> - Attending other screening methods like mammography regularly - Considering BSE unimportant - Disregarding the BSE - Thinking that breast cancer will not happen to me
	<p>Personal Excuses</p> <ul style="list-style-type: none"> - Having fear of finding something in their breasts. - Having some difficulties in adapting BSE in their daily lives - Having fear of advancing the existing disease - "I don't have time"
Informational	<p>Individualistic</p> <ul style="list-style-type: none"> - Not know own breast in detail - Not trust the information
	<p>Social</p> <ul style="list-style-type: none"> - Not share experiences between women - Not trust the healthcare clinic - Trust more developed&comprehensive healthcare facility
	<p>Practical</p> <ul style="list-style-type: none"> - Being not familiar with performing BSE - Having irritation in skin due to dryness - Not knowing where to specifically press down in breasts while performing BSE

4.1.5.3 Breast Self-Examination: Emotions

Emotions arisen from breast self-examination were gathered under this heading. Three main categories under the emotions heading were: i) Emotions related to experience, ii) Emotions related to performing, and iii) Emotions related to results, , as shown in Table 4.10.

i) Emotions Related to Experience

Most participants expressed their negative emotions such as fear, anxiety, panic, guilt, stress regarding their BSE experiences. For example, 7 participants mentioned their anxiousness about their BSE experience.

“When I performed BSE for the first time, I didn't even recognize my breasts because I had never looked at it in detail. Therefore, I was very nervous, and I was concerned about whether what I touched is normal. In the end, I felt anxiety about my breast health.” (P012)

ii) Emotions Related to Performing BSE

7 participants stated that they felt guilty since they did not perform BSE regularly. Also, 11 participants expressed their fear of finding something as a result of the breast self-examination.

iii) Emotions Related to Results

11 participants indicated that they were relieved when they did not find anything (for concern) at the end of BSE.

Table 4.10 Categories and sub-categories under ‘Breast Self-Examination: Emotions’



4.1.5.4 Mobile BSE Apps: Needs

The participants’ initial expectations regarding mobile BSE apps to enhance their experience were titled as ‘Mobile BSE Apps: Needs’ These needs were mentioned before and after usage of BSE apps. The Mobile BSE Apps: Needs heading was located in four general categories; i) Feature, ii) Content, iii) Support, and iv) Experience, as in Table 4.11.

i) Feature-related Needs

All participants mentioned different perspectives regarding Mobile BSE Apps: Needs. However, app features were most commonly stated topic. Feature-related needs were originated from four sub-categories as features related to BSE, breast health, women's health, and community. Accordingly:

Features related to BSE_ While 17 participants stated that they prefer creating a plan for BSE on the apps, 16 participants emphasized that the reminder feature of the apps was critical for the BSE experience as they had difficulty reminding them to perform BSE. Besides, 11 participants said recording BSE by taking notes about their practices and findings supported their BSE experience.

"Maybe a calendar would be nice. I can track from the calendar when was the last time I checked since I can't remember. It may be a feature where I enter data about my breast self-examinations. Also, the app can have a reminder and remind me to perform once a week or every two weeks." (P17)

Features related to breast health_ Another feature that was prominent during the analysis was to chat with doctors via mobile BSE apps. Similarly, making an appointment with doctors for breast health and reminding them of this appointment were essential for participants.

Features related to women's health_ Most participants emphasized that it would be more beneficial to have a comprehensive mobile app that not only enables them to perform BSE and can monitor their health, especially women's health. For example, 15 participants highlighted that tracking menstruation, which is a vital feature, will encourage them to use BSE apps.

"I would like the app to tell me when I should perform a breast self-examination. I need to track my period since the right time for BSE is linked to my period." (P15)

"In fact, an app that gives information about the menstrual cycle, breast tissue, breastfeeding, and gynecological diseases can also be considered. I would like to use that kind of app. It would be more useful because of being comprehensive. I

would not prefer downloading an app that enables me to use it for only one issue.”
(P02)

Features related to community_ Participants stated that it would be exciting and motivating to see information, such as the number of people performing now or techniques people adopt for performing BSE. In addition, socializing with other users was one of the significant features desired for 12 participants.

ii) Content-related Needs

The content was another critical category under the Mobile BSE Apps: Needs. The participants had a wide range of views on the content of BSE apps. All participants agreed that BSE apps need to include content regarding symptoms, BSE techniques, and breast health.

Information related to BSE_ 6 participants referred to the importance of training videos that show users BSE techniques and steps. Although some participants did not prefer to see other users' information, 11 participants stated that user comments would contribute to their experiences and help them in their process.

“For example, I would read user comments to understand whether people had the same concerns and to view how they describe their symptoms.” (P09)

Information related to breast health _ Participants desired to get summarized information about breast health via mobile BSE apps. 7 participants welcomed receiving suggestions about health clinics since they had no opinion about where they need to apply for a breast check.

“If I need to see a doctor every year, the app should help me take action by reminding me to get a breast examination. I don't know to whom and which doctor I should go. Thus, the app should provide information about where I can have a breast examination or mammography.” (P15)

Additionally, 8 participants said that sharing new and informative content about breast health on the apps at specific time intervals would enhance their experiences.

iii) Support-related Needs

Numerous participants stated that mobile BSE apps should support the breast self-examination process by guiding users and giving psychological or physical help.

Guiding users_ 6 participants said that mobile BSE apps should help users understand the findings during BSE. 4 participants mentioned that mobile BSE apps should guide them with a personalized experience based on states such as their age, health, knowledge level, and so on.

Giving psychological support_ 6 participants noted that BSE apps need to keep users positive and motivate them.

“BSE apps should reduce my anxiety. Actually, performing BSE worries me, so it should motivate me to practice.” (P15)

Giving physical support_ Most participants stated that they were not familiar with what the lump should look like; therefore, if BSE apps guide them with a physical comparison, it would make the experience more comfortable.

iV) Experience-related Needs

In general, most participants expressed a desire for an experience where BSE apps are facilitative, enabling active participation, and creating self-awareness.

Facilitative_ All participants said they could not remember BSE’s process and steps, and 17 participants emphasized that mobile BSE apps should guide them to follow BSE moves step by step.

Creating self-awareness_ According to field study results, users' self-tracking ability is an essential feature in a mobile BSE app that improves their self-awareness, and various experiences on BSE apps could contribute to creating self-awareness. For example, 5 participants declared that the level of information offered by the BSE app remained the same during all breast self-examinations. However, as they were more knowledgeable about BSE over time, they desired to move to a level where they

could see more detailed information; in other words, they demanded to level up according to their knowledge about BSE.

“It would be better if the BSE app should adapt and continue by reminding us that we have already learned these in the first use, second use, etc. Thus, the content can increase according to our knowledge over time.” (P10)

Enabling active participation_ Throughout the interviews, participants stated that they started using the mobile BSE app with excitement and motivation, but they did not need the app after a certain use, as they learned to perform BSE. In contrast to this statement, they also mentioned that they skipped many steps when performing BSE without using the app. In this respect, 7 participants stated that mobile BSE apps should keep users involved and active with interactive features such as gamification, answering questions, and reward systems. Lastly, one individual stated that she did not prefer to hold the phone during BSE. Therefore, she indicated that voice commands, along with graphical guidance, would be more practical.

Table 4.11 Categories and sub-categories under 'Mobile BSE Apps: Needs'

MOBILE BSE APPS: NEEDS		
Feature	<p>Features related to BSE</p> <ul style="list-style-type: none"> - Creating a plan - Having a reminder - Having background music - Having checklist for steps - Recording breast self-examinations - Taking notes about their practices and findings 	<p>Features related to breast health</p> <ul style="list-style-type: none"> - Chatting with doctors and other users - Having a reminder for doctor appointments - Making an appointment with doctors - Reviewing the symptoms by doctors - Tracking breast healthcare - Taking notes about emotions
	<p>Feature related to women health</p> <ul style="list-style-type: none"> - Having a comprehensive mobile app to monitor women's health - Tracking menstruation 	<p>Feature related to community</p> <ul style="list-style-type: none"> - Seeing information like the number of people performing now - Seeing information like techniques people adopt for performing BSE - Socializing with other users
Content	<p>Information related to BSE</p> <ul style="list-style-type: none"> - Getting summarized information about BSE - Learning how to perform BSE - Learning symptoms - Providing video related to performing BSE - Providing the right and reliable information - Seeing other users' information - Seeing other users' comments 	<p>Information related to breast health</p> <ul style="list-style-type: none"> - Getting summarized information about awareness month - Getting information about breast health - Getting information about breastfeeding - Getting summarized information focused on men - Receiving suggestions about health clinics - Reading user stories - Sharing new and informative content
	<p>Guiding users</p> <ul style="list-style-type: none"> - Helping users understand the findings - Helping users to get familiar with own breasts - Providing analysis and explanation of the process by doctor - Providing personalized information about breast health and BSE 	
Support	<p>Giving psychological support</p> <ul style="list-style-type: none"> - Keeping users positive - Motivating users - Making users feel relaxed 	<p>Giving physical support</p> <ul style="list-style-type: none"> - Guiding users with physical comparison - Providing physical resource - Sending a kit to help performing BSE
	<p>Facilitative</p> <ul style="list-style-type: none"> - Guiding users to follow BSE moves step by step - Providing voice command for steps 	<p>Creating self-awareness</p> <ul style="list-style-type: none"> - Leveling up according to their knowledge about BSE - Seeing progress
Experience	<p>Enabling active participation</p> <ul style="list-style-type: none"> - Keeping users involved - Keeping users active with interactive features 	

4.1.5.5 Mobile BSE Apps: Benefits

Participants' statements of the advantages of using mobile apps for BSE were grouped under Benefits, has three categories: i) Support, ii) Content, and iii) Feature, as shown in Table 4.12.

i) Support-related Benefits

First of all, for participants, the primary category of benefits to performing BSE with apps was the support related advantages. Several participants stated the importance of guidance several times, such as learning their breasts, tracking breasts, etc. Moreover, another sub-category was psychological support like enabling people to feel responsible for their health.

Guidance_ 8 users stated that the BSE apps guide them to follow BSE techniques. Also, 4 participants expressed their satisfaction in using the apps, which make them perform BSE regularly.

Psychological support_ 11 participants confirmed that the BSE apps made them feel responsible for their health since apps help them adapt to their daily lives. Moreover, according to 6 participants, BSE apps increased users experience due to having a light-hearted theme.

ii) Content-related benefits

One of the primary categories of benefits to performing BSE with apps was the content related advantages.

Information related to BSE_ 19 participants referred to learning how to perform BSE during the app use as:

"Getting information about the breast self-examination process and moves through an app made the process significantly easier." (P14)

Information related to breast health_ 9 users mentioned that they learned about breast health, although the information was not sufficient.

iii) Feature-related Benefits

Several features were mentioned by the participants. According to responses, features such as setting reminders, socializing with friends through the app, creating personal plan, and following the breasts health positively affected their experiences.

All 8 participants using the Breast Check Now app agreed that recording the checks was helpful to track their breasts and the symptoms. 14 participants stated that having a reminder was a fundamental feature to continue performing BSE. 10 participants mentioned that creating a plan for BSE made it more comfortable to adapt the BSE into their daily lives.

Table 4.12 Categories and sub-categories under 'Mobile BSE Apps: Benefits'

MOBILE BSE APPS: BENEFITS	
Support	<p>Guidance</p> <ul style="list-style-type: none"> - Guiding users to follow BSE techniques - Guiding users if they found any symptoms - Learning own breast - Making users perform BSE at least - Making users perform BSE regularly <p>Psychological support</p> <ul style="list-style-type: none"> - Being able to adapt users' daily life - Making users feel responsible for their health - Making users feel safe - Making users feel that they are not alone - Having light-hearted theme - Keeping users positive - Providing sense of community
Content	<p>Information related to BSE</p> <ul style="list-style-type: none"> - Getting summarized information about BSE - Having a body positivism for visual representation - Learning how to perform BSE - Learning symptoms - Providing video related to performing BSE <p>Information related to breast health</p> <ul style="list-style-type: none"> - Learning about breast health
Feature	<ul style="list-style-type: none"> - Creating personal plan - Following the breasts health - Setting reminders - Socializing with friends through the app - Tracking menstruation

4.1.5.6 Mobile BSE Apps: Limitations

Although it changes in all apps, the Mobile BSE Apps: Limitations heading generally refers to the situations that the BSE apps could not meet the users' expectations and support or even restrict them in fulfilling their actions. These restrictions related to as follows: i) Feature, ii) Experience, iii) Support, iv) Content v) and Privacy categories were located under the Mobile BSE Apps: Limitations heading, as in Table 4.13.

i) Feature-related Limitations

The Feature-related limitations category was constructed on the restrictions about BSE arising from the lack of features that facilitate BSE and the failures arising from product or system errors.

Restrictions about BSE_ All three of the apps had a reminder in different ways. While Know Your Lemons and Check Yourself! allow users to choose the day to perform BSE and remind them once a month; Breast Check Now offers four options for reminders: once a week, every other week, once a month, and every three months; also, users could decide one specific day of the week. After the participants used these three mobile BSE apps, several issues emerged related to the reminder feature. 12 participants stated that the mobile BSE apps could not set a reminder to perform BSE. As stated in the interviews, participants met several limitations, such as not noticing the reminder and not understanding how to install it.

In Breast Check Now, users can create a personal plan, as well as record breast self-examinations by answering some questions and taking notes. 13 of the participants who used the other two mobile BSE apps stated that they could not create a plan and take notes. They emphasized that if they could use these features, these features would support their BSE experiences.

"I would like to create a calendar for my breast self-examinations. I desired to take notes about my checks and see when was the last time I perform BSE. It would be

nice if I could follow my data and review what appeared at every control. Also, I need a breast image for taking notes on it to track symptoms and their locations in my breasts.” (P11)

6 participants noted that tracking menstruation was a significant feature, and the mobile BSE apps did not support them to follow menstruation.

Failures_ In addition to the participants not being able to use the features they need, they have experienced phone-oriented and app-oriented problems. For example, one user said that the mobile BSE app had a failure in the reminder feature since it did not send a notification to perform BSE even though she set up the reminder.

ii) Experience-related Limitations

Limitations rooted in problems related to usability, user interface, and user experience were named under the experience-related limitations category.

Usability_ During the field study, common problems that emerge about usability were complex interactions, unnecessary features, complicated expressions, extra steps that make the process difficult to follow, and annoying tone and voice. First of all, participants said that they expect to see primary features on the home page or should be easily found. 7 users mentioned that more essential features were difficult to find while irrelevant features to BSE were on the apps’ navigation bar.

User experience_ 6 participants stated that following the BSE steps was difficult, and they could not pass the steps or return to a previous step. As mentioned in the Experience related needs, users demanded to level up in the apps according to their BSE knowledge. However, 14 participants emphasized that they stopped utilizing the apps for BSE after a few uses; explained this was due to the inability to access new information, the provision of the same and beginner level information always.

User interface_ All three of the apps utilized during the study had different types of user interfaces theme; consequently, they consisted of diverse user interface elements such as visuals, icons, color, and photographs. The Breast Check Now and Check Yourself apps consisted of illustrations instead of breast visuals and soft

colors. The Know Your Lemons app had bright and vivid colors and lemon illustrations. Moreover, the Check Yourself and Know Your Lemons apps contained moving photographs of a woman who performed BSE like GIFs. Nonetheless, 5 participants using the Know Your Lemons app declared that the app has very light-hearted theme, but it did not make users calm when it was necessary. In addition, they said that they prefer soft colors, simple but informative visuals.

“The app is entertaining and colorful. It tried to make a scary situation entertaining by using lemons and GIFs. However, I want to know that everything is fine, so the app should make me feel safe.” (P11)

iii) Support-related Limitations

Another category mentioned by numerous women were limitations related to support. The participants stated that the mobile BSE apps sometimes were insufficient in supporting the breast self-examination process by guiding users and giving psychological or physical help.

Guiding users_ When the participants were asked how the general experience for mobile BSE apps, 9 participants stated that the apps could not provide guidance for following BSE moves as the apps did not indicate where they needed to check step by step. Also, 7 users noted that they did not understand whether the findings were symptoms, and the apps did not help in analyzing these findings.

Giving psychological help_ 3 participants highlighted that the apps were unable to give motivation to users sometimes. In particular, the apps made them feel in danger since they repeatedly underline the severity of breast cancer.

“Mobile apps give several tasks and keep reminding me of these tasks, but I do not carry out the tasks if I do not have the motivation. Thus, this BSE app should give me motivation.” (P16)

Giving physical help_ Since mobile apps are virtual technology, they were not able to support users physically. Five participants stated that they could not understand

what a lump on their breasts should look like, and the apps did not support users to analyze the symptoms.

iv) Content-related Limitations

Statements associated with the lack of comprehensive information shaped the category of content. Several participants commented that mobile BSE apps had not summarized and essential information, also visuals for breasts and BSE steps were inadequate.

Information related to BSE_ According to participants, all three apps did not clearly describe where and how users should touch during BSE. Thus, participants expressed concerns about performing BSE adequately and obtaining essential information from BSE apps.

Information related to breast health_ As users mentioned, the apps mainly focused on breast self-examination and did not provide detailed breast health information. However, 12 participants said they would prefer to be informed about breast health through BSE apps.

Visuals_ In addition to informative content, visuals of BSE apps were also one of the essential contents. While 3 participants stated that they would prefer to see breast images instead of illustrations, 2 participants said that seeing breast images disturbs them.

v) Privacy-related Limitations

A few participants had concerns that the app could share their personal information or watch them from the front camera during exams, and these concerns were located under privacy.

Table 4.13 Categories and sub-categories under 'Mobile BSE Apps: Limitations'

MOBILE BSE APPS: LIMITATIONS		
Feature	<p>Restrictions about BSE</p> <ul style="list-style-type: none"> - Being unable to create a plan - Being unable to record checkings - Being unable to remind - Being unable to track menstruation - Being unable to take notes - Being unable to track women's health 	<p>Failures</p> <ul style="list-style-type: none"> - Being unable to adjust language setting - Being unable to find reminder feature - Failed Feature: Reminder - Failed Feature: Schedule Next Checking - The screen turns off
	Experience	<p>Usability</p> <ul style="list-style-type: none"> - Complex interactions - Unnecessary features - Complicated expressions - Extra steps that make the process difficult to follow - Annoying tone and voice
Support		<p>User interface</p> <ul style="list-style-type: none"> - Having complex user interface - Being unable to make users feel calm
	<p>Guiding users</p> <ul style="list-style-type: none"> - Being unable to help understand whether the findings were symptoms - Being unable to make sure whether users doing BSE accurately - Having no connection with health facilities - Not providing guidance for following BSE move 	
	<p>Giving psychological help</p> <ul style="list-style-type: none"> - Being unable to give motivation to users - Being able to adapt my daily life - Making users feel in danger - Reminding users that this is a vital situation 	<p>Giving physical help</p> <ul style="list-style-type: none"> - Abstractness of symptoms - Being unable to support users physically - Not supporting users to analyze the symptoms
Content	<p>Information related to BSE</p> <ul style="list-style-type: none"> - Not clearly describing where and how users should touch during BSE - Being unable to give sufficient information about BSE 	<p>Visuals</p> <ul style="list-style-type: none"> - Seeing breast visuals directly - Being unable to see breast visuals
	<p>Information related to breast health</p> <ul style="list-style-type: none"> - Being unable to give essential information about breast health - Having no detailed information about breasts - Not providing detailed breast health information 	
Privacy	<ul style="list-style-type: none"> - Having fear of being seen by camera of phone - Having concerns that the app share users personal information 	

To sum up, several categories and relevant sub-categories under six headings based on women's behavior, motivations, concerns, preferences, and expectations regarding BSE and the usage of mobile BSE apps were identified. These were 1) BSE: Strategies, 2) BSE: Limitations, 3) BSE: Emotions, 4) Mobile BSE Apps: Needs, 5) Mobile BSE Apps: Benefits, and 6) Mobile BSE Apps: Limitations. In the light of the participants' statements, it is believed that mobile BSE apps that adopt a user-centered approach and designed based on the needs and expectations of women would provide women with a positive BSE experience and encourage them for healthy behaviors like performing BSE. Consequently, these categories and sub-categories were defined as design strategies that provide insight for a positive mobile BSE app experience.

4.2 Discussion

This section includes discussion in relation to BSE and BSE apps: discussion on the changes in the participants between phases (i.e., changes in their attitudes, changes in their knowledge level and changes in their emotions), analysis of characteristics of BSE apps utilized in the fieldwork through the Persuasive System Design (PSD) model, and discussion on design strategies through positive technology to suggest dimensions of positive BSE apps experience. Lastly, several design recommendations related to each dimension were proposed by the researcher.

4.2.1 Changes in Participants' Attitudes, Knowledge Level, and Emotions between Phases

As mentioned in the literature review (see Chapter 2), numerous studies confirmed that women do not perform BSE, for the following reasons: not knowing how to perform, fear to discover symptoms, not believing in their ability to perform BSE correctly, having low breast cancer risk perception, lack of motivation and/or knowledge, negative experiences such as witnessing a breast cancer treatment and a

consequent death, and so on (Alazmi et al., 2013; Özkan and Taylan, 2020; Yang et al., 2010).

In the present research, seven out of 24 participants stated that they have never performed BSE, and five participants said that they performed long time ago and were not sure whether they did it correctly or not. Moreover, the participants were asked why they did not perform BSE; they mentioned some psychological, practical, and informational barriers that were introduced in the previous section. These findings broadly support literature in this area, describing women's behaviors for not performing BSE. However, based on the analysis of the statements gathered from 24 participants from the Pre-usage and Post-usage phases, there were some changes observed in their attitudes, knowledge level, and emotions regarding BSE.

4.2.1.1 Changes in Participants' Attitudes

In comparison to the pre-usage phase, the first change in the participants' approaches was their *decision* to perform BSE. Twenty participants declared that they would continue performing BSE. Another important finding was that the *frequency* of performing BSE was slightly increased. This result may be explained by the fact that the BSE apps could not sufficiently emphasize the importance of performing BSE monthly. The participants were asked about their expectations from a BSE app, and sixteen women stated that receiving *reminders* was critical. Despite all three apps had a reminder feature, twelve users said that they did not use this feature. This might be because of the lack of emphasis on this feature and the poorly designed user experience. Hence, it is possible to hypothesize that this situation might be affecting the frequency of performing BSE.

Another change in the participants' attitude was the shift in the methods of *how to perform BSE*. Before the study, the participants stated that they performed BSE without adopting any techniques, but they learned BSE techniques such as the Touch-Look-Check technique after the study. As a result of this change, the

participants stated that they performed BSE more attentively. Moreover, their attitude towards self-monitoring of their breast health affected positively at the end of the study. Owing to the study, most participants got informed about breast cancer risks and symptoms, and they started tracking the symptoms.

Additionally, all participants indicated that they discovered the existence of BSE apps and learned how to utilize these for BSE. While 9 participants stated that they would continue to use BSE apps, 3 participants would continue if their needs have been met better. To illustrate, participants mentioned that BSE apps did not allow them to follow BSE steps and 10 participants noted that the apps should have a checklist for this.

Another important finding was that the apps caused a number of limitations on BSE experience, and these limitations were revealed in detail in the data analysis section (See Section 4.1.4.6). A possible explanation for this might be that the given apps had insufficient features to fulfill BSE adequately, and these apps will be discussed separately in the next section. Taken together, it could be inferred that a BSE app designed with design strategies based on women's needs will provide them with many advantages and ultimately change their BSE behaviors.

4.2.1.2 Changes in Participants' Knowledge Level

Lack of knowledge is a significant barrier affecting to perform BSE. As explained in Chapter 2, most women have little information about screening methods (e.g., BSE), although they acknowledge that breast cancer was a severe disease. Consistent with the literature, lack of knowledge was found to be a significant barrier affecting to perform BSE across the participants of the study as many participants mentioned they did not know how to perform BSE. All three apps provided users with some information regarding BSE. In Check Yourself, the number of participants that indicated not receiving sufficient information about BSE was higher than the other

two apps' users. This might be due to the design of app with a very simple, brief content.

Although most of the participants stated that they were interested in gaining knowledge about breast health and women's health in the first phase, some of them asserted that they could not learn due to the insufficient information provided by the BSE apps. It is also important that after learning the basics about BSE and techniques to perform it, women should be kept updated. Hence, as some of the participants recommended, the apps can provide users with new and informative content at specific time intervals to keep women's attention and enhance their experience.

4.2.1.3 Changes in Participants' Emotions

In previous studies, women described their BSE experiences with negative emotions; therefore, the PANAS was utilized to understand women's feelings before and after using the given apps. After the PANAS, a paired t-Test was performed to check for significant differences on 'before' and 'after' data. As a result, there were a highly significant increase in positive affect while a significant reduction in negative affect. The increase in the PA value after using the apps could be explained with several factors. For example, women's knowledge level increased, and they started to perform BSE regularly, so they felt more interested, proud, and enthusiastic. Likewise, the reduction in negative affect may be due to increasing knowledge level, taking responsibility for own health, and feeling relieved after completing BSE without finding any symptoms.

4.2.2 Analysis of Characteristics of BSE Apps Chosen for the Study Through Persuasive System Design (PSD) Model

One of the objectives of the study was to evaluate current BSE apps and then to define characteristics that BSE apps should have, in terms of providing a positive experience and encouraging behavioral change for BSE. For this aim, fieldwork was

carried out with 24 women by utilizing three mobile BSE apps to obtain insights about the current situation of BSE apps.

While assessing results of the study, the data analysis process was carried out without concentrating on the chosen BSE apps for the study separately. Based on statements of the participants, the needs for the BSE apps experience and the benefits and limitations of the apps on BSE experience were given in the data analysis section (Sections 4.1.5.4 to 4.1.5.6). In order to better understand the current situation of BSE apps in terms of encouraging behavioral change for BSE, the three chosen BSE apps for the study were analyzed based on their persuasive nature for behavior change by adopting the Persuasive System Design (PSD) model.

As explained in the literature review, PSD Model was conceptualized by Oinas-Kukkonen and Harjumaa to be utilized especially in the process of evaluating and analyzing persuasive systems (Matthews et al., 2016). The model has been widely employed in evaluating mHealth apps to figure out their persuasive context and persuasive strategies. The model defines four categories which are 1) primary task support, 2) dialogue support, 3) system credibility support, and 4) social support, and 28 persuasive strategies to assess mobile apps.

During this evaluation, the researcher benefited from the participants' statements obtained through the fieldwork, and the categories determined by data analysis especially the categories in the headings of Mobile BSE Apps: Benefits and Mobile BSE Apps: Limitations. Consequently, it was determined which persuasive strategies adopted by the three BSE apps that chosen for the study and how the apps implemented these strategies, by employing the PSD model.

4.2.2.1 Primary Task Support

The advantage of this category is to provide essential content for supporting and guiding users to achieve a target behavior. The design strategies that can be employed to achieve desired behaviour are reduction, tunneling, tailoring,

personalization, self-monitoring, simulation, and rehearsal (Oinas-Kukkonen & Harjumaa, 2008). As a result of the analysis, which persuasive strategies related to primary task support category that the three BSE apps adopted and how the apps implemented these strategies were identified (see Table 4.14).

Table 4.14 Persuasive strategies related to Primary Task Support employed in the three BSE apps chosen for the study

Strategies	Know Your Lemons	Breast Check Now	Check Yourself
Reduction	Step-by-step demonstrations of BSE	Step-by-step demonstrations of BSE	Step-by-step demonstrations of BSE
Tunneling	Suggest talking to someone after BSE if a symptom found	Suggest talking to someone after BSE if a symptom found	-
Tailoring	Describe risk factors based on women's age, lifestyle choices and menstruation	Suggest several options associated with daily routine for the plan of performing BSE	-
Personalization	-	Take notes, create customizable plan	-
Self-monitoring	-	Keep previous examinations	-
Simulation	-	Keep previous examinations	-
Rehearsal	Simulate BSE with Mona Lisa	-	-

*Know Your Lemons*_ The app adopted four strategies which are *reduction*, *tunneling*, *tailoring*, and *rehearsal*. Although four participants stated that step-by-step demonstration of BSE with Mona Lisa had vague explanations about where to touch and how to examine, all participants that used the app declared that these demonstrations had a great impact on their learning process. Also, the app guided users by making suggestions to talk someone such as a doctor, family member, or friend if a symptom found during BSE. However, none of the participants mentioned

using this feature of the app. Additionally, the app personalized the content and describes risk factors based on women's age, lifestyle choices, and menstruation. Some participants (3/8) felt it was beneficial that the app provided personalized information based on their age rather than a generalized knowledge about breast cancer.

Breast Check Now_ The app employed all strategies in the primary task support category except *rehearsal*. Some of the most outstanding features of the app were enabling users to create a personal plan and take notes about their BSE. Also, the app provided tailored options associated with daily routines such as shower, exercise, and breakfast to participants for the reminders of performing BSE. Similar to Know Your Lemons app, the app included a step-by-step demonstration of BSE and it advised participants to contact a doctor if they noticed a symptom during BSE. In addition, the app allowed participants to keep previous BSE. Almost all participants using the app (7/8) stated that seeing when was the last time they performed BSE was helpful to monitor their breast health and BSE plan.

Check Yourself_ The app adopted *reduction* as a persuasive strategy. It provided a step-by-step demonstration of BSE, likewise other two apps. Five participants found the step-by-step demonstration of BSE useful as it remind them what needs to be done during BSE in detail.

4.2.2.2 Dialog Support

The design strategies that can be employed to achieve desired behaviours in this category are praise, rewards, reminders, suggestion, similarity, liking, and social role. These strategies assist individuals to achieve the target behavior and to continue doing target behavior (Oinas-Kukkonen & Harjumaa, 2008). The persuasive strategies and implementation examples included in the apps were determined through the analysis, as can be seen in Table 4.15.

Table 4.15 Persuasive strategies related to Dialog Support employed in the three BSE apps chosen for the study

	Strategies	Know Your Lemons	Breast Check Now	Check Yourself
Dialog Support	Praise	-	-	-
	Rewards	-	-	-
	Reminders	Remind performing BSE	Remind performing BSE	Remind performing BSE
	Suggestion	Other screening methods	-	-
	Similarity	Lemon visuals instead of breast visuals	-	-
	Liking	-	-	-
	Social role	-	-	-

Know Your Lemons_ The three persuasive strategies which are *reminders*, *suggestion*, and *similarity* were adopted in the app. One of the most prominent characteristics of the app was its theme that uses lemon visuals instead of breast visuals. Six participants indicated that they were able to simply internalize the symptoms of breast cancer with the help of this theme. Another feature mostly mentioned by participants was reminders. The benefits of the feature were reminding users of BSE as well as encouraging behavioral change by keeping them active. Even though, the app had features that guide the participants by explaining and suggesting different screening methods from BSE, there was no participant who stated utilized these features.

Breast Check Now_ The app employed one persuasive strategies in this category, which is *reminders*. The app allowed participants to set a reminder with associated their daily routines such as shower, exercise, and breakfast. The half of those who used Breast Check Now stated that they better adapted the BSE to their daily life owing to this feature of the app.

*Check Yourself*_ The only strategy the app adopted was *reminders*. The app enabled participants to set a monthly reminder by choosing a date and time. However, 3 participants complained that the reminder feature did not work.

4.2.2.3 System Credibility Support

The design strategies of this category are trustworthiness, expertise, surface credibility, real-world feel, authority, third-party endorsements, and verifiability. The strategies in this category define how a system can be designed more reliable and thereby more persuasive (Oinas-Kukkonen & Harjumaa, 2008). The persuasive strategies and implementation examples included in the apps were determined through the evaluation, as shown in Table 4.16.

Table 4.16 Persuasive strategies related to System Credibility Support employed in the three BSE apps chosen for the study

Strategies	Know Your Lemons	Breast Check Now	Check Yourself
Trustworthiness	Be part of a foundation	Be part of a foundation	Be part of a foundation
Expertise	-	-	-
Surface credibility	-	-	-
Real-world feel	-	-	-
Authority	-	-	-
Third-party endorsements	-	-	-
Verifiability	Be part of a foundation	Be part of a foundation	Be part of a foundation

All three apps were part of a foundation related to breast cancer and breast health. The foundations that apps related were: Know Your Lemons Foundation (Know Your Lemons), Breast Cancer Now (Breast Check Now), and Keep a Breast Foundation (Check Yourself). While Know Your Lemons Foundation and Keep a

Breast Foundation were based in the USA, Breast Cancer Now was based in the UK. Therefore their recommendations about BSE and breast health differ from each other due to government health policy.

All three apps adopted *trustworthiness* and *verifiability* as persuasive strategies. The apps provide links to direct the participants the website of related foundations, and a few participants declared that they examined these websites directed by the apps. Also, all participants mentioned about their need of more qualified and meaningful content, instead of the trustworthiness of the content.

4.2.2.4 Social Support

Social support category defines how to motivate users by benefiting from social influence. The design strategies in this category are social facilitation, social comparison, normative influence, social learning, cooperation, competition, and recognition. What stands out in the evaluation is that all three apps did not adopt any persuasive strategies related to social support. Apart from persuasive strategies, the apps enabled participants to share in social platforms such as Instagram, Facebook, Twitter, etc.

In summary, the apps that implemented the most persuasive strategies were respectively Know Your Lemons (10 out of 28 strategies), Breast Check Now (10/28), and Check Yourself (5/28). The findings of the review indicate that features related to the primary task support category were generally dominant among the evaluated apps. Reduction was found to be adopted in all apps. In addition, tunneling and tailoring observed to be the most commonly employed persuasive strategies to assist participants. Moreover, the features associated with supporting users to continue doing target behavior like persuasive strategies from the dialog support category were partly included in the apps. For example, reminders were utilized as a persuasive strategy in all three apps. Also, praise, reward, liking, and social role were found to be absent from the all evaluated apps. The system credibility support

category was largely under-utilized in the apps. All three apps adopted just trustworthiness and verifiability as persuasive strategies, and the adoption was exceptionally superficial. Even though previous studies demonstrated that social interaction is an important role to motivate individuals to achieve their target behaviours (Matthews et al., 2016), the apps did not provide any features related to social support category.

Consequently, the BSE apps utilized in the study were evaluated employing 28 persuasive strategies outlined by the PSD model. In order to determine design dimensions and recommendations for positive BSE app experience, design strategies determined by using grounded theory were discussed through positive technology in the next section.

4.2.3 Discussion on Design Strategies through Positive Technology to Suggest Design Dimensions for Positive BSE Apps Experience

As a result of the study, it was identified several categories as design strategies based on women's behaviors, motivations, concerns, preferences, and expectations regarding BSE and BSE apps. These categories were BSE: Strategies, BSE: Limitations, BSE: Emotions, Mobile BSE Apps: Needs, Mobile BSE Apps: Limitations, and Mobile BSE Apps: Benefits. When positive technologies and the fieldwork results were reviewed together, some relationships were observed in terms of experience.

As mentioned in the literature review, positive technology combines positive psychology and HCI to improve the personal experience to strengthen people's wellness. Based on the categories from data analysis, dimensions as specific design strategies were determined, considering positive technology approaches. These dimensions can be considered as improvements to enhance the experience of BSE and BSE apps.

4.2.3.1 Hedonic Level

As briefly mentioned in the literature review, hedonic level aims to develop positive emotions such as pleasure, relaxation, and enthusiasm by using technology (Botella et al., 2012). As a result of the field study that aims to determine design strategies for positive experiences with the use of mobile BSE apps, it was seen that the usage of the apps drove some positive emotions, which is one of the positive technology levels. Example statements from the participants were: "it made me feel responsible for my health", "it made me feel safe", "it kept me positive", and "it made me believe I am not alone". According to the fieldwork results, some dimensions that help to create experiences related to the hedonic level included: i) being motivating, ii) creating self-awareness, iii) providing uplifting experiences, and iv) providing a light-hearted experience.

i) Being motivating

Motivation is one of the critical factors for behavior change and is defined as the drive to do something (Fogg, 2009). The present study revealed that the BSE apps employed in the fieldwork fell short of motivating participants to perform BSE even though they became well aware of its role in women's health. At the beginning of the study, the participants were willing to use the BSE apps even though they had little information and perhaps some concerns about BSE. Throughout the study, they learned about the breast cancer risks, its symptoms, and BSE practices with the help of the BSE apps they used. However, some participants mentioned that they delayed performing BSE even if the app sent a reminder. This might be due to lack of persuasive strategies that BSE apps were missing, such as gamification and rewards to motivate women for performing BSE and using the app. Some design recommendations for BSE apps to be more motivating can be rewarding the users for their significant behavior with messages like "You have been performing BSE

for five months !"; enabling goal setting; and giving information about personal progress.

ii) Creating self-awareness

Self-awareness is defined by George Herbert Mead (1934) as “focusing attention inward toward the self”, and is important for BSE because breast self-awareness enables women to be aware of symptoms in their breasts thus increases healthy behaviors. Based on the women's needs toward BSE apps obtained from the fieldwork, being informed about breast cancer symptoms and BSE, and tracking their breast health were essential for maintaining breast health with the help of BSE apps.

Throughout their BSE app use, the participants became more aware of breast cancer symptoms and the anatomy of their breasts. By performing BSE regularly for a month, the participants stated that they took an active role in their breast examination and felt more responsible and in-charge for their own health. In line with this, the participants desired to obtain information specific to themselves, rather than general information about BSE. Many participants (11 participants) mentioned that past BSE checks and notes were beneficial to track and see their own progress. Overall, self-awareness could be a critical factor to consider for design to enable users to keep performing BSE. In order to boost self-awareness, BSE apps can support self-tracking by providing examination history, note taking during each examination, and feedback on the users progress.

iii) Providing uplifting experiences

Based on the participants' statements, it can be inferred that BSE experiences affect their psychology. If an experience causes distress and anxiety, people would not like to want it happen again. However, the fieldwork results indicate that BSE is not a stress-free experience. Some participants (5/24) stated that they were concerned

about discovering a symptom at each BSE. They also mentioned about being worried due to uncertainty about their examination findings.

Some participants stressed that they expect BSE apps to have a positive tone. Therefore, BSE apps can provide uplifting experiences to reduce users' concerns and increase the positive emotions. Additionally, most participants desired a more calming interface, interaction, and content. For example, participants suggested that BSE apps could calm users when they find a symptom and offer possible solutions or directions. Consequently, the recommendations for providing uplifting experiences can be summarized as: providing a calm interaction with a simple interface, asking users about their mood and adapt the guidance based on it, supporting users' BSE experience with relaxing sounds and visuals.

iv) Providing a light-hearted experience

Some participants, who have limited knowledge about BSE, were nervous at the beginning of the study. Providing enjoyable interactions and content through an BSE app can be a critical point to make the BSE experience less tense. For example, the Know Your Lemons app offers a light-hearted experience by adopting a theme that uses lemons instead of breasts. Of the 8 participants who used the Know Your Lemons app, 6 of them stated that the theme of the app made the BSE process more pleasurable rather than boring and tense. However, a few users mentioned the theme became irritating after a while as there has been no changes or progress. Consequently, the BSE apps offering some features and content can enable a light-hearted experience, but in order to keep the theme fresh and to be more preferable it needs to evolve with the user's journey.

4.2.3.2 Eudaimonic level

Eudaimonic level concentrates on technologies that support people to engage and self-actualize (Riva and Gaggioli, 2015). According to the participants' statements during the pre-usage phase, it was revealed that they had little knowledge about BSE, they had concerns about cancer and finding a symptom; however, they were still eager to learn and perform BSE. Generally, as the participants performed BSE and gained information about themselves, their enthusiasm to use the mobile BSE apps decreased. According to the fieldwork results, some dimensions that help to create experiences related to the eudaimonic level included: i) allowing personalization, ii) allowing self-monitoring, iii) being informative, iv) being multifunctional, v) encouraging active involvement, vi) presenting different kinds of breast visuals, and vii) providing daily suggestions.

i) Allowing personalization

BSE is closely associated with menstruation time. According to experts, the most appropriate time for BSE is the second or third day after the menstruation ends (the Turkish Ministry of Health, 2017). Since menstruation is personal and varies from person to person, BSE apps can provide a customizable BSE plan. Breast health and the risk of breast cancer are also affected by factors like age, health history, daily habits, etc. (Campbell, 2002). Therefore, women's needs regarding the BSE apps may differ based on these factors and their level of BSE knowledge. For example, women's knowledge about BSE generally increases once they start performing BSE; but expectations about the level of expected information changes throughout the process. Some participants mentioned how they wanted to feel unique, therefore providing a personalized interface, features and content appear as important design dimensions. To allow personalization, BSE apps can provide a customizable BSE plan and different contents for beginners and advanced users.

ii) Allowing self-monitoring

As participants learned the necessary information about breast cancer symptoms and performed BSE, they started to monitor their breast health by themselves. The three apps utilized in the fieldwork had several features to support participants to track their breast health, including personal BSE plan, examination records and notes, and reminders. Most participants mentioned the benefits of these features in terms of motivating them to perform BSE and to use the app. In addition, some participants stated that they expected the app to track their menstruation and monitor women's health. Consequently, some potential features that support users' self-monitoring can be in the form of graphs and texts showing examination history and progress, reminders, and BSE notes.

iii) Being informative

Being informative is about providing accurate, important, relevant, and reliable information through BSE apps. Most participants stated that they needed a brief information about BSE and a step-by-step demonstration of BSE to support their BSE learning process. Additionally, this dimension is associated with creating self-awareness to help women learn about their breasts. Although the critical content is about BSE, the participants stated that they needed knowledge about breast health, breast cancer symptoms, menstruation, gynecological diseases, breastfeeding, etc. Therefore, to facilitate BSE, step-by-step demonstration of BSE and displaying content related to women's wider health information appear to be necessary features for BSE apps.

iv) Being multifunctional

Being multifunctional is one of the primary dimensions for BSE apps since many participants stated that they would not use BSE apps if the app only presents BSE and BSE techniques. For example, most participants said that they would also like

to use the app for tracking menstruation, and they desired to perform BSE and track menstruation together. In order to provide a comprehensive experience, BSE apps can have features related to breast healthcare and menstruation. The app can also have features associated with other cancer types like ovarian cancer, which is another common type of cancer for women and believed to be related.

v) Encouraging active participation

Some participants stated that they wanted to read the relevant content but also be involved in the process actively. More clearly, this dimension is about providing users more interactive experiences such as fulfilling checklists for BSE steps, setting goals with gamification, rewarding systems, and answering questions.

vi) Presenting different kinds of breast visuals

Participants' statements related to the presentation of visuals, images, illustrations, and videos in BSE apps were listed under this dimension. Although there were many different perspectives about the presentation of the breast visuals, all participants agreed on the visuals could have high quality and be informative. For example, some participants stated that they prefer to see real breast images to clearly understand how to perform BSE. In contrast, others stated that they were uncomfortable to see real breast visuals and would rather see breast illustrations. However, the training video was found essential by all participants to learn BSE in detail. Therefore, the BSE apps might present detailed breast visuals and a video in order to explain BSE.

vii) Providing daily suggestions

Guiding users and providing them with necessary content are important criteria for the BSE apps experience. Apart from learning about BSE, the participants also wanted the content and features of the BSE apps to guide them during BSE. Some participants stated that they learned all the content in the app after using it for a certain period, thereby not having enough motivation to continue using the app due to lack of new content. They added that some daily suggestions and tips would enhance their BSE experience. For these reasons, BSE apps can provide brief and

informative daily content from experts or former cancer patients to keep users motivated for BSE and for using the app.

4.2.3.3 Social/Interpersonal Level

During the analysis, it was found that some of the BSE app features provide a sense of community feel, which is related to one of the positive technology levels. Social/Interpersonal level interested in technologies that are supporting and improving the commitment of individuals, communities, and groups among themselves. The majority of the participants suggested that features that allow users to socialize with friends or with other users could be advantageous for continuing to use the apps. Moreover, some participants mentioned that collaboration with doctors and healthcare clinics can improve their experience. Some dimensions that support participants' experiences related to social/interpersonal level included i) enabling social networking and ii) providing data regarding personal experiences.

i) Enabling social networking

The participants were asked about their thoughts about connecting with healthcare clinics. Some responded that they would like to communicate with healthcare professionals and ask questions; these features were interpreted as direct social networking. However, specific needs for BSE apps indirectly showed up, such as sharing with friends and motivating them to participate.

In the study, twelve participants mentioned their needs for socializing with other users, and four participants stated that sharing the BSE apps with their social circle would enhance the overall experience. According to the participants, social connection can be used for: a) inviting their friends and families to perform BSE, b) sharing their experiences with other women, c) getting inspired by women's stories, and d) communicating with other women, doctors, and healthcare professional. Perhaps, the reason for needing to reach out to other women can be in circumstances

when women find out that they are faced with a problem, so they wish to share their concerns and get some help and reassurance.

These results support the idea that women require to talk with someone to continue performing BSE, as explained in Chapter 2. Considering these, BSE apps can enable social interaction to enhance the BSE experience. To illustrate, women could invite their friends to use the BSE app and motivate them to perform BSE by assigning tasks and sending notifications through the app. Also, one of the features that make BSE apps socially interactive could be seeing other users' performing status like "Aylin performed BSE yesterday".

ii) Providing data regarding personal experiences

During the study, 16 participants mentioned that they would be interested in other user comments and stories. As the BSE was a tense experience, the feelings of other women during the process were considered essential by the several participants. In particular, they assumed that stories of women who survived breast cancer would guide them and help them understand what to look out for. Thus, BSE apps can provide data regarding personal experiences and allow users to communicate through the app to offer a better experience. However, a few participants (6 participants) stated that social interaction could be disturbing. Therefore, features related to social interaction can be optional.

CHAPTER 5

CONCLUSIONS

The primary aim of this research was to find out how a positive breast self-examination (BSE) experience can be delivered through the use of BSE apps, and how behavior change for BSE can be encouraged with the support of BSE apps. The research also sought to define what design dimensions and recommendations can be adopted for BSE apps that better fulfill women's needs. In accordance with these aims, the following objectives were set: i) to uncover motivations of women to perform BSE; ii) to figure out women's needs to perform BSE, and iii) to recommend ways to enhance women's BSE experiences through the BSE apps.

First, the literature review on breast healthcare and BSE was carried out to better understand women's approaches to BSE. This helped to discover women's behaviors, concerns, and barriers that prevent them from performing BSE. Moreover, the shift in healthcare, the current situation in the mHealth apps, and the prior works about mHealth apps for women and breast health were summarized. After finding out about mHealth apps, a review about current approaches in design for healthcare was carried out to propose ways for enhancing the current BSE experiences of women with mobile apps (see Chapter 2).

Following the literature review, three-phase fieldwork, including semi-structured interviews with women, was carried out to uncover women's pre-usage, during-usage, and post-usage experiences of existing mobile BSE apps. Three selected mobile BSE apps (i.e., Know Your Lemons, Breast Check Now, and Check Yourself!) were used by a total of 24 participants (8 different women used each of the apps) for four weeks to reflect on their experiences, and uncover their needs, and expectations (see Chapter 3).

Consequently, in order to identify design strategies for BSE and BSE apps, the collected data from the participants were analyzed by the coding procedures of the grounded theory, and the results of the fieldwork were presented along with a discussion on the implications of the findings. The emerged design strategies were interpreted through levels of positive technology, which are hedonic, eudaimonic, and social and interpersonal levels, to propose necessary design dimensions and recommendations for development of BSE apps that provide positive experience. An analysis of characteristics of the BSE apps employed in the fieldwork through the Persuasive System Design (PSD) Model by Oinas-Kukkonen and Harjumaa (2009), changes in the participants' attitudes (before and after using these apps) carried out, their knowledge level, and emotions were also discussed.

In the following sections, answers to research questions will be offered considering the literature review and fieldwork findings. Then, limitations of the study and recommendations for further research will also be presented. It is believed that the findings of this research highlights two important areas. First, it provides knowledge for the association between women's behavior and BSE apps by systematically analyzing various disciplines including healthcare, design, and technology. Secondly, the research presents insights on current BSE apps as well as their assessment on persuasive nature for behavior change. The research outcomes also reveal necessary design strategies and proposes dimensions for positive BSE and BSE app experience benefitting from positive technology literature. Therefore, designers, design researchers, technology developers, and healthcare stakeholders in the field of breast healthcare and its systems can benefit from the outcomes of this research as a source of summarized literature knowledge and insights for related studies. All these can support the better integration of mobile health apps in the daily lives of women by addressing a positive BSE and BSE apps experience.

5.1 Revisiting the Research Questions

In this section, the main and supporting research questions will be revisited and answers will be offered.

Q1: How do women feel about breast self-examination? What are their behavior and experiences regarding BSE?

In order to answer this question, the literature review and the fieldwork results were evaluated together. What is known about women's experiences is largely based on previous studies investigating breast healthcare, breast cancer, and BSE (see Chapter 2).

According to previous studies, having negative emotions are one of the most critical states mentioned about BSE by women. Most women are afraid of performing BSE, since they have the perception of discovering something bad, like breast cancer, if they check their breasts. The results of the fieldwork confirm the literature findings. The results from the Pre-PANAS scale and the answers to the interview questions in the fieldwork substantiated the knowledge on women's emotions regarding BSE. In accordance with the literature, most participants described their BSE experiences with negative emotions such as fear, anxiety, panic, guilt, and confusion, and they stated that they are afraid of breast. Some participants also mentioned positive emotions such as happiness, hope, and relief since they or their relatives have not had breast cancer.

The fieldwork findings show that most participants suffer from a lack of knowledge and lack of awareness related to breast health, breast cancer, and BSE, similar to literature findings. Also, it was found that most participants have never performed BSE or avoided performing it regularly. For this reason, it is indicated in previous studies and again confirmed by the fieldwork that the rate of performing BSE is low. In the case of the fieldwork 7 out of 24 participants had never performed BSE, and the remaining 17 participants had performed BSE with different frequency such as occasionally (8/17), frequently (5/17), and regularly (4/17).

The study results also show that the participants developed strategies to perform BSE and to continue doing it. For example, associating BSE plans with an activity from their daily lives, such as while ‘taking a shower’ was one of the most common strategies. Some other strategies included: learning BSE by yourself by searching on the web, learning from the environment by getting informed about BSE from brochures at the health clinics, and getting help by consulting a family member, a friend or a doctor.

Q2: What are the limitations that prevent women from performing BSE according to them?

Answers to this question came from the literature and the fieldwork results.

There are a number of studies investigated why women do not perform BSE and/or situations that prevent them from performing it. Based on the meta-synthesis study of Özkan and Taylan, barriers for women to perform BSE emerged under three themes: “personal barriers”, “social barriers”, and “system barriers” (2020, p.20).

As explained in Chapter 2, ‘personal barriers’ are mostly related to lack of motivation and knowledge, negative emotions and experiences, and socioeconomic status. While ‘social barriers’ are associated with society’s critical issues, such as the lack of preventive health culture and the stigma of being unhealthy women, system barriers include lack of healthcare clinics and professionals related to breast healthcare (Özkan & Taylan, 2020). In developing and underdeveloped countries, where women have little knowledge and awareness, these barriers appear more strongly and they affect women’s attitudes toward BSE (Gürsoy et al., 2011).

In addition to barriers found in the literature, the fieldwork revealed that the participants had several other limitations related to performing BSE. These limitations are classified under the following three headings: ‘practical barriers to understanding process and findings’, ‘psychological barriers’, and ‘informational barriers’. While ‘practical barriers to understanding process and findings’ are related to participants’ concerns about performing BSE accurately and misinterpreting the

findings, ‘psychological barriers’ are associated with being unaware of the importance of BSE and the perception of not having breast cancer. In addition, ‘informational barriers’ were derived from the lack of knowledge regarding breast healthcare, breast cancer, and BSE. To give an example, one of the participants (P18) stated that she did not know where to apply for learning about BSE and how to learn performing BSE; thus, she ignored the need to perform BSE. Another participant (P10) mentioned that she is afraid of progressing her existing disease by performing BSE. All these limitations are explained in Section 4.1.4.2.

Consequently, women have numerous limitations that restrict them from performing BSE. According to the previous studies and the fieldwork results, these limitations can be categorized as follows: “personal barriers”, “social barriers”, “system barriers”, ‘practical barriers to understanding process and findings’, ‘psychological barriers’, and ‘informational barriers’.

Q3: What is current state of BSE apps in terms of providing a positive experience and encouraging behavior change?

In literature, there are four main behaviors mentioned for effective BSE and BSE experience: (a) performing BSE, (b) learning about BSE, (c) discussing BSE with friends, and (d) having someone remind one to perform BSE (Misovich et al., 2003). It can be inferred that supporting these four core behaviors with mobile BSE apps would help to improve women’s BSE experience; thus, it is important that mobile BSE apps have features related to the abovementioned behaviors.

In order to understand the current state of BSE apps, three selected mobile BSE apps (i.e., Know Your Lemons, Breast Check Now, and Check Yourself!) were utilized in the fieldwork, and the apps were analyzed based on the participants' statements in relation to their app usages for four weeks. The analysis with Grounded Theory revealed the essential discussion in relation to BSE Apps: Needs, Benefits, and Limitations (see Sections 4.1.4.4, 4.1.4.5, and 4.1.4.6, respectively), and the emergent topics formed the basis of the design criteria necessary to encourage positive experience.

The analysis is made based on the participants statements in relation to the three BSE apps utilized in the fieldwork. Naturally, there may be other apps that meet some additional needs/expectations of women from BSE apps. Yet, the aim of the fieldwork was not to find an app that best meets the women's needs, but to explore what they (the needs and expectations) were. On the other hand, some examples offered by the participants were specific to the BSE app that they used during the fieldwork.

While the analysis with grounded theory revealed the necessary directions for positive experience, it was also necessary to analyze the persuasive nature of the apps. In order to investigate which persuasive strategies the BSE apps adopted, the PSD model was employed. The model has four categories: primary task support; dialogue support; system credibility support; and social support, and accompanying 28 persuasive strategies to assess mobile apps. As can be seen in Table 5.1, based on the participants statements, it was determined which strategies from 28 persuasive strategies of the PSD model were adopted by the BSE apps. As a result, the strategies from the 'primary task' support category were generally broadly employed among the evaluated apps. While strategies related to 'dialog support' category were partly included, but the 'system credibility support' category was under-utilized. Lastly, the evaluated apps had no features related to strategies form 'social support' category. However, there were some features such as sharing the app on social network and directing the website of the app for more information.

Table 5.1 Persuasive strategies employed in the three BSE apps chosen for the study

Strategies	Know Your Lemons	Breast Check Now	Check Yourself
Primary Task Support	Reduction		
	Tunneling		
	Tailoring		
	Personalization		
	Self-monitoring		
	Simulation		
	Rehearsal		
Dialog Support	Praise		
	Rewards		
	Reminders		
	Suggestion		
	Similarity		
	Liking		
	Social role		
System Credibility Support	Trustworthiness		
	Expertise		
	Surface credibility		
	Real-world feel		
	Authority		
	Third-party endorsements		
	Verifiability		
Social Support	Social comparison		
	Cooperation		
	Normative influence		
	Social facilitation		
	Competition		
	Recognition		
	Social learning		

Q4: What are the effects of utilizing BSE apps on women's BSE behavior and BSE experiences?

To answer this question, changes in women's attitudes, knowledge level, and emotions were investigated based on the PANAS scales and interviews carried out as part of the fieldwork. Even though some of the changes found to be more prominent, it is critical mentioned that all changes are somewhat interrelated.

As a result of the study, there were several important changes in the participants' attitudes and knowledge level towards BSE (see Chapter 4 for full detail). Out of 24 participants, only two used a BSE app before, thus the remainder were curious about using the apps for BSE. The participants of the study volunteered to take part and were interested in performing BSE at the beginning, although they had limited knowledge and some concerns about BSE. Concordantly, they were eager to learn about breast cancer, its symptoms, and BSE since they stated that they read all information on the first usage of the app. Generally, as participants used the apps for performing BSE, their knowledge level about BSE gradually increased; thus, the apps started to become insufficient for them. Therefore, half of the participants (12 out of 24) stated they would not use the app (provided to them) for BSE after the study; while three participants mentioned that they were unsure using the app. It seems that mobile BSE apps help to increase the knowledge level about BSE, the frequency of performing BSE, and the number of women utilized the BSE apps; yet, it is not so straightforward that they will enable or encourage women to perform BSE every month as recommended.

Moreover, the analysis of the fieldwork revealed several other benefits of using mobile BSE app. For example, learning how to perform BSE, learning about breast cancer symptoms, and getting familiar with one's own breasts (e.g., their formation, structure, size, and shape), performing BSE according to BSE techniques, tracking breasts, and creating a personal plan for BSE (see Chapter 4, Section 4.1.4.6).


The PANAS scale, consisting of ten positive and ten negative words defined under the general term 'affect', was utilized to measure differences in the participants'

mood states. The affects were evaluated by 24 participants by using a five-point Likert scale. The evaluation was made based on the participants' previous BSE experiences (Pre-PANAS) and experiences related to using the mobile BSE app (Post-PANAS). The mean values for before usage's Positive Affect (PA) and Negative Affect (NA) and the mean values for after usage's PA and NA were calculated. Then, a paired T-test was used to analyze the differences in the mean values. Consequently, there were a highly significant increase in positive affect and a significant reduction in negative affect. Taken together, these results verify that the apps were successful in their task of supporting positive affect and alleviating negative affect.

Lastly, the changes between 24 participants' attitudes, knowledge level, and emotions pre- and post-usage of mobile BSE app in the fieldwork were discussed in Section 4.2.1. The summary comparison of these changes between phases can be seen in Table 5.2.

- Twelve participants stated that they previously performed BSE, while twenty participants declared that, after the study, they will continue to perform BSE owing to realize the importance of BSE with the study.
- In general, mobile BSE apps made the participants more aware of BSE. With the help of mobile BSE apps, the participants were able to follow correct BSE steps and techniques. Even though all three mobile BSE apps indicated step by step what women should do during BSE, the given knowledge in these steps and clarity of these steps differed. For example, the Breast Check Now app made it more difficult for participants to follow steps and to perform BSE since the information for BSE is presented separately in 'How to check' and 'Recording of a check'. Thus, if the apps provide a comprehensive step-by-step demonstration of BSE, they might be more useful for the BSE experience. In addition, the given information in the Check Yourself! was found inadequate by participants to learn breast cancer and BSE in detail.

Table 5.2 The Participants' Pre -/ Post-Attitudes, Knowledge Level, and Emotions

Mobile BSE App Usage _ The Participants' Pre- / Post- Usage Attitudes, Knowledge Level and Emotions		
◀ Before		After ▶
Performing BSE (12p)	⤴	Performing BSE (20p)
Unconsciously performing BSE	⤴	Following BSE techniques
Having a lack of knowledge about BSE	⤴	Rising in knowledge level about BSE
Ignoring symptoms	⤴	Tracking symptoms
Neglecting of using BSE apps	⤴	Utilizing the BSE apps for BSE
Frequency of BSE	⤴	Frequency of BSE
Knowledge about breast health	=	Knowledge about breast health
Positive emotions about BSE(2.1)	⤵	Positive emotions about BSE(3.3)
Negative emotions about BSE(2.3)	⤵	Negative emotions about BSE(1.9)
⤴ increase / = no change / ⤵ decrease		

- Monitoring breast health by performing BSE is one of the most significant behaviors for managing breast healthcare, and the mobile BSE apps made most participants to become aware about it and pay attention to the symptoms of a breast cancer.
- Prior to the study, it was identified that only one participant downloaded a BSE app but stopped using it afterwards. Once the participants completed the study, they mentioned about the benefits of using BSE apps. When participants were asked whether they will continue to use the apps provided to them, the answers were: will continue to use (9/24), not sure about

continuing to use (3/24), will stop to use (12/24). After all, the number of women who would like to use BSE apps were increased.

- Although the app usage slightly increased the participants' frequency of performing BSE, it was not definite that women would perform BSE every month as recommended. This result may be explained by the fact that the apps were unable to highlight the importance of performing BSE monthly and unable to offer clear reminders. In addition, 'Know Your Lemons and Check Yourself!' app did not allow the participants to customize their BSE performing plan in detail. For example, 'Breast Check Now' provided a more detailed plan by questioning the user's personal habits such as associating the plan with the user's daily routine, while the other two apps allow women to choose only a reminder date and time.
- The awareness about of the necessity of performing BSE monthly is increased. The participants were asked whether they will continue performing BSE, and the answers are as follows: 'I would maintain performing regular BSE after the study' (13/24), 'I would perform BSE, but probably not on such a regular basis' (7/24), and 'I would not perform BSE in the hereafter' (4/24). However, only four participants stated that they have performed BSE regularly before the fieldwork.
- According to the participants' statements, learning about breast healthcare was an essential need to maintain breast health. However, they stated that they could not learn due to the insufficient information provided by the BSE apps, thereby their knowledge level about breast health remained the same.
- Based on the results of the PANAS and paired T-test, participants' positive emotions about BSE and performing BSE were increased, while their negative emotions were decreased.

Q5: Which characteristics do BSE apps require to provide a positive BSE experience and encourage behavior change for BSE?

The results of the fieldwork were analyzed with an eye to propose the characteristics of a mobile BSE app should have to contribute to women's positive BSE experience. Accordingly, the results that were related to design strategies were categorized under six headings: BSE: Strategies, BSE: Limitations, BSE: Emotions, Mobile BSE Apps: Needs, Mobile BSE Apps: Limitations, and Mobile BSE Apps: Benefits.

Then, all six categories were discussed through positive technology to identify dimensions related to positive BSE experience. These dimensions were then reviewed and categorized under the three levels of positive technology: hedonic level, eudaimonic level, and social/interpersonal level.

Hedonic Level

Hedonic level refers to dimensions related to the development of positive emotions. The dimensions that help to create experiences related to the hedonic level included;

- being motivating,
- creating self-awareness,
- providing uplifting experiences,
- providing a light-hearted experience.

Eudaimonic Level

Eudaimonic level refers to dimensions related to supporting users to enhance their knowledge about BSE and related to enhancing users' BSE experience. The dimensions that help to create experiences related to the eudaimonic level included:

- allowing personalization,
- allowing self-monitoring,
- being informative,
- being multifunctional,
- encouraging active involvement,

- presenting different kinds of breast visuals,
- providing daily suggestions.

Social/Interpersonal Level

Social/interpersonal level refers to dimensions related to providing a sense of community feel. The dimensions that support participants' experiences related to social/interpersonal level included:

- enabling social networking,
- providing data regarding personal experiences.

Consequently, the research findings confirm that there are multiple dimensions to consider while designing a positive BSE and mobile BSE app experience to support women's breast health and promote BSE behavior. These dimensions of mobile BSE apps (refer to Chapter 4 for detailed explanation) define which characteristics the apps need for a positive BSE experience. Accordingly, several design recommendations that can be adopted in the design of mobile BSE apps were determined considering the result of fieldwork, and presented in terms of recommendations for creating an experience with dimensions related to three levels included: hedonic level, eudaimonic level, and social/interpersonal level.

Recommendations for creating an experience with dimensions related to hedonic level

- awarding for significant behaviors like "I have been performing BSE for five months",
- enabling goal setting,
- giving information about personal progress,
- giving motivational messages,
- supporting self-tracking by providing examination history,
- enabling note taking in each examination,
- giving feedback on the user's progress,

- providing a calm interaction with a simple interface,
- asking users about their mood and adapt the guidance based on it,
- supporting users' BSE experience with relaxing sounds and visuals.

Recommendations for creating an experience with dimensions related to eudaimonic level

- providing a customizable BSE plan and different contents for beginners and advanced users,
- providing graphs and texts that demonstrate examination history and progress,
- having reminders,
- enabling note taking for BSE,
- providing step-by-step demonstration of BSE,
- providing features and content related to women's health, such as menstruation and fertility,
- providing features related to other cancer types like ovarian cancer, which is another of the most common types of cancer in women,
- enabling users to fulfill checklists for BSE steps,
- enabling goal setting with gamification,
- providing rewarding systems,
- guiding users with questionnaires,
- presenting different kinds of breast visuals such as detailed breast visuals and a video,
- providing brief and informative daily content from experts or former cancer patients.

Recommendations for creating an experience with dimensions related to social/interpersonal level

- enabling social interaction,

- allowing to invite friends to BSE apps and motivate them to perform BSE by assigning tasks and sending notifications through the app,
- enabling to see other users' performing status like "Aylin performed BSE yesterday",
- allowing to communicate through the app - user forums,
- allowing to share past experiences,
- enabling to comment.

These recommendations, as they presented, do not offer any priority and not all of them are needed to be equally emphasized. Their adoption can change based on the context of design. However, the recommendations are suggested for positive experience; thus, as many recommendations as possible should be considered while designing for positive mobile BSE app experience.

The recommendations can be used as a source of inspiration by designers, developers, researchers, and healthcare stakeholders to create a positive BSE experience with mobile BSE apps. It is important to note that the present research outcomes offer recommendations for positive BSE experience and for possible changes of women's BSE behaviors. Although some examples of how to implement these recommendations are offered, how to fulfill these recommendations is outside the scope of the thesis. On a basic level, these recommendations could be adopted to determine the features that the existing or new mobile BSE apps should have for positive experience and behavior change, and to design for positive user experience of mobile BSE apps.

Main Question:

How can BSE apps promote women's BSE behavior and positively contribute to their BSE experience?

To answer this question, first of all, a literature review and fieldwork that give insight into women's approaches to BSE, their emotions about BSE, and their behavior and experiences regarding BSE were conducted. According to the answers to the Q1 and

Q2, consistent with the results of the literature review, the fieldwork showed that women describe their BSE experience with negative emotions and they tended to avoid performing BSE. Additionally, the fieldwork findings demonstrated that there are several barriers for women to perform BSE and various limitations of the current BSE apps that prevent them to provide a positive BSE experience. All these limitations are explained in Section 2.1.2.2 and 4.1.4.2.

Moreover, it is also found that the utilization of mobile BSE apps had positive effects on the BSE experience, like performing BSE more attentively. During the fieldwork, participants mentioned their needs from the mobile BSE apps, the benefits of using the given apps, and the problems they faced during their usage. Additionally, the analysis of characteristics of BSE apps chosen for the study through the Persuasive System Design (PSD) Model was conducted by the researcher in order to evaluate current BSE apps in terms of their persuasiveness. As a result, in the line with the statements of participants, several dimensions and recommendations were determined for design for positive breast-self examination experience. It is believed that mobile BSE apps that adopt a user-centered approach and are designed based on the needs and expectations of women would provide women a positive BSE experience. Therefore, BSE apps designed based on these dimensions and recommendations could meet the women's needs for BSE, encourage them for behavior change, and provide them a positive BSE experience. These dimensions and recommendations were explained in Section 4.2.3 and summarized in Q5.

5.2 The Researcher's Reflections

Through the study's findings, it was understood the perspectives of women on BSE, and women's behavior, strategies, concerns, emotions, and needs regarding BSE and the usage of mobile BSE apps. In light of the results of the study and data analysis, it could be assumed that no matter how excellent the experience is provided, performing BSE falls to the women's decision and motivation. Nevertheless, several improvements on BSE apps could help enhance women's motivation. As mentioned

earlier, several design dimensions and recommendations that could support women to perform BSE and use the BSE apps were identified based on the study's results (see Chapter 4 for full detail). The researcher believes that these recommendations could enhance women's BSE experience positively and have an impact on their BSE behavior like giving a motivation to perform BSE monthly as suggested.

Moreover, all participants stated that they were glad to participate in the study and perform BSE regularly during a month-long study. The participants added that the presence of the BSE apps on their smartphones help them feel happier as it enabled them to take care of their own health. Yet, the recognition level of BSE apps was remarkably low at the beginning of the study.

However, the chosen BSE apps belong with foundations that seek to increase awareness for breast cancer. For example, the Know your Lemons app provides several educational materials for supporting women to detect breast cancer in early phase. One of them is the 12 breast cancer symptoms with explaining through lemon visuals instead of breast visuals. Even, the poster including the explanation of 12 breast cancer symptoms (see Figure 5.1) quickly spread on social media and attracted great attention. According to comments on social media and app stores, it can be assumed that the reason why this poster gets a great attention is using lemons visual that encourage individuals for checking breasts with a stress-free way. In addition, the participants in the study agreed that the app promoted performing BSE without constantly scaring them about breast cancer. After all, a webby award-winning Know Your Lemon app had great impact on increasing the awareness for breast cancer and promoting performing BSE, thereby it can be assumed that it enabled rising the survival rate for breast cancer. As a result, the researcher suggests that the studies for rising awareness can be more prevalent, and the authorities can promote BSE apps by including them in healthcare services to increase awareness.

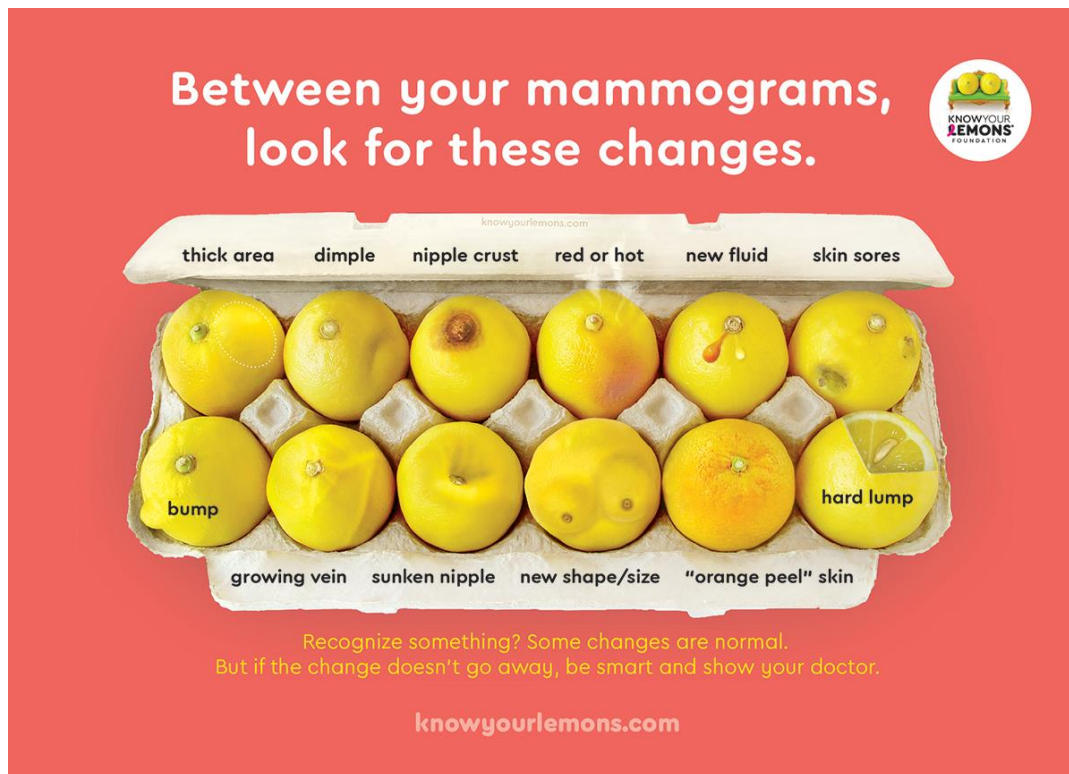


Figure 5.1 The Know Your Lemons app' image that explains 12 symptoms of breast cancers (retrieved from <https://www.knowyourlemons.com/symptoms>)

Some participants indicated that they might delete the apps after the study because they were unsure about whether they continue performing BSE. Whilst a dozen apps is available on our smartphones, it might be challenging to expect women to download an mHealth app only for BSE. In researcher's opinion, a multifunctional mHealth app that includes features related to BSE, menstruation, and women's health might be adopted by more users rather than a stand-alone BSE app, as suggested in design dimensions.

Moreover, it was observed that the BSE apps failed to provide features regarding social interaction. Nowadays, most mobile apps have features related to social networking and people are familiar with using these features. In the study, the participants immensely mentioned their need for social interaction such as communicating with other women and doctors, and inviting family and friends. Based on these statements of participants, two design dimensions related to social

interaction suggested: enabling social networking and providing data regarding personal experiences. Consequently, the researcher thinks that it is very significant that BSE apps include features regarding social interaction to assist behavior change and provide a positive experience.

5.3 Limitations of Research and Suggestions for Future Studies

A web-based questionnaire was published through several social media channels to reach potential candidates to participate in the fieldwork study. As a result, 116 women completed the questionnaire, and there were 68 women who were willing to participate in the following stage. The two inclusion criteria for the participants were having a smart mobile phone and an adequate level of English to be able to follow the instructions on the three selected apps. Selecting participants from women who actively use the BSE apps were not included as a criterion since the study investigated the initial impression and reactions of women regarding utilizing BSE app. Besides, of the women who completed the questionnaire, there were only two women used BSE apps before. Therefore, the participants were asked to download the given apps. An alternative way to select participants would be to try to reach women who are actively using BSE apps, this would allow to observe for longer term reflections in relation to what features of the apps make them to continue using. For the current research it was not possible to secure such profile of users, however this did not have a bearing on the research aims and outcomes.

Breast self-examination is an intimate and personal experience that depends on women's motivations. During the fieldwork, the participants were asked to use the given mobile BSE apps at least four times in a month. It was a challenging task to have all participants finish performing in a given timeframe. The researcher reminded participants performing BSE with utilizing BSE apps one or two times via WhatsApp.

The apps utilized in the fieldwork were used for a fixed period of time (4 weeks) and the participants' initial reactions and expectations from BSE apps were successfully collected. In order to observe the long-term effects of using mobile BSE apps on the BSE experience, and perhaps additional features that need to be integrated into the apps can be assessed in a research setting with an extended period.

The participants' native language was Turkish. Nevertheless, the number of mobile BSE apps available in Turkish was very limited in number. Therefore, the language of the selected mobile BSE apps for the fieldwork was English, thus the participants of the study had to be recruited from women who can comprehend English.

The fieldwork included two interview sessions (pre-usage and post-usage) with 24 participants, five of the participants were interviewed face-to-face. However, interviews with other participants had to be conducted via Skype and Zoom due to the COVID-19 pandemic restrictions. A few participants initially mentioned their concerns about discussing such a private issue on Skype or Zoom. However, after being reassured by the researcher and reminded of the ethical clearance that the information will not be shared with third parties, they shared their thoughts and emotions related to BSE and mobile BSE app experience.

During the running of the fieldwork study, the selected mobile BSE apps were updated several times. Although the Breast Check Now app was compatible with iOS and Android operating systems at the beginning of the study, it stopped functioning on the phones with iOS operating systems after the updates. The mobile BSE apps assignments to the participants were made considering this situation and guaranteed the balance in the number of participants for each of the three apps. Still, it is recommended to consider such unexpected situations in advance that may cause more critical changes in mobile apps, and make a backup plan. Luckily, this did not have a negative effect on the present study.

It was observed that there are different levels of knowledge and experience among the participants related to breast healthcare and BSE. It is possible to infer that these differences could influence their expectations and evaluation of mobile BSE apps.

Thus, in research settings where the researcher needs to obtain more specific results a more defined samples, such as women who perform BSE monthly, women who have/had (or somebody close by) breast cancer experience, etc. can be used.

The fieldwork was conducted with three selected mobile BSE apps. In order to assess a wider range of mobile BSE app features and their effects on the BSE experience, a number of mobile BSE apps utilized in research can be increased. For the present research, although the number of apps employed in the study was limited, the research aim is fulfilled and initial answers to research questions are answered. Consequently, there is a potential to integrate such apps in women's routines to support them and offer a better BSE experience, and design can play an important role in it.

Ultimately, a review of characteristics of BSE apps through Persuasive System Design (PSD) model was conducted to evaluate persuasiveness of the BSE apps utilized in the study. In addition, a number of design dimensions and recommendations were proposed as a result of the research. Further research can investigate the effects of mobile BSE apps where these features are implemented. Lastly, further research might explore behavior change in women for BSE with an app developed in line with the outcomes of this study although the aim of this study is not to determine whether there is a behavioral change in women.

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APPENDICES

A. POSITIVE AND NEGATIVE AFFECT SCALE(PANAS)

P:

Positive and Negative Affect Scale (Watson, Clark, and Tellegen, 1988).

This scale consists of a number of words that describe different feelings and emotions. Read each item and then list the number from the scale below next to each word. Indicate to what extent you feel this way right now, that is, at the present moment OR indicate the extent you have felt this way over the past week.

1	2	3	4	5
Very Slightly or Not at All	A little	Moderately	Quite a Bit	Extremely

1. Interested	_____	11. Irritable	_____
2. Distressed	_____	12. Alert	_____
3. Excited	_____	13. Ashamed	_____
4. Upset	_____	14. Inspired	_____
5. Strong	_____	15. Nervous	_____
6. Guilty	_____	16. Determined	_____
7. Scared	_____	17. Attentive	_____
8. Hostile	_____	18. Jittery	_____
9. Enthusiastic	_____	19. Active	_____
10. Proud	_____	20. Afraid	_____

K:

Positive and Negative Affect Scale Presented to the Participants

Bu ölçek farklı his ve duyguları içeren bir takım kelimeler içermektedir. Her maddeyi okuyun ve aşağıdaki ölçekteki numaraları her kelimenin yanına listeleyin. Şu anda ne kadar bu şekilde hissettiğinizi belirtin. / Geçtiğimiz hafta boyunca ne kadar bu şekilde hissettiğinizi belirtin.

1	2	3	4	5
Çok Az ya da Hiç	Az	Kısmen	Epeyce	Aşırı derecede

- | | | | |
|---------------------------|-------|------------------------------|-------|
| 1. İlgili (Interested) | _____ | 11. Sinir Bozucu (Irritable) | _____ |
| 2. Sıkıntılı (Distressed) | _____ | 12. Tetikte (Alert) | _____ |
| 3. Heyecanlı (Excited) | _____ | 13. Utanmış (Ashamed) | _____ |
| 4. Üzgün (Upset) | _____ | 14. Esinlenmiş (Inspired) | _____ |
| 5. Güçlü (Strong) | _____ | 15. Gergin (Nervous) | _____ |
| 6. Suçlu (Guilty) | _____ | 16. Kararlı (Determined) | _____ |
| 7. Korkmuş (Scared) | _____ | 17. İnce (Attentive) | _____ |
| 8. Düşmanca (Hostile) | _____ | 18. Tedirgin (Jittery) | _____ |
| 9. Hevesli (Enthusiastic) | _____ | 19. Aktif (Active) | _____ |
| 10. Gurur Duyan (Proud) | _____ | 20. Ürkümüş (Afraid) | _____ |

B. TECHNOLOGY READINESS INDEX (TRI)

P:

TECHNOLOGY READINESS INDEX (Abbreviated)

Please, check the statement reflecting your views for each of the items below.

- 5 = Strongly agree
- 4 = Agree
- 3 = Neither agree nor disagree
- 2 = Disagree
- 1 = Strongly disagree

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I find new technologies to be mentally stimulating.					
If I provide information to a machine or over the internet, I can never be sure it really gets to the right place.					
I like computer programs that allow me to tailor things to fit my own needs.					
I do not consider it safe to do any kind of financial business online.					
Other people come to me for advice on new technologies.					
I worry that information I send over the Internet will be seen by other people.					
I can usually figure out new hi-tech products and services without help from others.					
When I get technical support from a provider of a hightech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do.					
In general, I am among the first in my circle of friends to acquire new technology when it appears.					
It is embarrassing when I have trouble with a high-tech gadget while people are watching.					

K:

TEKNOLOJİYE OLAN YAKLAŞIM ÖLÇEĞİ (Kısaltılmış)

Lütfen, aşağıdaki maddelerin her biri için görüşlerinizi yansıtan ifadeyi işaretleyiniz.

- 5 = Kesinlikle katılıyorum
4 = Katılıyorum
3 = Ne katılıyorum ne katılmıyorum
2 = Katılmıyorum
1 = Kesinlikle katılmıyorum

	Kesinlikle katılmıyorum	Katılmıyorum	Ne katılıyorum ne katılmıyorum	Katılıyorum	Kesinlikle katılıyorum
Yeni teknolojileri fikren ilham verici olarak görüyorum.					
Bir makineye veya internete bilgi sağladığımda, doğru yere ulaştığımdan asla emin olamam.					
İşleri kendi ihtiyaçlarıma göre düzenlememe izin veren bilgisayar programlarını severim.					
Mali işleri çevrim içi olarak yapmayı güvenli bulmuyorum.					
İnsanlar yeni teknolojiler konusunda benden tavsiye almak ister.					
İnternet üzerinden gönderdiğim bilgilerin başkaları tarafından görüleceği endişesini taşıyorum.					
Yüksek teknoloji ürün ve hizmetleri genellikle kimseden yardım almadan çözebilirim.					
Yüksek teknoloji ürün veya hizmet sağlayıcısından teknik destek aldığımda, benden daha fazla bilen birinin benden faydalandığını düşünürüm.					
Genel olarak yeni teknolojiler çıktığında arkadaş çevremden önce ona sahip olurum.					
İnsanlar izlerken yüksek teknoloji ürünlerle sorun yaşamamı utanç verici buluyorum.					

C. ANALYSIS OF MOBILE BSE APPS

Breast Cancer Healthline

Health & Fitness

4.4

App

- Aims at people living with breast cancer
- Matches users with others based on treatment, stage of cancer, and personal interests
- Creates a community

Features

- Share experiences, bounce ideas off of each other, and express thoughts and feelings with someone who understands firsthand
- Browse member profiles and request to match instantly
- Send message to one another and share photo
- Feel encouraged to converse
- Get informed with reputable articles

Breast Cancer Staging TNM

Medical

5.0

App

- Focuses on healthcare professionals

Features

- Generate a patient's overall anatomic and prognostic stage simply and easily using the TNM 8 staging criteria.
- Perfect for physicians, surgeons, radiologists, physician assistants, nurses, medical students, trial managers, research, and any healthcare professional in the field of breast cancer.
- Send email the breast cancer stage to colleagues and patients
- Generate the overall prognostic stage using: HER2 status, ER status, PR status, and the OncotypeDx Recurrence Score

Breast Check Now

Health & Fitness

4.5

App

- Supported by Breast Cancer Now Foundation

Features

- Give full of helpful information about the signs and symptoms of breast cancer
- Perform BSE with TLC: Touch Look Check
- Set a reminder
- Create a personal breast self-exam plan
- Record breast self-exam checkings
- Simple to use
- Free

Breast Test

Health & Fitness

4.5

App

- Focuses on young women
- Sign-Up Button for Volunteer opportunities, special events, and newsletter

Features

- Learn how to perform a breast self-exam
- Set an automatic monthly reminder that's in sync with your monthly menstrual cycle

B4BC-Boarding for Breast Cancer

Lifestyle

5.0

App

- Focuses on young women
- Sign-Up Button for Volunteer opportunities, special events, and newsletter

Features

- Learn how to perform a breast self-exam
 - Set an automatic monthly reminder that's in sync with your monthly menstrual cycle
 - Access several health & wellness information tailored for the active girl on the go
 - Watch B4BC's award-winning documentary "Chasing Sunshine"
 - Community & Events Info
-

Brexa

Lifestyle

5.0

App

- Gives confidence about self-exams
 - Supported by Know Your Lemons Foundation
 - Focuses on the US mostly for some features like booking mammogram
 - Need to sign-up
-

Check Yourself!

Health & Fitness

4.5

App

- Supported by Keep a Breast Foundation

Features

- Learn how to perform BSE step by step
 - Give information about breasts
 - Guide to take action
 - Schedule reminder by choosing the date and time
 - Share with your social network
-

Know Your Lemons

Lifestyle

5.0

App

- Gives confidence about self-exams
- Supported by Know Your Lemons Foundation
- Focuses on the US mostly for some features like booking mammogram
- Need to sign-up

Features

- Book your mammogram with reminders based on your age and breast cancer risk
- Learn how to do a self-exam the right way with your virtual exam coach
- Learn steps to investigate with video
- Book a mammogram with an FDA-certified center in seconds
- Know what to expect for your mammogram, ultrasound, and more.
- Customize your own screening plan based on your personal risk
- Schedule your self-exams with the period tracker for best results
- Set a reminder monthly
- Learn the 12 symptoms of breast cancer and note any changes
- Learn the 9 risk factors
- Be guided step-by-step on how to investigate a symptom
- Share with your social network

D. DETAILS ABOUT PARTICIPANTS

	1	2	3	4	5	6	7	8	9	10	11	12
Age	25	26	27	25	45	36	42	38	24	32	28	33
Occupation	Business development specialist	Marketing specialist	Research assistant	UX Designer	Project Manager	Content Writer	Content Writer	Project Manager	Product Designer	Social Entrepreneur	Product Designer	Lawyer
Selected Application	Know Your Lemons	Know Your Lemons	Check Yourself!	Breast Check Now	Check Yourself!	Check Yourself!	Check Yourself!	Breast Check Now	Check Yourself!	Know Your Lemons	Know Your Lemons	Breast Check Now
	13	14	15	16	17	18	19	20	21	22	23	24
Age	27	32	26	53	37	55	49	22	24	48	45	31
Occupation	Research assistant	Housewife	UX Researcher	Retired Lecturer	Research assistant	Academician	Academician	Academician	Doctor	Product Designer	Sociologist	Product Designer
Selected Application	Know Your Lemons	Breast Check Now	Breast Check Now	Know Your Lemons	Breast Check Now	Check Yourself!	Check Yourself!	Know Your Lemons	Breast Check Now	Check Yourself!	Know Your Lemons	Breast Check Now

E. THE STUDY PROCEDURE (TURKISH VERSION)

Araştırmaya Gönüllü Katılım Formu

Bu araştırma, Orta Doğu Teknik Üniversitesi Endüstriyel Tasarım Bölümü öğretim üyesi Prof. Dr. Bahar Şener-Pedgley danışmanlığında yürütülmekte olan Aylin Karadeniz'in yüksek lisans tezi kapsamında yapılmaktadır. Bu form sizi araştırma koşulları hakkında bilgilendirmek için hazırlanmıştır.

Çalışmanın Amacı Nedir?

Araştırmanın amacı, mobil teknolojilerin kullanımıyla kadınların kendi kendine meme muayenesi süreçlerini nasıl pozitif bir deneyimle geçirebileceğinin kavranması ve kadınların ihtiyaçları dikkate alarak tasarım tanımlarını yapmaktır.

Bize Nasıl Yardımcı Olmanızı İsteyeceğiz?

Araştırma süreci üç ana aşamadan oluşmaktadır. İlk aşamada yüz yüze yapılacak yaklaşık yarım saatlik görüşmede size sorulacak sorulara cevap vermeniz beklenmektedir. İkinci aşamada ise kendi kendine meme muayenesi yapabileceğiniz bir mobil uygulamayı dört hafta boyunca kullanmanız ve bu dört hafta boyunca bir defa yapılacak olan yaklaşık on beş dakikalık telefon görüşmesinde sorulacak sorulara cevap vermeniz istenecektir. Çalışmanın son aşamasında ise yine yüz yüze yapılacak yaklaşık yarım saatlik görüşmede çalışma sürecinde uygulama kullanımı ile yaşadığınız deneyim hakkında sorulacak sorulara cevap vermeniz beklenmektedir.

Sizden Topladığımız Bilgileri Nasıl Kullanacağız?

Araştırmaya katılımınız tamamen gönüllülük temelinde olmalıdır. Çalışmada sizden kimlik veya çalıştığınız kurum/bölüm/birim belirleyici hiçbir bilgi istenmemektedir. Cevaplarınız tamamıyla gizli tutulacak, sadece araştırmacılar tarafından değerlendirilecektir. Katılımcılardan elde edilecek bilgiler toplu halde değerlendirilecek ve bilimsel yayımlarda kullanılacaktır. Sağladığınız veriler gönüllü katılım formlarında toplanan kimlik bilgileri ile eşleştirilmeyecektir.

Katılımla ilgili bilmeniz gerekenler:

Çalışma, genel olarak kişisel rahatsızlık verecek sorular içermemektedir. Ancak, süreç boyunca sorulardan ya da herhangi başka bir nedenden ötürü kendinizi rahatsız hissederseniz araştırmadan çıkmakta serbestsiniz. Böyle bir durumda çalışmayı uygulayan kişiye, çalışmadan çıkmak istediğinizi söylemek yeterli olacaktır.

Araştırmayla ilgili daha fazla bilgi almak isterseniz:

Bu çalışmaya katıldığınız için şimdiden teşekkür ederiz. Çalışma hakkında daha fazla bilgi almak için Aylin Karadeniz (E-posta: aylinkaradeniz7@gmail.com). Bu çalışmaya katılımınız için şimdiden teşekkür ederiz.

Yukarıdaki bilgileri okudum ve bu çalışmaya tamamen gönüllü olarak katılıyorum.

(Formu doldurup imzaladıktan sonra uygulayıcıya geri veriniz).

Katılımcının Adı Soyadı

Tarih

İmza

---/---/---

Araştırmacının Adı Soyadı

Tarih

İmza

---/---/---

Yarı Yapılandırılmış Görüşme Soruları

İlk Görüşme

1. Katılımcıyı Tanı

1.1. Ad Soyad:

1.2. Meme Sağlığı:

1.3. Kendi Kendine Meme Muayenesi:

1.3.1. Duydunuz mu?

1.3.2. Nasıl yapıldığını biliyor musunuz?

1.3.3. Daha önce hiç yaptınız mı?

1.3.4. Yaptıysanız nedenleri:

1.3.5. Yaptıysanız ne sıklıkla yapıyorsunuz:

1.3.6. Yapmadıysanız nedenleri:

1.4. Mobil uygulamalar:

1.4.1. Sağlıkla ilgili mobil uygulamalar:

1.4.2. Kendi kendine meme muayenesi ile ilgili uygulamalar:

2. Kendi Kendine Meme Muayenesi

2.1. Meme sağlığı

2.1.1. Kendi kendine meme muayenesi yapan katılımcılar:

2.1.1.1. Daha önce meme muayenesi için neler yaptın? Örneğin Klinik meme muayenesi, mamografi, ultrason

2.1.1.2. En son kendi kendine meme muayenesini ne zaman yaptın? Neden? Nasıl?

2.1.1.3. En son kendi kendine meme muayenesi yaptığında yaşadığın deneyimler nelerdi? Hislerini 3 kelime ile ifade edebilir misin? Nelerden faydalandın? Not aldın mı? Yapmadan önce araştırma yaptın mı? Birileriyle muayene hakkında konuştun mu?

2.1.1.4. Kendi kendine meme muayenesi hakkında arkadaşların, ailen vb. kişilerle konuşuyor musun?

2.1.2. Kendi kendine meme muayenesi yapmayan katılımcılar

- 2.1.2.1. Daha önce meme muayenesi için neler yaptın? Örneğin Klinik meme muayenesi, mamografi, ultrason
- 2.1.2.2. Daha önce muayeneyi yapmama nedenlerini detaylı açıklar mısın? Yapmamak ile ilgili hislerini 3 kelime ile ifade edebilir misin? Kendi kendine meme muayenesi hakkında araştırma yaptın mı? Birileriyle muayene hakkında konuştun mu?
- 2.1.2.3. Kendi kendine meme muayenesi yapacak olsaydın nelerden faydalanırsın? Ör: internet, video, dergi, doktor, hastane
- 2.1.2.4. Kendi kendine meme muayenesi hakkında arkadaşların, ailen vb. kişilerle konuşuyor musun?

2.2. Mobil Uygulamalar

- 2.2.1. (Sağlıkla ilgili mobil uygulamalar) Gereksiniminizi biraz anlatır mısınız? Neden? Hangi özellikler?
- 2.2.2. (Kendi kendine meme muayenesi ile ilgili uygulamalar) Gereksiniminizi biraz anlatır mısınız? Neden? Hangi özellikler?

2.3. Mobil Uygulama Seçimi

Üç uygulamanın temel özelliklerini gösteren kartlar katılımcıya tanıtılacak.

- 2.3.1. Bu uygulamadan ne gibi özellikler beklersiniz?

Lütfen, uygulamayı yükleyin ve hızlıca inceleyin, Bundan sonraki aşamada, dört hafta boyunca uygulamayı kullanmanızı rica ediyorum, her hafta 1 kere olmak üzere en az dört defa kullanmanızı isteyeceğim. Süreçte istediğiniz zaman benimle iletişime geçebilirsiniz. Dört defa kullandıktan sonra tekrar yüz yüze görüşeceğiz.

Ayrıca, uygulamayı kullanırken hangi özellikleri kullandığınızı not almanızı istiyorum, özellik listesinin yazılı çıktısından 10 tane veriyorum. Aynı zamanda kağıdın arkasına o anki duygu ve düşüncelerinizi not edebilirsiniz, böylece son

görüşmemizde soruların üstünden geçerken bu notlardan faydalanabiliriz. Yorum ya da sorularınız var mı? Tekrar katılımınız için teşekkür ederim.

İkinci Görüşme

1. Meme Sağlığı

- 1.1. Kendi kendine meme muayenesi ile ilgili duygularınız genel olarak nasıl?
- 1.2. Sizce nasıl bir deneyimdi? Yeni bilgiler öğrendiniz mi?
- 1.3. Kendi kendine meme muayenesi ilgili beklentileriniz nelerdi?
- 1.4. Kendi kendine meme muayenesi yapmaya devam eder misiniz?

2. Mobil Uygulama

- 2.1. Uygulama kullanımını genel olarak nasıl gitti? Hangi sıklıkla? Ne zaman? Neden? Kaç kere?
- 2.2. Hangi özellikleri kullandınız? Neden?
- 2.3. Genel duygularınızın yanısıra, kendi kendine meme muayenesi için bu uygulamayı kullanmak neler hissettirdi? Neden?
- 2.4. Uygulamada en çok beğendiğiniz özellik/özellikler ne oldu? Neden?
- 2.5. Sorun yaşadığınız anlar/beğenmediğiniz özellikler var mı? Varsa nelerde sorun yaşadınız/ neleri beğenmediniz? Neden?
- 2.6. Sizce uygulama kullanımının muayene deneyimi üzerinde nasıl bir etkisi oldu?
- 2.7. Bundan sonra bu uygulamayı kullanmaya devam etmeyi düşünür müsünüz? Neden? Neden değil?
- 2.8. Uygulamada eksik gördüğünüz ve olsa beni daha mutlu ederdi/daha rahat bir kullanım sağlardı dediğiniz özellikler var mı?

F. APPROVAL ETHIC

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
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20 Şubat 2020

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Bahar ŞENER PEGDLEY

Danışmanlığını yaptığınız Aylin KARADENİZ'in "Design Research For Positive Experience in Healthcare: A Study on Breast Wellbeing Practices in Order to Improve Self-Management Healthcare of Women" başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve 045-ODTU-2020 protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.


Prof. Dr. Mine MISIRLISOY
Başkan


Prof. Dr. Tolga CAN
Üye

Doç. Dr. Pınar KAYGAN
Üye


Dr. Öğr. Üyesi Ali Emre TURGUT
Üye

Dr. Öğr. Üyesi Şerife SEVİNÇ
Üye


Dr. Öğr. Üyesi Müge GÜNDÜZ
Üye


Dr. Öğr. Üyesi Süreyya Özcan KABASAKAL
Üye

G. RESULTS OF PANAS

		The Participants' Answers to Pre-PANAS																		
		POSITIVE AFFECT						NEGATIVE AFFECT												
		Interested	Excited	Strong	Enthusiastic/Proud	Alert	Inspired	Determined	Attentive	Active	Distressed	Upset	Gulity	Scared	Hostile	Irritable	Ashamed	Nervous	Jittery	Afraid
P01	5	4	3	4	4	4	5	1	5	2	4	1	3	3	1	1	3	3	2	2
P02	1	2	1	1	1	2	2	1	4	2	1	3	1	2	1	1	1	1	4	4
P03	2	2	2	1	1	4	1	3	4	4	3	1	1	3	1	1	1	4	4	4
P04	3	1	1	2	1	2	1	1	2	2	1	3	3	3	2	2	2	2	1	2
P05	4	1	4	2	2	3	3	2	1	1	2	3	3	2	2	2	2	3	3	2
P06	2	2	1	2	1	1	1	1	1	1	1	3	4	1	4	2	4	3	3	3
P07	4	2	3	3	4	3	1	3	1	3	1	2	1	3	2	2	2	3	3	5
P08	1	1	1	1	4	1	1	1	1	1	3	3	4	1	3	3	1	3	3	3
P09	2	1	3	1	1	1	1	1	1	1	1	2	3	2	1	1	1	2	2	4
P10	4	1	1	4	1	4	1	1	1	1	4	3	3	1	3	2	4	1	4	4
P11	3	1	1	1	1	1	1	1	1	1	1	1	3	2	2	4	4	2	2	2
P12	2	1	2	1	1	2	1	2	1	1	1	1	1	2	1	2	3	3	1	3
P13	4	1	3	1	2	5	2	5	2	1	3	1	3	1	4	3	1	2	2	1
P14	3	4	2	2	2	3	5	2	3	1	4	4	1	1	3	2	2	2	4	3
P15	1	3	2	2	3	1	1	1	1	1	4	1	1	1	2	3	3	3	2	1
P16	5	3	4	1	1	5	1	2	2	4	4	2	2	3	1	4	2	3	3	4
P17	3	1	4	1	1	1	1	2	4	2	3	1	1	3	2	1	3	1	1	4
P18	4	2	3	2	1	3	1	2	1	1	2	4	1	3	3	2	1	3	1	2
P19	2	1	1	3	1	2	2	3	1	1	2	1	3	1	1	3	3	1	1	3
P20	3	2	3	1	1	4	1	3	1	3	2	1	1	2	1	2	2	2	2	3
P21	2	3	4	4	1	3	2	4	2	3	1	1	3	2	3	3	4	2	2	1
P22	2	5	5	2	1	5	2	5	1	5	4	2	1	3	3	2	5	2	3	5
P23	4	5	1	2	2	1	1	1	1	2	5	1	5	5	5	4	5	5	4	5
P24	2	1	1	2	1	2	1	2	1	2	2	1	1	1	4	2	3	4	2	1
Total	68	50	56	49	40	67	33	57	36	57	52	43	55	53	52	58	60	61	65	66
Mean	2.83	2.083	2.333	2.041	1.666	2.791	1.375	2.375	1.5	2.375	2.1666666	1.7916666	2.2916666	2.2083333	2.1666666	2.4166666	2.5	2.5416666	2.5833333	2.75

The Participants' Answers to Post-PANAS

	POSITIVE AFFECT										NEGATIVE AFFECT									
	Interested	Excited	Strong	Enthusias	Proud	Alert	Inspired	Determine	Attentive	Active	Distressed	Upset	GUILTY	Scared	Hostile	Irritable	Ashamed	Nervous	Jittery	Afraid
P01	5	3	4	3	4	2	3	4	1	4	4	3	2	2	1	1	1	2	3	2
P02	4	2	4	3	5	4	4	4	1	3	2	1	3	2	1	2	1	1	2	3
P03	4	3	4	3	5	2	3	3	2	3	3	2	2	2	1	2	1	3	2	3
P04	4	3	5	4	5	3	3	3	1	4	1	1	1	1	1	1	1	1	1	1
P05	3	4	3	5	5	4	4	3	2	3	3	2	1	3	1	1	1	1	1	3
P06	3	3	4	3	3	3	5	3	2	3	1	1	2	3	1	1	1	2	3	2
P07	5	4	4	5	5	4	4	3	3	4	1	1	2	1	1	1	1	1	2	1
P08	3	4	3	4	2	2	3	3	2	4	1	1	1	1	1	1	1	1	1	2
P09	3	4	5	5	4	2	3	4	2	3	2	1	4	1	2	2	3	2	3	3
P10	5	1	4	2	5	5	4	3	1	3	5	2	3	5	2	2	1	4	4	5
P11	4	3	5	3	5	4	4	3	1	4	4	1	1	5	3	3	2	4	4	4
P12	4	2	5	3	5	3	5	3	1	3	1	1	1	1	1	1	2	4	4	4
P13	5	2	4	4	4	4	4	5	4	2	4	1	1	2	2	3	1	1	1	1
P14	4	5	3	4	5	3	3	3	1	4	2	1	2	2	3	2	1	2	2	2
P15	3	2	2	3	3	3	2	4	1	3	3	1	1	2	2	1	3	2	2	2
P16	3	2	4	3	3	4	3	3	2	5	2	1	4	1	1	3	2	3	3	4
P17	4	1	5	3	4	1	3	5	1	5	1	1	2	1	2	1	1	1	1	5
P18	1	3	4	5	3	2	4	4	1	2	3	2	3	1	3	3	3	3	2	3
P19	3	4	5	4	5	1	3	5	1	3	3	2	1	4	1	2	1	4	3	2
P20	4	2	4	2	4	3	5	2	1	3	2	1	1	2	1	1	1	2	2	1
P21	4	2	4	5	3	2	3	5	3	3	3	1	2	1	2	2	2	2	2	2
P22	3	3	3	4	5	3	3	5	3	5	4	2	3	3	3	2	2	3	2	2
P23	5	3	4	3	4	2	4	3	1	4	4	2	1	3	1	1	2	4	3	1
P24	5	4	5	3	5	1	3	3	2	5	3	1	1	2	3	3	1	3	2	3
Total	91	69	97	85	101	67	86	85	38	87	60	33	41	55	39	42	35	56	54	57
Mean	3.7916666	2.875	4.0416666	3.5416666	4.2083333	2.7916666	3.5833333	3.5416666	1.5933333	3.625	2.5	1.375	1.7083333	2.2916666	1.625	1.75	1.4583333	2.3333333	2.25	2.375