Radboud Universiteit

The experience of m-Health Apps for habitual change

From a user's perspective

Master Thesis Business Administration Radboud University
Specialisation: Innovation & Entrepreneurship
Student Name: Teun Ranx van Kesteren
Student Number: s1065922

Date: August 25th 2022
Supervisor: Olga Tsoumani
Second Examiner: Ruud Wetzels

Acknowledgements

I want to address my gratitude to my supervisor O. Tsoumani for coaching me while writing this thesis and for the expertise and advice given during meetings. I would also like to thank R. Wetzels, who provided knowledge for the thesis proposal.

I am very grateful for my participants for their openness during the interviews and providing me with interesting insights.

I would also like to acknowledge my thesis circle and my classmates, especially R. Breebaart and S. Kuijsten for their moral support during the year.

Lastly, I would like to mention my family and friends for their support and their belief during the process of the master thesis.

Teun van Kesteren

Nijmegen, August 25th, 2022

Table of Content

Chapter 1 Introduction

1.1 Problem description

Research has identified a growing concern about lifestyle-related diseases among young consumers about the rise of lifestyle-related diseases (e.g. obesity) due to insufficient physical activity (Peterson et al., 2018; Lascar et al., 2018). *Lifestyle* is defined in the dictionary as "the habits, attitudes, tastes, moral standards, economic level, etc., that constitute the mode of living of an individual or group." This showcases that habitual change is needed to tackle lifestyle-related diseases because the lifestyle is largely defined by an individual's habitual behaviour and attitude. However, a long time is required to disrupt and change habits (Neal & Wood & Quinn, 2006). To overcome the problem of insufficient physical activity, changes in (habitual) behaviour are needed, in which mHealth apps can provide a possible solution.

The fast-paced innovation of mobile-based services is making several organisations (e.g. Under Armour) move toward offering a bouquet of services through mobile applications that intend to help users stay healthy and fit in their everyday life (Payne et al., 2015; Edwards et al., 2017; Maher et al., 2016). Molina and Myrick (2020) state that mHealth technologies are one of many initiatives attempting to discourage sedentary lifestyles. mHealth applications are mobile applications that provide services to help users stay healthy and fit. Some of the ways in which mHealth applications help users stay healthy and fit include tracking their physical activities, sharing their physical activities and constantly being notifying of one's own performance (Korinek et al., 2018; Walsh et al., 2016).By presenting to users information about their habitual behaviour, which is largely unknown to the user, mHealth applications help users become aware of their unhealthy, habitual behaviours. However, increasing awareness through tracking habitual behaviour is not sufficient for discontinuing unhealthy behaviours and adopting healthier ones. As dual-process theories of motivation suggest, human behaviour is controlled by both automatic and controlled processes (Maher & Conroy, 2016). Habitual behaviours are largely controlled by automatic processes, which are difficult to control. For that reason, mHealth applications also include a number of other behaviour change techniques, such as goal-setting, action-planning, and coping-planning (e.g. Compernolle et al., 2016).

As mentioned earlier, the successful change of habitual behaviour is a time-consuming process. Although the potential of mHealth for changing habitual behaviour is substantial, it is often not realized as mHealth applications fail to engage users in the long-run. Even though the number of mHealth apps is increasing, most downloaders only access these apps sporadically (Soni et al., 2021). After the initial adoption, users' usage of health-related apps often lasts only for a short time. According to Burns (2020), only 2% of the app users uses the app in the long run. Low user engagement results in limited exposure to the intervention. This limitation leads to small or no intervention impact (Kelders et al., 2012). This lack of impact raises questions about consumers'

experience with mHealth applications in the post-adoption phase and how their experiences could affect habitual behaviour change. Existing research in the consequences of mHealth usage suggest that the behaviour change techniques integrated in mHealth applications offer a number of benefits to their users. For instance, Compernolle et al. (2020) state that through monitoring and reporting activities physical activity is stimulated. This increase discourages health-related problems resulting from sedentary behaviour or lack of physical activities. Moreover, BMI (Body Mass Index) & weight can be decreased with the active engagement of an mHealth app (Dounavi & Tsoumani, 2019). Another positive consequence of the use of mHealth technologies are the mental consequences of physical activity. When physical activity is implemented regularly, the symptoms of stress, anxiety and depression can be reduced, leading to improved psychological well-being (Paluska & Schwenk, 2000). Next to their physical and mental health benefits, mHealth technologies offer additional psychological benefits. For example, self-reporting is said to offer a sense of reflection on results. This reflection generates autonomous and responsible behaviour regarding their health through the understanding of the self-reported data in the context in which the mHealth technology is used. In other words, understanding the quality of these quantities users are able to better understand there being. Boam & Webb (2014) names this a shift from the 'quantified self' towards a 'qualified self'.

However, a number of negative consequences of mHealth usage have also been reported. For example, whereas the use of mHealth applications may increase self-reflection, it may also lead to incomplete self-knowledge (Sharon, 2017). Furthermore, users may also experience a higher sense of external control by the app when receiving push notifications (Bidargaddi et al., 2018) – an experience that may result to the decision to stop using the application. Such negative consequences are not necessarily experienced independently from positive ones. As shown by a recent study in consumers' experience with mHealth applications, their usage can cause positive and negative consequences to occur simultaneously (Klintwort 2018; Mick & Fournier, 1998). For instance, while push notifications may cause users to feel externally controlled, the same notifications may also enhance their feeling of self-control over their behaviour (Klintwort 2018). This contradiction is known as 'paradox' (Mick & Fournier, 1998). The experience of such paradoxes might lead to paradoxical tensions for users, thereby impacting the user's mHealth app experience and eventually their engagement with the mHealth application.

The knowledge gap entails two arguments. First, there is a knowledge gap regarding the experience of using a mHealth application. Current literature on the post-adoption phase connected to mHealth application does not entail the psychological experience. The current studies on the post-adoption phase concentrate on the effectiveness of using the mHealth application. For example, Liew et al. (2019) studied the usability of the mHealth application. Next to the effectiveness, there have been studies on the engagement with mHealth applications (Burns et al., 2020). The research of Burns et al. (2020) concludes that only 2% of the app users use the app in the long run. This raises the question about the psychological experience of using mHealth applications. This question makes more

research on the psychological experience in the post-adoption stage needed.

Secondly, there is a gap in the current literature on whether the psychological experience of using the mHealth application impact habitual change. There have been studies on whether using applications leads to forming a habit. Only these studies do not entail how the psychological experience with using the application affects the habits. With this angle, the research can uniquely contribute to the existing knowledge.

1.2 Objective of the thesis

This research aims to explore user experiences with mHealth applications. The user experience is explored from the perspective of conflicting positive and negative consequences (paradoxical tensions). Preliminary research on mHealth applications and anecdotal evidence from users state the user does experience not only positive consequences yet also unanticipated negative consequences. The consequences might create a conflict. Research on technologies concludes that using technology can cause a paradoxical tension (Mick & Fournier, 1998). In the case of this research, the paradoxical tensions are explored with respect to the use of mHealth for habitual behaviour change. The experience of mHealth applications is explored in three steps to address the knowledge gap. At first, the paradoxical tensions are identified. The next step is determining how the user copes with these paradoxical tensions. At last, the effects of the paradoxical tensions on habitual behaviour are explored. Therefore, the objective of the thesis is to answer the following questions:

> ➢ *How does the user experience of mHealth applications affect habitual change?*
>> o *What paradoxical tensions do the users of mHealth application experience?*
>> o *How do the users of mHealth application cope with paradoxical tensions?*
>> o *How do the paradoxical tensions impact habitual change?*

The research takes on a qualitative approach to explore the user experiences in-depth. The thesis explores how people experience mHealth applications to change their habits. This research concentrates on users with the motivation to change their habits. The research focuses on healthy living apps designed to track health metrics such as diet, exercise, heart rate, and sleep. With a particular focus on consumer's lifestyle application. For example, popular mHealth apps like MyFitnessPal, Fitbit, Headspace, Pillow, Strava or Streaks.

1.3 Relevance to the topic

1.3.1 Academic relevance

With the importance of technology in our lives increasing (Kemp, 2022), research within the field of digital technology use has been called upon. The domain of mHealth interventions is relatively new and would benefit from new insights. Research on the post-adoption phase of mHealth applications has already been done. These studies have been on the effectiveness of mHealth applications. However, the research on the experience of mHealth applications is relatively scarce. By addressing the knowledge gap, the research provides new insights into the experience of mHealth

applications in the post-adoption phase. In general, it will also extend to using technological interventions in the post-adoption phase.

Earlier studies primarily focus on the outcome of the use of mHealth applications. This focus is also present in studies the habitual changes made by users. The effects of the experience of using the application on habitual change. Therefore, by addressing the knowledge gap, the research also provides fresh insights into how the experience might affect the use of mHealth applications for habitual changes. Within the field of habitual health research, there has been a call for new research on the impact of disrupting health-related habitual behaviours (Gardner et al., 2021). This research will add to this call by exploring the effect of the experience of mHealth applications on habitual behaviour.

In their study, Mick and Fournier (1998) suggested that further research could explore the paradoxes in different domains. By conducting the research on the experience through a paradoxical lens. The research will also extend on the concept of paradoxical experiences of technologies in the domain of mHealth applications. With a particular focus on the user experience of mHealth applications when aiming to change habits.

1.3.2 Practical relevance

The research entails the experience of mHealth applications through a paradoxical lens. The research will identify positive negatives and tensions and how participants cope with them. By requiring these insights, the research could provide practitioners with the awareness of the tensions and improvements to tackle these tensions. For instance, the application designer could alter the interface of the application in a way that will reduce the negative experience of the application. It would also provide insights that when the user starts ignoring the application, the app developers could realise that the user experiences tension. Therefore they could communicate to the user whether they still want to reach their goals or wants to adjust their goals. The interaction between the application and the user could be improved by making adjustments to the user's experience.

Insights in this research could also benefit policymakers that want to promote mHealth applications for institutions like hospitals. This research also explores the negative sides of mHealth applications and the potential coping strategies of users. By being aware of the potential negative consequences of using mHealth applications. Policymakers can design the often costly promotional programmes of mHealth applications in a more informed manner.

The healthcare practitioners who work with a mHealth application will be better informed on the experience of their clients/patients. Therefore they could provide a more personal accompaniment in the application. For instance, dietitians who work with mHealth applications to monitor their food intake are informed about what their patients/clients experience and how it could affect their habitual patterns.

At last, the (potential) users will be better informed on what using a mHealth application entails. For instance, users who expect the use of a mHealth application to be a joy every day could be

more informed on which tensions may lie in using a mHealth application. The research also allows the user to better prepare themselves for using the application by having knowledge of the tensions. Participants could also have better insight in how to deal with these paradoxical tensions to build habits.

1.4 Outline of the thesis

In the following chapter, the theoretical background will be discussed. The theoretical background elaborates the key concepts and underlying theories in this thesis. The third chapter discusses the methodology. The research is done qualitatively. Chapter 4 presents the research results. The research results are discussed and concluded on in the final chapter.

Chapter 2 Theoretical framework

The theoretical background in this thesis consists of an introductory part about Habitual change focusing on the connection with mHealth. After that, the notion of paradox is discussed, which is specified to technological paradoxes from the framework of Mick and Fournier (1998). The coping strategies are discussed following the technological paradoxes are also the coping strategies discussed that relate to the technological paradoxes.

2.1 Habitual change

This paragraph explores habitual change. A habit is defined as "action triggered by impulses that are automatically activated upon exposure to cues, due to learned cue-action associations" (Gardner et al., 2021). To thoroughly gain insight into the concept of habitual change with mHealth the following topics are elaborated upon: the creation of (health) habits, the disruption of (health) habits and the relationship between mHealth and habit disruption.

2.1.1 Habit creation

Habits are formed by encoding context-response patterns in their procedural memory (Orbell & Verplanken, 2010). Habitual behaviour originates from performed actions; the habit is slowly able through repetition to respond to triggers directly by the perception of cues in the performance context. Therefore, the performance of a habit involves giving behavioural control to the cues that were related to action (Orbell & Verplanken, 2010). For example, a person's decision to order 'junk food' on a Friday night might be guided by an active goal state (e.g. too tired to cook). However, over time the goal becomes less necessary as ordering 'junk food' is repeated and becomes integrated with the act of it being Friday night so that it can be triggered by the cue alone. So it is Friday night which automatically means that the person in question is ordering junk food.

2.1.2 Habit disruption

Habit disruption has a multifaceted nature, covering four discrete ways of preventing habitual action (Gardner et al., 2020a). These for ways are: habit inhibition, habit discontinuation, habit degradation, habit substitution.

All four discrete ways do not need to take place to change a habit. One is enough to make a change in your habitual behaviour. To create healthy habits the abandonment of an unhealthy habit and the development of healthy habits are both focus points of the research. This is because the users to create a healthy lifestyle through the use of a mHealth application by replacing unhealthy habits with healthier habits. 'Habit inhibition' refers to self-convincing not to act on an activated impulse. For example, thinking 'do not do it!' on encountering cues to habitual snacking (Quinn et al., 2010). 'Habit discontinuation' refers to avoiding habitual cues. The discontinuation can be on purpose, for example, avoiding stress to stop snacking, or it could be naturally, e.g. loss of employment resulting in the removal of cues to desk-based snacking (Verplanken et al., 2018). 'Habit degradation' refers to

purposefully or naturally decomposing cue–response associations, and 'habit substitution' refers to replacing an unwanted response with a cue (e.g. unhealthy snacking) wanted alternative response (e.g. eating fruit). Looking at the four ways of disrupting habitual behaviour(Gardner et al., 2020b). Gardner et al. (2021) conclude that inhibition and discontinuation block interaction with impulses but do not address the cues that generate impulses. Inhibition and discontinuation target habitual behaviour instead of habit.

2.1.3 Habit disruption in mHealth applications

The four ways of habit disruption are incorporated into the design of mHealth applications. All four ways are related to the design at some level.

'Habit inhibition' is incorporated in the design of mHealth application through the stimulants of conscious awareness (Boam & Webb, 2014). For example, Compernolle et al. (2020) found that users are less aware of their sedentary behaviour than their physical activity. By making users aware of their habits, the user is better informed about their habitual behaviour. Therefore, the user can build stronger arguments against acting on an impulse. This would make the user more capable of convincing themselves not to act on an impulse. A long time is required to disrupt and change habits (Neal & Wood & Quinn, 2006). The long time required makes users of a mHealth application need triggers to keep interrupting their unwanted habits. This interruption is to prevent a relapse in old habitual behaviour (Wood & Neal, 2016). Therefore, notifications in the applications can trigger the user to inhibit the response on an impulse by reminding them of their goals(Korinek et al., 2018; Walsh et al., 2016). Furthermore, by monitoring and reporting their activities, the application's design stimulates the continuity of the wanted response (Compernolle et al., 2020; Korinek et al., 2018; Walsh et al., 2016).

'Habit discontinuation' is incorporated in the design of the mHealth application at the level of purposeful discontinuation. By making the user aware of their current health situation, for example, their heart rate (Boam & Webb, 2014). The application, therefore, similarly stimulates habit discontinuation as habit inhibition. The user can build better arguments against acting triggers for unwanted habitual behaviour by being more aware of habits. Therefore, the user could decide to avoid associations with triggers for unwanted habitual behaviour. This could lead to the decision to avoid associations.

In the case of 'habit degradation', the mHealth application semi-incorporates degradation in the design. Only the decision to purposefully decompose a habit can be empowered by an insight gained in the mHealth application. The impact on habit degradation by mHealth applications is negligible since the degradation is a natural process that only can be stimulated by the application to a limited extent.

'Habit substitution' is the most relevant way to disrupt a habit through mHealth applications. The mHealth application offers users a support system to potentially change their habitual behaviour.

The unwanted response is shown in the mHealth application, and a wanted response can be formulated through the information presented in the mHealth application. For the formulation of wanted responses, additional behaviour change techniques (e.g., goal setting) can be used (Compernolle et al., 2020). The mHealth application also offers to personalise the plan to the user's goals and fitness status (Free et al., 2013). Therefore the application wants to provide the user with a sustainable plan to change their habits. Furthermore, the application provides feedback on the user's current performance (Free et al., 2013; Korinek et al., 2018; Walsh et al., 2016). This is to showcase how they could improve to achieve better fitness results. This helps the user to constantly improve their wanted response to build the best possible health habits.

2.2 Technological paradoxes

Experience with the use of technology can cause positive and negative consequences to occur simultaneously. This contradiction is known as a 'paradox'. Paradoxes are "conditions that can simultaneously exist, or at least can be potentiated, in the same thing" (Mick & Fournier, 1998 p. 124) The research of Mick & Fournier (1998) was one of the first conducted about paradoxes in technology, specifically household technology. In this a framework of paradoxes and coping strategies are provides which are still used for further studies about technology. The framework consists of eight paradoxes. In table 1, the eight paradoxes are named and explained.

Control/Chaos	Technology can facilitate regulation or order, and technology can lead to upheaval or disorder
Freedom/Enslavement	Technology can facilitate independence or fewer restrictions, and technology can lead to dependence or more restrictions
New/Obsolete	New technologies provide the user with the most recently developed benefits of scientific knowledge, and new technologies are already or soon to be outmoded as they reach the marketplace
Competence/Incompetence	Technology can facilitate feelings of intelligence or efficacy, and technology can lead to feelings of ignorance or ineptitude
Efficiency/Inefficiency	Technology can facilitate less effort or time spent in certain activities, and technology can lead to more effort or time in certain activities
Fulfils/Creates needs	Technology can facilitate the fulfillment of needs or desires, and technology can lead to the development or awareness of needs or desires previously unrealized
Assimilation/Isolation	Technology can facilitate human togetherness, and technology can lead to human separation

Engaging/Disengaging	Technology can facilitate involvement, flow, or activity, and technology can lead to disconnection, disruption, or passivity

Table 1 Technological paradoxes (Mick & Fournier, 1998)

The eight paradoxes have later been studied for mobile technologies. In this research the paradoxes have been defined for mobile technologies (Chae et al., 2010). This study added two extra paradoxes: private/public and planning/improvisation. Their research concluded that these two paradoxes were not significant. The negative relationships could imply that users consider the paradoxes beneficial instead of conflictual. The mobile technology's capability to improvise may help users do their work efficiently (Chae et al., 2010). The versions of the paradoxes defined by will be taken into account heavily since it already structured towards mobile technology. Mobile technology is closer to mHealth because it shares the same platform/device.

The paradoxical tensions have been studied for mHealth applications. In this research the paradoxes have been defined for mHealth applications (Klintwort, 2018). The research has identified five paradoxes that were most prominent among the users of mHealth applications: integration/ disintegration, self-control/ external control, confirmation/ disconfirmation, individual/ community, and motivating/ demotivating (Klintwort, 2018). The paradox integration/ disintegration concerns how easily the mHealth app is adopted (Mick & Fournier, 1998; Klintwort, 2018). The paradox self-control/ external control is about the extent to which the application controls a user's lifestyle. The paradox of confirmation/ disconfirmation entails the balance in which the mHealth app provides information that matches pre-existing thoughts or suspicions. The paradox of individual/ community is about sharing achievements through the mHealth app with a community (e.g. family). This could lead to positive and negative feelings. The positive feeling entails compliments received from the community (Klintwort, 2018). The negative feeling could be developed through rivalry within the community (Mick & Fournier, 1998; Jarvenpaa & Lang, 2005). The paradox motivating/ demotivating concerns how a mHealth app helps the motivation to remain a user of the mHealth application (Klintwort, 2018). The study of Klintwort (2018) found several paradoxes that fit the domain. This research aims to use these paradoxes to analyse the user experience of mHealth applications further.

2.3 Coping strategies

The research relies on the paradoxes of technology and the thereby belonging coping strategies proposed by Mick & Fournier (1998). In particular, the research builds upon earlier research about goals concerning the user's app engagement. Chae et al. (2010) use the knowledge/paradoxes formulated in the article of Mick & Fournier (1998) and focus on the elaboration of the mobile technology paradoxes to develop coping strategies. Coping strategies could be either avoidant or confrontative (Mick & Fournier, 1998). Avoidance minimises the usage of technology, which includes ignoring the information on the product's usefulness, refusing to own the item and delaying the purchase. A confrontation is when a user makes an effort to learn and use the features or services of

the technology and revises his expectation value as he understands the potential technology and restraints (Chae et al., 2010). In the table below, three types of avoidant behaviour and three types of confrontative behaviour. The coping strategies are also found by Klintwort (2018).

Avoidant	Confrontative
Distancing Developing restrictive rules for when or how a technological possession will or will not be used	*Accommodation* Identifies the advantages and disadvantages of the mobile device
Neglect Loss of interest in mobile device/service	*Partnering* Personalise the mobile device and service to meet personal requirement
Abandonment Exchange of mobile device/ Cancellation of mobile service contract	*Mastering* Dominating a technological possession by thoroughly learning its operations, strengths, and weaknesses.

Table 2 Coping strategies (Chae et al., 2010)

For mHealth, coping strategies responding to paradoxical tensions are attractive for a habitual change. For instance, when the application does not match their expectations. The user could potentially be abandoned, never to be used again. This has consequences for the creation of habits since no healthy habits are built with the use of the application. The limited exposure to the application leads to small or no intervention impact (Kelders et al., 2012). Therefore, neglect and abandonment are decremental for the effects of the application. The response could also be confronting. When the user partners with the application. The behavioural change technique tailoring (personalisation) towards the user can be more effective since the application adheres to the user (Free et al., 2013). Therefore, the effect is more likely to be sustainable in the long term. When a user masters the application, feedback given in the application will showcase more and better insights (Korinek et al., 2018; Walsh et al., 2016). These insights would stimulate awareness of habitual behaviour (Boam & Webb, 2014). As mentioned above, this would stimulate the disruption of habits.

Furthermore, having mastered the app would benefit the behavioural change technique goal setting (Compernolle et al., 2020). By constantly using the application, the goals formulated in the application will be more attainable and adjustable to the user's performance and needs. Therefore, the user can be helped healthily and sustainably.

Chapter 3 Methodology

3.1 Research Methods

As mentioned in the introduction, the objective of the thesis is to answer the research question: How does the user experience of mHealth applications affect habitual change? The research question talks about the user experience; however, it highlights the effects on habitual change. So we look into what consumers experience when using mHealth applications and specify towards changing habits. For the part of the user experience, the paradoxical tensions and coping mechanisms are explored (Fourmier,1998; Chae, 2010). Therefore, it is the objective of this research to apply the concept of technology paradoxes towards the app user's experience. So what do they feel when they faced such paradoxes. The part of the habitual change entails the focus on habitual change motive. For this research these are users of mHealth applications that intend to use the application to change their habitual behaviour. In the part of habitual change motive, it is of interest to deep dive into the experience. It is further taken into account how users feel and how their experience influences habits. So how does their experience relate to disrupting their habits and building towards a healthier lifestyle.

Finally, the overall objective is to explore the field of mHealth applications and gain valuable in-depth information about the impact on the consumer.

3.1.1 *Research form*

In this research qualitative methods have been used. Qualitative methods are common to study social and cultural phenomena, which helps understand people's perspectives, motivations and actions (Myers, 2013). Previous research on mHealth applications their user's experience is about the topic of this research is relatively limited, which makes explorative research logical. A hypothesis formulation is not required for qualitative research. However, a clearly defined objective must be specified beforehand (Cropley, 2011).

This qualitative research has been conducted in with abductive reasoning (Myers, 2013). Abductive reasoning looks for cause-and-effect relationships in comparison to a inductive approach, which seeks to determine general rules. The abductive approach uses evidence to determine what is likely to be true, however not guaranteed to be true. Therefore, a*bductive* reasoning typically starts with an incomplete set of observations and proceeds to the likeliest possible explanation for the set. There is decided to utilize abductive reasoning because of the scarcity of the literature about the explored topic *(Myers, 2013).* The abductive approach allows for new insights and theories to arise through the use of logical reasoning (Bleijenbergh, 2015). Therefore, the research will be conducted with a broad perspective in mind, to develop new theories or add to previous research. For example, the five paradoxes found by Klintwort (2018) are further explored and possible new insights in regard to habitual behaviour.

3.1.2 Semi-structured interviews

To answer the research question, qualitative data collection is necessary. For this research, the data is collected through semi-structured interviews. The semi-structured interview provides the interviewer with a pre-determined general outline of the interview. Before the interview, a couple of questions are established. However, there are possibilities for the interviewer to go more in-depth on topics (Myers, 2013). This means that some of the questions will emerge from the conversation. Semi-structured interviews combine open and closed interview styles. This combination leads to certain benefits of both styles (Bleijenbergh, 2015). For example, they allowed the interviewer to explore topics more relevant for a particular interviewee and an objective comparison of interviewees by offering a basic structure. The combination of the benefits from an open and closed style of interviewing, which semi-structured interviews offers is the best fit to answer the research question. The research question requires room for exploration since the user experience of mHealth has not been investigated as much. However, user experience can be subjective and excessive, making it beneficial to have some structure to narrow down this experience to relevant questions/topics.

3.2 Sampling methods

For this research, it is vital to establish which participants are interesting to interview. This qualitative research explored the phenomenon through the participants' experiences instead of a statistical analysis (Flick, 2007). Next to the experiences, the sample selection is based on whether the participants can offer insights. Participants who do not aim to change their habits and have no recent experience with the use mHealth applications are not included in this research. For the sample size, it is imperative to focus on whether a new participant can still offer fresh insights (Boddy, 2016). When the researcher notices that an extra interview will not offer new insights, data collection will be stopped. Also, take into account that this thesis has no unlimited time resources. According to Boddy (2016), the point that there are no more new insights falls around twelve interviews. Therefore, the researcher has conducted twelve interviews for this research

This research focussed on the experience of mHealth applications. The user experience is discussed and linked with habitual change in the interviews. Therefore, the sample of this research consists of individuals that are using or have used mHealth applications within the last year. In particular, users of healthy living apps designed to track health metrics such as diet, exercise, heart rate, and sleep are interviewed. With a particular focus on a consumer's lifestyle. For example, popular mHealth apps like MyFitnessPal, Fitbit, Headspace, Pillow, Strava or Streaks. This to ensure that entry-level knowledge on the topic was provided and the longitudinal element of the knowledge gap is addressed.

Within this research, participants are recruited through the circle of acquaintances of the researcher. Because of the popularity of the named mHealth applications it was possible to collect fitting participants through the circle of acquaintances of the researcher. This makes that the

convenient sampling approach is used. A convenience sample is drawn from a source that is conveniently accessible to the researcher. In table 3 an overview is presented of the characteristics of the participants.

Participant #	Gender	Age	Residence	Occupation	App
1	Male	23	Apeldoorn	Student	Sleepcycle, MyFitnessPal (Former-user)
2	Female	22	Venray	Student	MyFitnessPal, Steppsapp
3	Male	23	Wijchen	Student	MyFitnessPal (former user)
4	Male	25	Eindhoven	Student	Sleepcycle, Gezondheid (apple watch), 7minuteworkout
5	Male	23	Gasselt	Student	Strava
6	Male	27	Arnhem	Student	Basic-fit app, Komoot
7	Male	26	Arnhem	Student	Headspace (former user), Technogym (gym)
8	Male	24	Nijmegen	Student	Strava, MyFitnessPal (former user)
9	Female	67	Nijmegen	Retired	Fitbit
10	Male	27	Nijmegen	Student	Strava (former user), Samsung health (Samsung watch)
11	Female	30	Nijmegen	ZZp-er	Garmin (smart watch)
12	Male	24	Utrecht	Student/ZZp-er	Sleepcycle, Fitdays (Scale)

Table 3 Overview Participants

3.3 Research procedure

The interview started with the appropriate preparation. In preparation for the semi-structured interview, an interview guideline was developed. The guideline is pre-tested in a practice interview and discussed to test the structure, flow and duration. The testing ensured that the interview would go as planned so the interview would have the desired outcome. After testing the interview guideline the first interviews were conducted. After every interview the interview was analysed to look for possibilities for improvements. Therefore, a larger adjustment has been made after four interviews. This means that there is a interview guide from the first four interviews and an interview guide for the last eight interviews. After the later interviews no major adjustments have been made to the interview guide. Both interview guidelines can be found in the appendix. Next to making a guideline the

researcher has made sure to try out all the applications the participants have used to be more educated on the possibilities of the application. The interviewer chose to do this to familiarize with the features. With this knowledge the interviewer knew more on the potential experience of using the application. This helped anticipating on what participants intend to say during the interviews.

The interview followed a pre-determined structure. At first, the interviewee is informed that their interview will be analysed for the purpose of this research only. And the participant has been made aware that he/she can always leave the research, since the participation is fully voluntary. Second, at the start of the interview, the interviewee is asked if they are okay with being recorded for the interview transcription. Third, the interview started with an introduction which entails the goal of the research, the purpose of the interview and information on the subject. After the introduction, the questions started. The first questions are some preliminary questions. These questions are asked to identify the type of interviewee. E.g. which mHealth applications do you use? After the preliminary questions, the central part of the interview will start. The subjects of motivation for using mHealth applications, the user experience, and the relation with changing habits are discussed in this part. At last, there is an conclusion to the interview in which the interviewee can give their remarks on the interview and bring up a topic that maybe should be addressed. After the interview, the participant was thanked for their participation.

3.4 Research analysis

The data in this research is analysed through a thematic analysis. Thematic analysis is a method for analysing qualitative data that entails searching across a data set to identify, analyse, and report repeated patterns (Braun and Clarke 2006). It is a method for describing data, but it also involves interpretation in the processes of selecting codes and constructing themes.

The first step is to familiarise with the data. With the consent of the participants, the interviews are recorded. By recording the interview, a transcription of the interview is made. The transcription offers a close to reality perspective of the interview. Transcribing, reading and rereading the transcriptions is done to familiarise with the data. The second step was to generate initial codes by coding interesting features of the data systematically across the entire data set, collating data relevant to each code. This is done through context mapping. This analysis method aims to make sense of the experience by collecting fragments of text to find underlying structures (Stappers, Guldner, & Veelen, 2010). By collecting fragments instead of words context mapping helps to get a deeper understanding of what users experience. The third step is to search for themes by collating codes into potential themes, gathering all data relevant to each potential theme. Fourth, the with the use of the method of context mapping underlying structures of these collated data (themes) are reviewed and adjusted (Stappers, Guldner, & Veelen, 2010). In the fifth step, the themes were defined and named. This was an ongoing process by constantly refining the specifics of each theme and the overall story that the analysis tells, generating clear definitions and names for each theme. In this stage the five paradoxes

found by Klintwort (2018) are compared with the found themes. At last, the data is reported. The data will be reported through the selection of vivid and compelling statements or series of statements.

3.5 Research ethics

Regarding research ethics, it is of the utmost importance that the researcher follows a particular rule, namely the "golden" rule: 'treat others as you want to be treated yourself and be beneficial for organisations and individuals involved' (Bleijenbergh, 2015). Actions were taken to ensure that this research's integrity and professionalism are warranted. As mentioned in the research procedure, participants have been informed about the research objective before asking them to participate. Before the start of the interview, the participants have been made aware that the participation is entirely voluntary and know their right to withdraw at any stage of the research. Also, the participants are made aware that the interview results will be used for academic purposes only. Furthermore, All the data of the interviews has been treated as confidential and anonymous.

Chapter 4 Results

The results are shown in three paragraphs related to the three sub-questions formulated in the research objective. The three topics of the paragraphs are: the user experience of mHealth applications, coping strategies for paradoxical tensions and the influence of the experience of using mHealth applications on habitual change. The results are based on the analysis of twelve semi-structured interviews. The analysis schemes can be found in the appendix.

4.1 The user experience of mHealth applications

In the analysis ten paradoxical tensions have been identified. The identified paradoxical tensions are related to paradoxes found by Klintwort (2018), Mick & Fournier (1998) and Chae et al. (2010). Therefore, is this paragraph formatted to the related paradoxes. These paradoxes are: integration/ disintegration, self-control/ external control, confirmation/ disconfirmation, individual/ community, motivating/ demotivating and public/private.

4.1.1 Integration/ disintegration

The paradox of integration/ disintegration concerns how easily the mHealth app is adopted. In the analysis of the interviews, two paradoxical tensions have been identified related to the paradox of integration/ disintegration. The paradoxical tensions concern two themes: workload and feature usage. In figure 1, the paradoxical tensions related to the paradox integration/ disintegration are visualised.
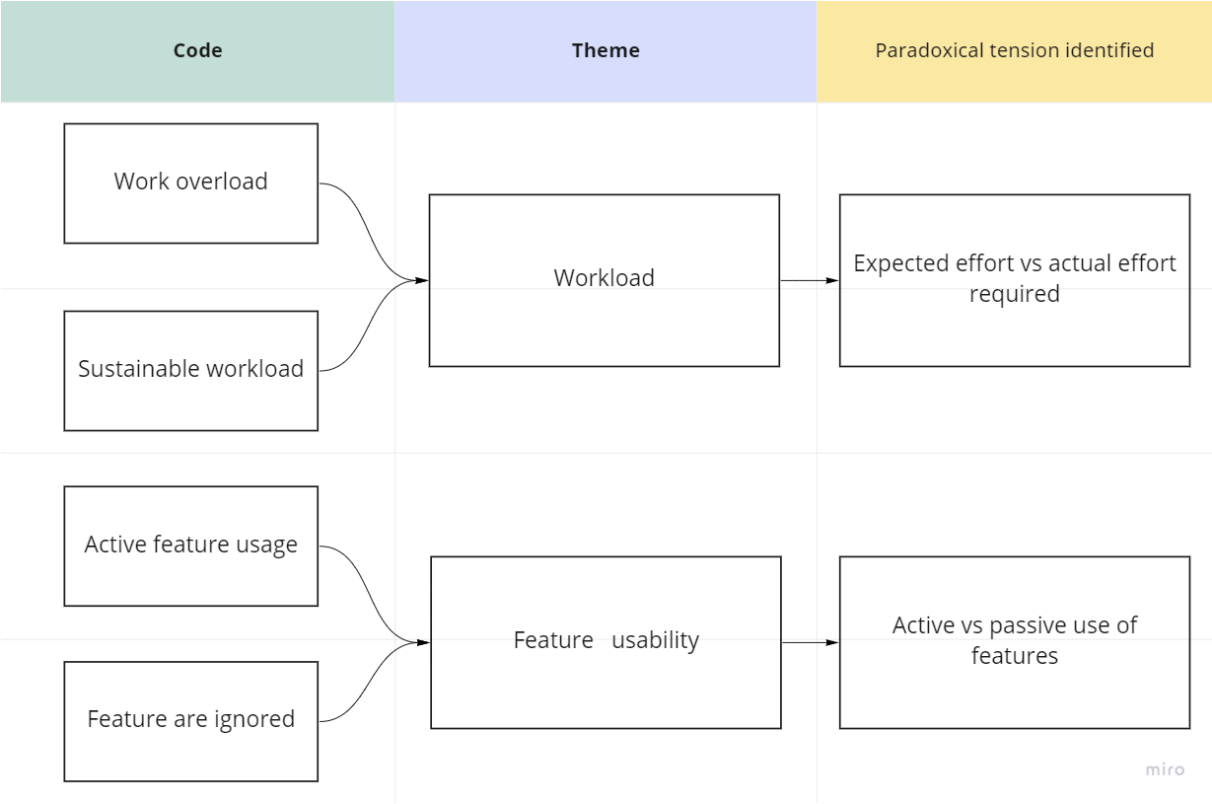

Figure 1 Visualisation paradoxical tensions integration/disintegration

On the theme workload, a tension is identified between the expected workload and the actual workload of the mHealth application. Participants either feel that the actual workload does not match the expected workload or that the workload matches their expectations.

On one side, participants state that using a mHealth application can require high effort. In the example of dietary mHealth applications, a participant says: "To use the application, you need to interact with the application constantly, and the interaction requires high effort, especially when food has to be weighed". When the participants were asked what changes they would make to the application, the response on dietary applications was to eliminate steps within the food administration process that requires a scale or research on portion size. This is to reduce the workload.

Conversely, participants state that the workload can be very sustainable, especially when the application does not require constant interaction. One participant stated: "the use of the physical activity tracker automatically traces activity, so this creates no extra effort." Other participants also stated that they can integrate the application daily. To quote one participant: "I use the application on a daily basis for two years now, and I always wear my smartwatch".

On the theme of feature usage, a tension has been identified between active and passive usage of the mHealth application Participants either make use of a feature or choose to ignore it. Participants judge the feature on potential value and decide whether to use it or not.

On one side, participants state that they use a feature because it is deemed valuable. For example, a participant stated: "The sleep tracker was used specifically for the goal of waking up better and improving rhythms. There, the function alarm interval was used". Other participants stated that they chose to focus on the essential features because of the workload. The following quote illustrates this: "I only use certain functions. Using this function is already a big workload, so I limit myself on the food part". One participant took this a step further and changed the purpose of the feature to make effective use of the application. This participant stated: "The food administration tools I use to orient myself on the information of products. I do not use them for administrational purposes". This showcases the effect of the hefty workload on the perception of a feature.

On the other side, choose not to use features. The participants state that they choose to ignore some functions since they lack value for them. For example, one participant says: "I exercise for recreational purposes, so for me, the application adds to this purposes with only two functions; other information is not interesting for me". Other participants add to that they focus on one feature and therefore forget others. One participant gives an example: "I always use the wake up better function that I ignore others like sleep maximisation and sleeping sounds". Purchase extensions can also influence the ignoration of features. Participants mention that multiple features are hidden behind a paywall and are ignored because of it. One participant stated that the free trial made him use certain features, yet this usage stopped at the end of the trial. To quote this participant: "I used the application twice a week for meditation and sleeping; however, after the end of my trial, I stopped using the app

for these functions". This illustrates that the financial investment of the user also influences the usage of features.

4.1.2 Self-control/ external control

The paradox of self-control/ external control concerns the extent to which the application controls a user's lifestyle. In the analysis of the interviews, two paradoxical tensions have been identified related to the paradox of self-control/ external control. The paradoxical tensions concern two themes: the sense of control over lifestyle and the decision to interact with the application. In figure 2, the paradoxical tensions related to the paradox self-control/ external are visualised.
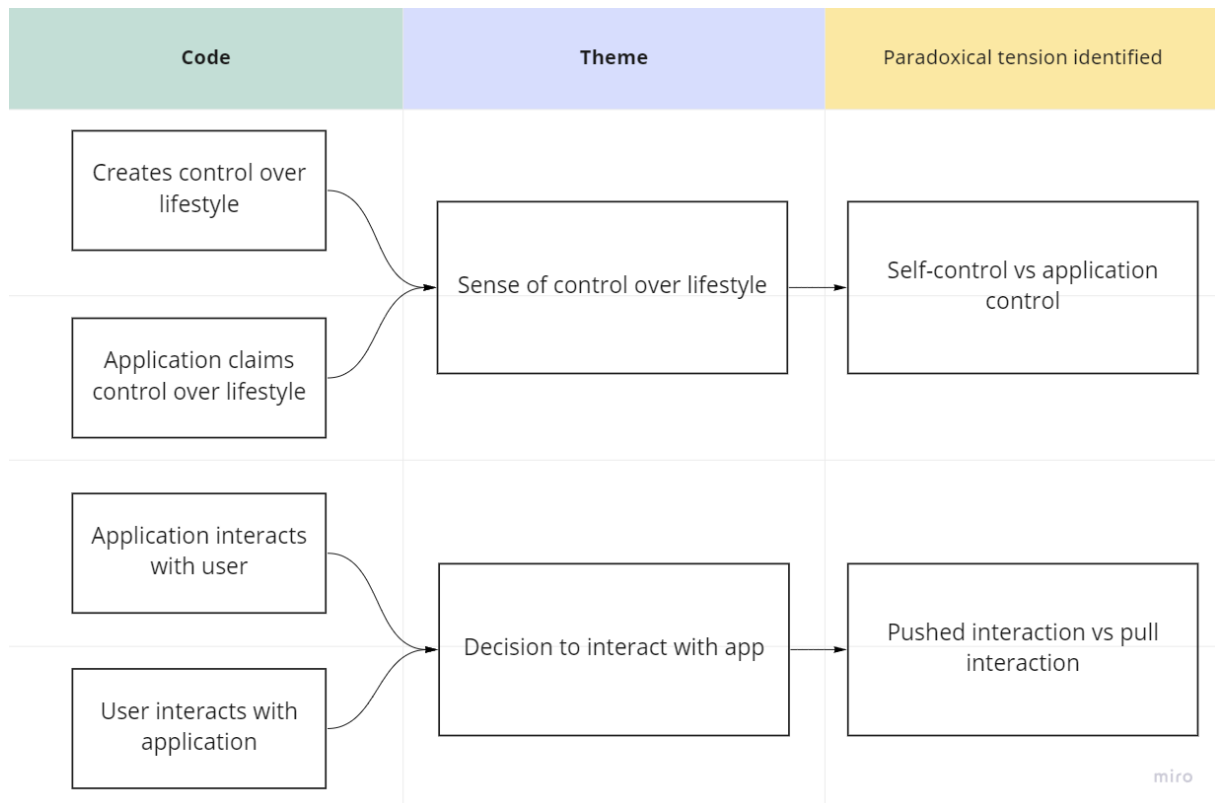

Code	Theme	Paradoxical tension identified
Creates control over lifestyle / Application claims control over lifestyle	Sense of control over lifestyle	Self-control vs application control
Application interacts with user / User interacts with application	Decision to interact with app	Pushed interaction vs pull interaction

Figure 2 Visualisation paradoxical tensions self-control/external control

A paradoxical tension has been identified in the theme of control over lifestyle. Participants either feel that the mHealth application takes over their lifestyle or that they can remain in control.

On one side, participants notice that they lose control over their lifestyle and the application takes over. For example, when an application gives the user feedback to sleep. This feedback intends to create a structure in the user's lifestyle patterns; however, it intends to do this with the dictation to go to sleep. To quote a participant on this example: "The app sends me push notifications when I should go to sleep, and I want to decide myself when I go to sleep. However, it could be good to know when you should aim to sleep". This quote also shows that the notification creates awareness for the moment he should go to sleep. However, he/she does not want the application to decide that.

On the other side, participants feel the other side of the tension where they feel that they can remain in control. A push notification or feedback from the application does not affect the participant.

A participant stated: "I do not experience a loss of control on the topic of sleep. I am still in control; the application only offers help". The participants feel that they do not lose control and that their agenda and beliefs are more significant than the application. The following quote illustrates this "My agenda is leading in determining my exercise; when I am too busy or have the feeling that I am not able to exercise, the feedback from the application does not affect me."

The other theme related to control is the interaction with the application. The paradoxical tension within this theme entails the moment that the user interacts with the application. Participants either feel that they decide when they interact with the application or that the application dictates this moment of interaction.

On one side, Participants feel that the moment of interaction is determined by themselves. The participant looks in the app when he/she wants to and is not affected otherwise. To quote one of these participants:

"I am in full control over my apps. I decide at the moment of interaction and have turned off the push notifications. When I am ready to use the application, I use them. However, I look at it when the icon has a mark on it, yet I do this at my own time".

Within this quote, a standard method of interaction from the application, the use of push notifications, has been mentioned. This method of interaction plays a prominent role in the moment of interaction. Participants often shut down push notifications to gain more control over the interaction.

On the other side, some participants feel that the application wants to claim their attention. One participant describes it as follows: "You have 3600 seconds in an hour and 24 hours a day, and it is a constant competition between applications to get your seconds of attention". Feeling overloaded with these notifications makes participants lose motivation to do it themselves. One participant mentioned that this negatively affects motivation to continue. To quote this participant: "If an app sends me messages constantly, I get demotivated because I want to do it with my own initiative". The quote describes that push notifications can also push someone away from the application rather than towards using it. Participants also mention that the timing of the push notification can be inconvenient. Participants say that the application interacts with them when they are not willing or able to respond. To quote a participant: "The moment I get the notification, I find them disturbing because they just come at the wrong moment. I often decide to neglect the notification until I am ready".

Nevertheless, there are moments when this interaction is valuable. Especially during the exercise when it offers coaching. "My Technogym app sends me an overview with suggestions for adjustments."

4.1.3 Confirmation/ disconfirmation

The paradox of confirmation/ disconfirmation entails the balance in which the mHealth app provides information that matches pre-existing thoughts or suspicions. The experience in which the

information matches pre-existing thoughts differs for the application. In the analysis of the interviews, two paradoxical tensions have been identified. The paradoxical tension concerns the match between reality and expectations in results and the app's functionality. In figure 3, the paradoxical tensions related to the paradox confirmation/ disconfirmation are visualised.
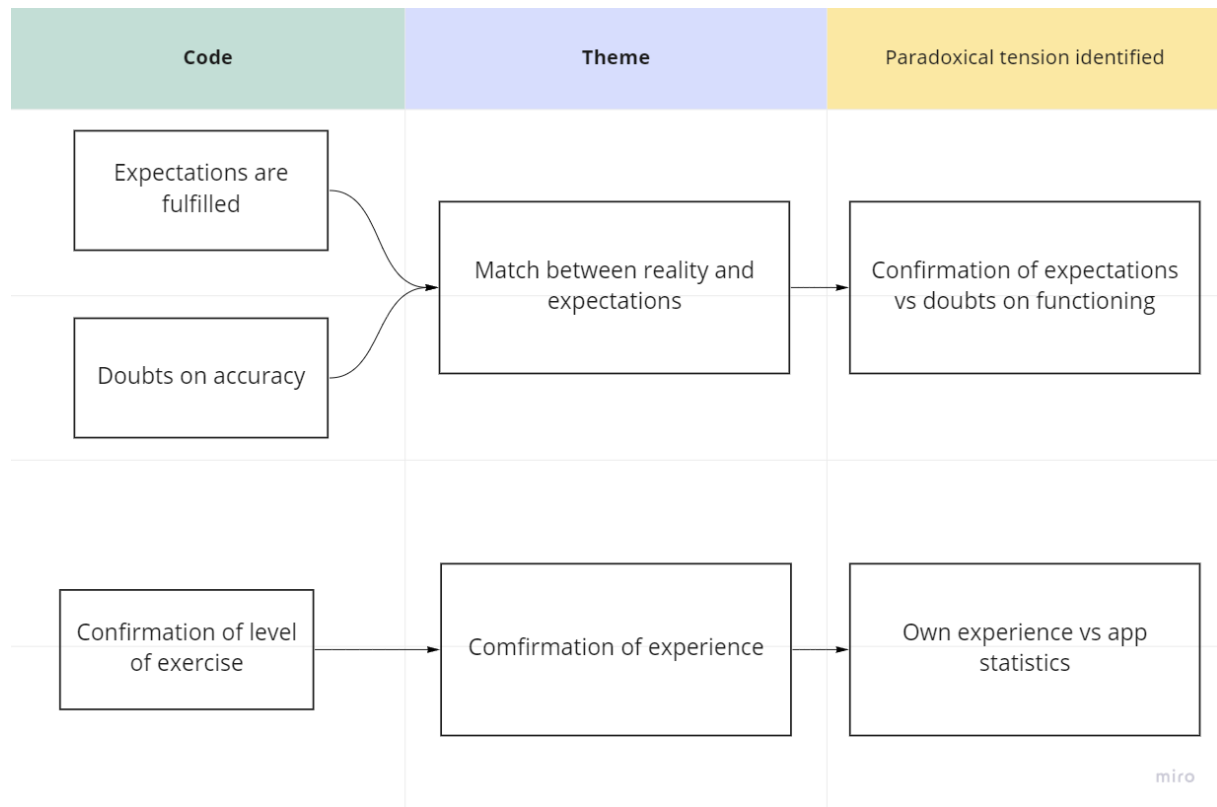

Figure 3Visualisation paradoxical tensions confirmation/disconfirmation

A paradoxical tension has been identified in the theme of the match between expectations and reality. Participants either feel that the application provides what they expected from the application or feel that the application does not match their expectations.

On one side, participants feel they got what they were looking for from the application. Participants said, "I wanted to know my sleeping pattern, and the sleep analysis was an excellent tool", and "The application did what it had to do for me". Participants mention that this positively affects their aim to change habits.

On the other side, participants doubt the mHealth application's accuracy and whether it functions properly. One participant stated: "It feels surreal sometimes an application could know everything of my sleep based on sounds". Also, tools can support the mistrust of mHealth applications, for example, the smartwatch. Participants state that they do not trust the data of the support tools. Participants made statements like "I doubt if my sports watch measures accurately" and "The inconsistencies in the measurements create doubts confirm my distrust".

A small group of participants also feels the tension between their results and the feeling of their exercise. Participants feel that they had a solid exercise and are disappointed when they look at the application. The results do not match their feelings and negatively impact their exercise experience. This does not help them build habits since they feel they just suffered a setback. While before looking at the results, they were full of joy and enthusiasm. One participant described it as follows:

"Sometimes the application disconfirms your own experience. I feel that I am running very well, which is not the case, which influences my experience of running a lot. De experience of the application feels more important to my own experience, and I find this confronting".

4.1.4 Individual/ community
The paradox of individual/ community is about sharing achievements through the mHealth app with a community. In the analysis of the interviews, one paradoxical tension has been identified. This paradoxical tension concerns competition. In figure 4, the paradoxical tensions related to the paradox individual/ community are visualised.
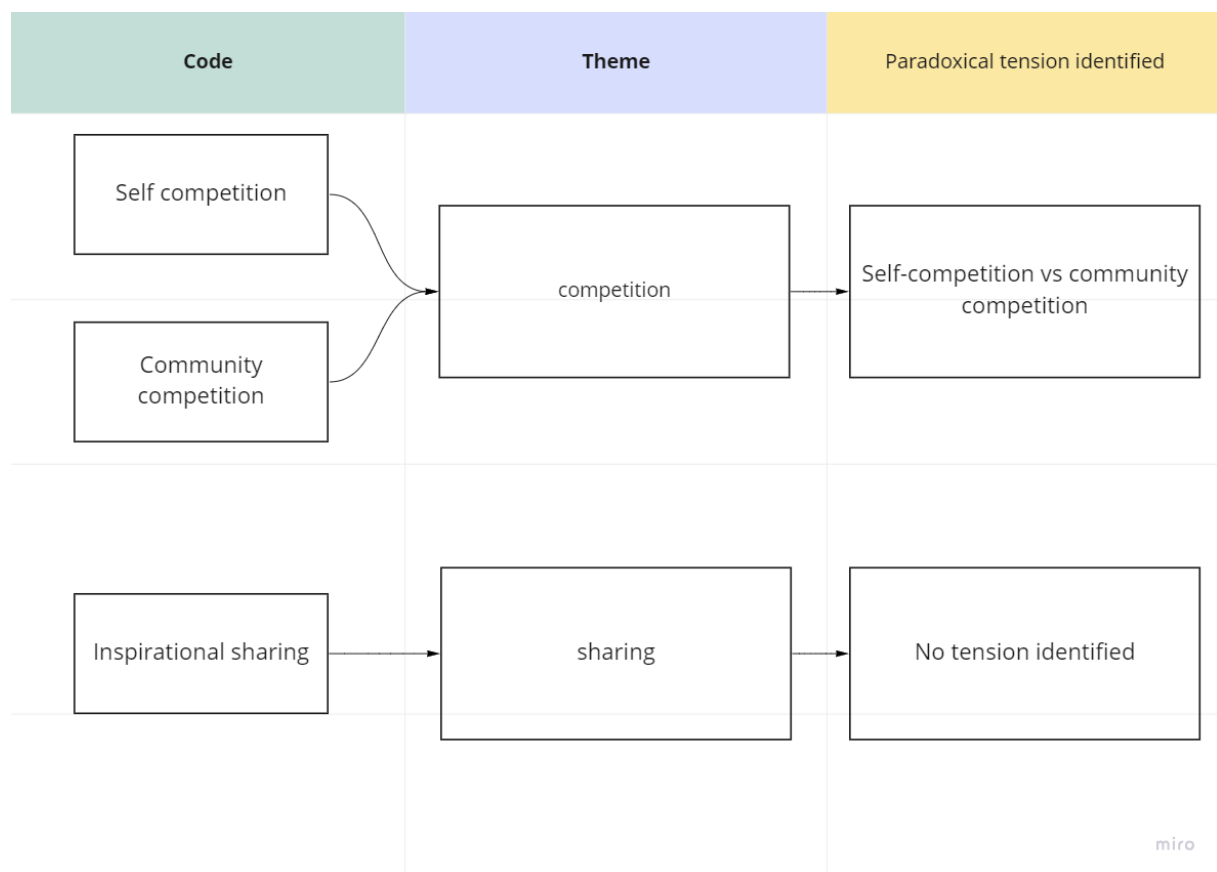

Figure 4 Visualisation of paradoxical tension individual/community

On the theme of competition, two forms of competition are held opposed to each other self-competition and community competition. Participants either feel that they want to compete against themselves or thrive because of competing with others.

On one side, participants state that they do not want to compete with others since they only want to focus on themselves. They state that they use mHealth applications for self-improvement, not to compete against others. To illustrate this: "The application confirms the completion of my goals. This gives me satisfaction in the form of self-competition. In which I track my rising results". Participants often mention self-competition in relation to their own goals. They compete against their own goals. Participants state: "I prefer to set my own goals, and I want to reach those goals". The competition with themselves attracts them more than competition against others.

On the other side, some participants feel that there are benefiting from the competition with others. Participants state that they like a friendly competition between fans and family. "If I see that my friends already have completed a route. This stimulates me to go run soon. I do not experience a negative side of the competition because I know my level". The participant also mentions that a certain confidence level in dealing with the competition element is beneficial. Competing with yourself could be a lot less scary.

Some participants mention that they like to share their achievements with friends. However, this does not entail any level of competition. Participants state that they find it fun to share their routes so that others could potentially copy this or find inspiration from it. The following quote illustrates this; "My friends and I attempt to provide each other with scenic routes". Participants do not experience tensions in this inspirational form of sharing.

4.1.5 Motivating/ demotivating
The paradox of motivating/ demotivating concerns how a mHealth app helps the motivation to remain a user of the mHealth application. In the analysis of the interviews, two paradoxical tensions related to the paradox of motivating/ demotivating have been identified—the paradoxical tensions concern response to the application and managing mHealth applications. In figure 5, the paradoxical tensions related to the paradox motivating/ demotivating are visualised.
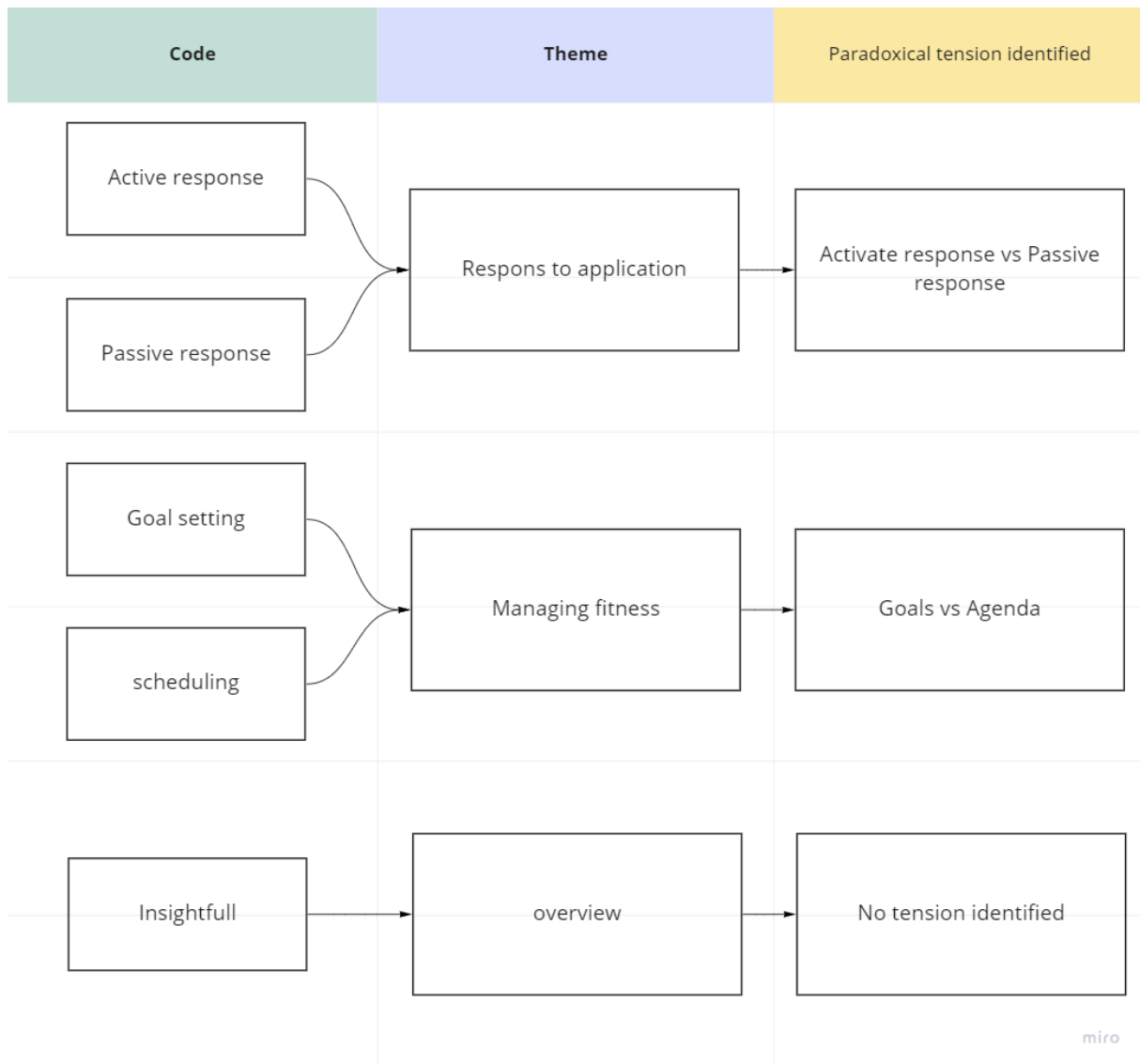
Figure 5 Visualisation paradoxical tensions motivating/demotivating

The theme response to the application entails the level at which the application activates the user to stay on the application. The participants either feel that the application triggers an active or passive response.

On one side, participants feel that the insights given in the application trigger them to engage in extra physical activity. For example, additional hikes to get the steps in or going on an extra run to reach their target. This is illustrated in the following quote: "I love the insight in my steps. I am so aware now of my steps that when I am still at eight thousand steps in the evening, I go for an extra hike to reach ten thousand steps target". Participants often use the metric variable as motivation since it shows the direct result. A participant stated: "My mHealth application stimulates me because it makes exercise metric". Besides the metric variable's motivation, the participants mention that feedback in the app stimulates constant use. The participants give examples of getting medals, messages and better visualization. To quote a participant: "On the front page, you have notifications of being logged in so many days in a row to stimulate maintaining this rhythm. The weekly summary

also stimulates to maintain the use of the application".

On the other side, participants remain passive towards the application. The participants state that they do not find the feedback personal enough. They state that the feedback does not trigger a response. A participant says, "I find the advice from an application not personal. With a personal trainer, I want to listen. A application is quite easy to ignore for me. A personal trainer cannot be refused". In this quote, a personal trainer is mentioned; participants state that they feel a need for more coaching in the application and that this would improve their motivation. Participants also conclude that they find some statistics confronting, which drives them away from the application. For example, when a user has a very passive day, the overview is changed negatively. The following quote illustrates this feeling: "I rather ignore the application when I rested on the couch all day long; when I have an active day, I get excited to interact with the application".

The theme of managing fitness entails the interaction between their goals and time. How do the goals match the agenda of the user? Participants either plan their lifestyle toward their goals or towards their agenda.

On one side, participants feel that goal setting stimulates them to build habits. They attempt to create a lifestyle that fits their goals to make them sustainable. A participant stated: "You start with a goal what you want to achieve, and the application presents ideas to make this achievable. The confrontation with the overviews makes you want to achieve these goals". The goal setting provides a dot on the horizon as participants give them comfort in knowing what to do to reach their goals. However, they still have to reach the goal. Participants also pointed out that having small attainable sub-steps or medals motivates them to continue. To illustrate this: "getting medals stimulates me and gives a small sense of victory".

Conversely, participants feel that the application has to fit their agenda. Otherwise, it is not maintainable. The agenda makes that the app's potential impact can be a part of their current lifestyle. The potential habits created with the application can only be sustainable when it does not make revolutionary changes to its agenda. A participant stated: "The moment it does not fit my schedule, I just quit the application". Participants realize that taking it slower could be more realistic; however, they experience that it is decremental for their motivation. The following quote illustrates this "You cannot exercise every day. This kills my motivation because you want to go again; sadly, this is often too intense". Participants feel that achieving goals within their agenda is complex and that the goals require new planning.

A small group of participants mentioned that they found the information presented within the application insightful. They do not experience tension when looking a the overview of data. The participants describe these insights as fun and do not add a motivational value to these insights. To illustrate this:" The apps show your timeline, and I find this a nice to look at".

4.1.6 Private/public

This research found the paradox of private/public to be relevant for mHealth applications relevant since almost all participants mentioned their comfortability with supplying the application with their personal information. So for this research, this paradox entails the comfortability of using personal information in the application. In the analysis, one paradoxical tension has been identified related to the paradox of private/public. This tension concerns the use of personal data. In figure 6, the paradoxical tension related to the paradox motivating/ demotivating is visualised.
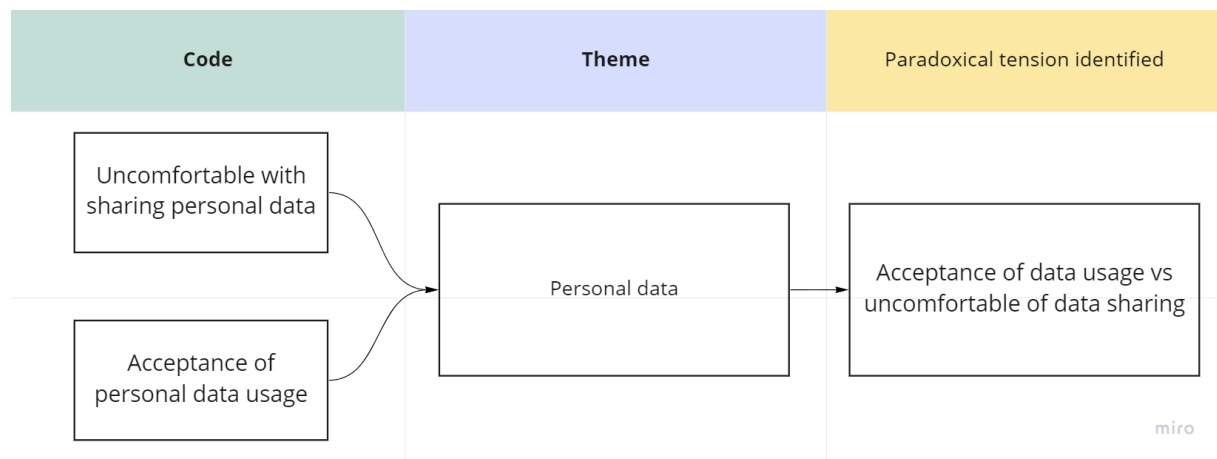

Code	Theme	Paradoxical tension identified
Uncomfortable with sharing personal data Acceptance of personal data usage	Personal data	Acceptance of data usage vs uncomfortable of data sharing

Figure 6 Visualisation paradoxical tension private/public

Most participants mentioned that it is essential to be careful with personal data. Participants are consciously aware of the dangers that the sharing of personal data may hold. Participants either feel uncomfortable and reluctant to share personal data or accept possible consequences and attempt to use services fully.

On one side, participants feel uncomfortable sharing personal data since they fear this could be used against them in the future. Participants even speculate that the package of information that tech companies currently have is very valuable. To quote one of these speculations:

"I wonder what information Samsung collects. The view of my life could be quite extensive now. A company like Samsung can target me for every product since they know so much about me. I believe this to be a dangerous development".

Participants also refrain from sharing their personal data with parties such as doctors or insurance agencies. "I would be uncomfortable when all my information would be shared with my doctor, or my insurance company can see what I do". The participants fear the 'big brother' concept will become a reality. That everybody knows and sees everything, a person does.

On the other hand, participants see the benefits of using personal information. This often leads to a more personal program to create new habits. This results in more personal feedback, which has been described as important by the participants. This leads to an acceptance of personal data useful for the mHealth application. Participants state that letting go of this concern relieves them from using the

application. To quote a participant on this: "I do not worry about the information they collect, because if I worry about that, I will sleep poorly". Participants also use the safety of personal data as a selection method for mHealth applications. To illustrate this: "This new smartwatch feels much safer in the privacy area. Therefore is the application more relaxing as earlier applications. I feel that I am currently not holding back in using the application". Participants feel that not holding back increases the effects of the application.

4.2 Coping strategies for paradoxical tensions
In paragraph 4.1, ten paradoxical tensions have been identified. These paradoxical tensions relate to six paradoxes formulated in earlier research. The questions that follows is 'How do participants cope with the paradoxical tensions?'. Therefore, the interviews have been compared to Chae et al. (2010) formulated coping strategies. This paragraph is formatted to the ten identified paradoxical tensions. This is to determine which coping strategies can occur when experiencing these tensions.

4.2.1 Workload
The paradoxical tension regarding workload has two responses. Participants who find the workload sustainable can fully integrate them into their lifestyle and, in some cases, use them daily. The participants can become masters of the application. Participants who feel that the application is too much effort abandon the application. This could be temporary until they find the time to do the work, or it is abandoned altogether. To illustrate the recurring abandonment, "I often quit the application since it is too much work, especially when you have an extraordinary day".

4.2.2 Feature usage
The paradoxical tension regarding feature usage leads to neglect or partnering with the application. Participants often decide to personalise feature usage when they find features not helpful or unrelated to their goals. The participant refrains from using them and personalises their usage of the application. Participants state that they only pay attention to features they find resourceful. The workload could strengthen the neglect of features. Participants feel that because of the workload, they need to focus on the most valuable part of the application. In the case of food administration, one participant gave the following example: "The application has become more resourceful as a search engine for insights into the nutrients foods contain". The participant states that with this information, he gets the most valuable information out of the application

4.2.3 Control over lifestyle
The paradoxical tension concerning the sense of control over lifestyle has different coping mechanisms. Participants experience a loss of control over the application and attempt to avoid the application. The participants state that they can feel pressured into exercising and find this uncomfortable and confronting. One participant gave the example that to comfort themselves, the smartwatch would be taken off and ignored for the entire day. To quote this participant: "At the moment that I feel that I lose control, I take off the watch to avoid the messages". On the other hand,

participants who feel in control over the application say that they can disregard the pushing factors of the application and use it on their own terms.

4.2.4 Interaction with the application

The paradoxical tension concerning the interaction with the application has participants cope with push notifications. Participants feel that the notifications are often mistimed and demotivating. Participants find that they want the initiative and often turn off the push notification. They choose to modify the application messaging to their preferences to reduce frustration with the application. In the scenario where push notifications would be more intrusive, the participants would consider abandoning the application. To quote a participant: "If the application were more intrusive, like push notifications in my agenda, I would quit the application" Participants state that they want to decide the moment of interaction with the application and are therefore neglecting the push mechanisms of the applications.

4.2.5 Match between expectations and reality

The paradoxical tension concerns the match between the expectations and reality of the application. Participants who feel that the application matches their expectations state they are extra motivated to use it. The participants say that the app does what it has to do for them and helps them achieve their goals. They become masters of the application to address their targets. To quote one of the participants: "I got out of the application what I needed a digital personal trainer". Participants who do not feel that the application matches their expectations often abandon the application. This often starts with the feeling that the app is inconsistent and therefore gives no valuable insights

4.2.6 Confirmation of results

The paradoxical tension related to the match between the feeling of their performance and their performance measured on the application has one specific effect. The effect is that the application makes participants feel an increase of emotion regarding their performance. When the application and the user's perception align, then the confirmation strengthens their desire to continue and master the application. When the users' perception and the application's measurements do not, the participant feels they have to question their experience. Participants describe this as confronting. The following quote illustrates this "The applications measurements feel more reliable as my feelings, and this is what I find very confronting". This does not lead to the abandonment of the application. However, it makes them consider the application's pros and cons.

4.2.7 Competition

The paradoxical tension concerning competition leads to a personalisation of the application. Participants who do not enjoy sharing their achievements ensure that the sharing function is offline during use. They ensure this personalisation is possible; otherwise, participants would look for a different application. Participants want to make sure they can use the application for their own improvement. The participants use the application function to create a self-competition. This

stimulates more and better exercise. To quote a participant on this: "During my bike sessions, I use the application to track my speed. I am constantly battling against my earlier achievements." Participants also state that in some cases, a community element feels unethical. For example, competition within dietary applications could lead to competition to measure who eats less. The participants would, in this case, abandon the application. Participants who enjoy community features state that it can stimulate them to continue their engagement with the application.

4.2.8 Response to the application

The paradoxical tension regarding the response to the application has two outcomes. Participants who get activated by using the application to exercise are motivated to use the app to its full extent. The participants want to master the application to ensure that they keep on track with their goals. The participants find that the application helps them to switch their habitual behaviour. One formulated this as follows "The practical overview that you can find anywhere else. If you are aware of what you consume, you will switch to a different way of behaviour". The conscious awareness of their lifestyle makes them more invested in their lifestyle and, therefore, master the application. Participants who are passive in their response to the application find struggle with the continuation of the application. Participants often mention the day of not using the application as the start abandonment. Participants feel that if they hit a lower point in their results. The possibility of restarting their process becomes tough to imagine. They instead choose to abandon the application. To illustrate this: "When the results are going down, for example around Christmas. The bar to restart gets increasingly higher to restart".

4.2.9 Managing fitness

The paradoxical tension between planning and goal setting concerns two coping mechanisms. The participants who let their planning rule use the application make a clear rule. The application is only to be used when my planning sees fit. This leads to a low level of application integration within their lifestyle. Participants who focus on their goals when using the applications feel more welcome to adjust to what is necessary to reach their targets. The participants attempt to make lifestyle changes only when they are too drastic; they start failing their goals, leading to distancing from the application. However, participants are keen to succeed in their targets. The idea that by following the suggested changes, they will reach the targets comforts the participants. This makes the user stay on track. The following quote illustrates this "The application gives me targets and formulates a plan to lose a certain amount of weight a week . This provides a dot on the horizon like when you follow this diet everything will turn out fine".

4.2.10 Personal data

The paradoxical tension concerning personal data use starts with one shared coping mechanism accommodation. Both participants who are confronted with the use of personal data evaluate the advantages and disadvantages. However, participants make different choices after the

evaluation. Some participants accept potential threats of using personal information; other participants do not want to entertain this threat. Participants who feel threatened by giving up the personal data end up neglecting features that demand this data or eventually abandon the application." When all the information becomes public, I do not want the app anymore" On the other hand, participants who do not feel threatened by the personal information use personalise the application to suit their goals the best. Participants state that they do not hold back when the feeling of safety of personal information is created. Participants are also aware that this safety is rarely ensured. A quote illustrates this realisation: "It may be the case that there are currently data leaks somewhere; however, you cannot be aware of that."

4.3 The effects of the experience on habitual change
The paradoxical tensions and coping strategies are described in paragraphs 4.1 and 4.2. This description entails the experience of the use of mHealth applications and how they deal with this experience. The question that follows is 'How do the paradoxical tensions impact habitual change?'. In paragraph 4.2 is described how participants deal with these paradoxical tensions. Therefore, how these coping mechanisms have affected habitual change has been analysed to understand how the tensions influence habitual change. To establish the influence on habitual change effects on the forms of habit disruption are considered (Gardner et al., 2021). The paragraph is formatted to the six coping strategies formulated by Chae et al. (2010). In table 4, an overview of the coping strategies for paradoxical tensions is presented.

Avoidant	Confrontative
Distancing ➢ Pushed interaction vs pull interaction ➢ Self-competition vs community competition ➢ Goals vs Agenda	*Accommodation* ➢ Self-control vs application control ➢ Own experience vs app statistics ➢ Self-competion vs community competion
Neglect ➢ Active vs passive use of features ➢ Self-control vs application control ➢ Pushed interaction vs pull interaction	*Partnering* ➢ Active vs passive use of features ➢ Self-competion vs community competion ➢ Goals vs Agenda ➢ Acceptance of data usage vs uncomfortable of data sharing

Abandonment	Mastering
➢ Expected effort vs actual effort ➢ Confirmation of expectations vs doubts on functioning ➢ Activated response vs Passive response ➢ Acceptance of data usage vs uncomfortable of data sharing	➢ Expected effort vs actual effort ➢ Confirmation of expectations vs doubts on functioning ➢ Activated response vs Passive response

Table 4 Overview coping strategies

4.3.1 Distancing

The paradoxical tensions push interaction vs pull interaction, self-competition vs community competition and goals vs agenda could lead to distancing behaviour from the application.

The creation of distance between user and application stimulates the formation of rules for the use of the application. For example, participants decide to let their planning rule use their application: "Push notification does stimulate me when my agenda has room for extra activities. In the case that there is no room in my agenda, I easily ignore the application". Participants feel that the rules make integrating the application into their current lifestyle easier. However, this limits the effects on their habitual behaviour.

Behavioural change techniques integrated into the application can barely affect the user since the user has too much control to function fully. For example, the behavioural change technique constant feedback on performance is denied by the distance between the user and the application. The following quote illustrates this experience interaction: "When the application sends me a notification, I think that I determine when I use the application. I determine the moment of interaction". The habit disruption is negatively affected by the blockade of behavioural change techniques. Because the participants are less involved with the application, no new habitual patterns are built.

Participants tend to only interact with the application during exercise. This leads to slight performance improvement within old habitual behaviour. However, no new behaviour is created. For example, participants mention that they have not started exercising more because of the application. To illustrate: "The application does not stimulate me or ignite a new motivation. Everything is done on my own initiative". This highlights that distancing is not beneficial for the inhibition of old patterns. Participants are therefore more likely to remain in their old habitual behaviour

4.3.2 Neglect

The paradoxical tensions push interaction vs pull interaction, self-control vs application control, and active vs passive use of features could lead to neglection the application.

The neglection often starts with the feeling that the user needs a pause or wants a pause from the application. For example, participants can feel so pressured by the application that they decide to ignore it. To illustrate: "The application gives me on a rest day during the weekend, the feeling that I

still need to do something. I feel pressured to exercise on my rest day. Therefore, I sometimes decide to turn off the watch to be free of notifications." By ignoring the application, participants shut down a potential influence on their habitual behaviour.

Behavioural change techniques integrated into the application cannot interact with the user. This leads to a decrease in the effectiveness of the application. Participants found that their goals in the application were harder to reach by taking some days off using the application. Participants also feel that it heavily affects the application's overviews, making the feature less valuable. To illustrate: "The more extensive overviews lose their value with a day of no use". With the neglect of the application, the effects on habits through behavioural change techniques like goal setting are minimal.

Nevertheless, the participants state that they are still aware of the importance of exercise through the application despite their avoidance behaviour. To illustrate, "Despite avoidant behaviour, a voice in my head remains. This voice reminds me to exercise more. This is an experience I did not have prior to downloading the application". This conscious awareness of the importance of making healthier choices could support inhibiting old impulses. On other forms of habit disruption, there is no mentionable impact made. Participants feel that they relapse into old habitual patterns. Participants add that they do not know how to maintain the new habits. To illustrate this lack of knowledge: "I feel that only a small group of people know how to maintain habits."

4.3.3 Abandonment

The paradoxical tensions expected effort vs actual effort, confirmation of expectations vs doubts on functioning, activated response vs Passive response and acceptance of data usage vs uncomfortable with data sharing could lead to the abandonment of the application.

Participants state that the application does not offer enough to maintain them as a user. A participant stated the following:" The application only provides information during exercise; however, this is not combined with suggestions. This makes it interesting at the start, yet in the long term, it is not stimulating at all". Multiple participants have mentioned the lack of suggestions or coaching. These participants also name this as a valuable addition to current mHealth applications. To illustrate this: "Substitution is not stimulated through the application. The tracker does not provide you with goals. Everything has to be done on my own initiative". Therefore, the participant feels that habitual change is not stimulated without coaching elements, since it is not sustainable in the long run. The application's abandonment makes the effect on habitual change almost non-existent.

However, some participants abandoned the application after a short, intense period of usage and stated that the education on a healthy lifestyle helped them create better habits outside the application. To illustrate this: "The educational part of the application provided lessons I know now what healthy habits are, and this enables me to eliminate unhealthy habits after I stopped using the application". So the experience has, in some cases, regardless of the abandonment, an effect on the awareness of habitual behaviour. This could stimulate the disruption of habits through the avoidance and containment of impulses.

4.3.4 Accomodation

The paradoxical tensions self-control vs application control, own experience vs app statistics and self-competition vs community competition could lead to the coping strategy: accommodation.

Participants state that using the application has its advantages and disadvantages. For example, participants feel that using the application can feel as intrusive and, on the other hand, personal at the same time. To illustrate this regarding personal data: "From one side, I think who cares whether they have my personal data on the other side I am very aware of the information I give to the application".

Participants who consider these advantages and disadvantages know what it means to use the application and decide to use it in the form that provides them with the most advantages. This supports their capability of habitual change. However, this also means that the participant's view of the application is leading. Functions of the application that bring disadvantages could also provide advantages. For example, a function on sleeping apps was just a general alarm clock which felt not aligned with the user's goal of better sleep. The misalignment with their goal was that using this function would not help them wake up more energised. However, participants later found that with the use of general alarm clock function, they could maximise their sleep. To illustrate this: "I have stopped with the waking up energised function to maximise my sleeping". Now they only use the general alarm clock function. So the basis to disrupt habits when accommodating to the application is present. However, potential misjudgement of features could slow down the habit substitution processes.

When participants are accommodating to the application, they can confront their own habits. Participants say that it sometimes feels too confronting and therefore stop using that function. Therefore, the feelings of the participants influence the selection of the function. To illustrate: "I find that some overviews are too confronting, which makes that I do not use these functions anymore". This limits the application in creating conscious awareness of behaviour since insightful functions will be ignored. This could negatively influence habit inhibition and habit discontinuation.

4.3.5 Partnering

The paradoxical tensions active vs passive use of features, self-competition vs community competition, goals vs agenda and acceptance of data usage vs uncomfortable of data sharing could lead to the user partnering with the application.

When the user partners with the application, the users personalise the use of the application to their goals. This personalisation enables them to make good use of the behavioural change technique incorporated in the design of the mHealth application, especially goal setting. By partnering with the application, the user is competent in formulating goals and a plan to achieve those. Participants state that in collaboration with the application, they can build a week-for-week plan to build a new lifestyle. To illustrate this: "The app proposes a plan to lose weight week by week, and this provides me with a dot on the horizon. I know now what I have to do to turn my goals into reality". This helps the user

substitute old habits with new healthier habits.

The participants feel that the personalisation of the use makes it more positive in the long term. To quote a participant: "By personalising my runs, I have made a promise to myself, and I can verifiably fulfil this promise". By personalising the application, the user determines how the features interact with the user. This makes users can be less aware of functions that do not adhere to the users' vision. This limits their awareness of potential alternatives or feedback. Therefore, habit inhibition and habit discontinuation are not optimal. Participants state only to use functions that they find helpful. For example, one participant said that he would only use the application for food administration since this was the one most relevant. To quote this participant: "I only use the food administration. The other functions like drink administration I find difficult to fill in, so I do not use them".

4.3.6 Mastering

The paradoxical tensions expected effort vs actual effort, confirmation of expectations vs doubts on functioning and activated response vs passive response could lead to mastering the mHealth application. The users explore the application's functions and then decide what fits their purpose best. In this way, users can fully integrate the application into their lifestyle. Participants state that using the application is a daily activity for them. The participants are constantly confronted with feedback on performances. Therefore the user is consciously aware of their behaviour and can decide to act upon this feedback. To illustrate this: "The application quantifies your day. This insight provides you with what to do or not to do". The increase in conscious awareness supports the user in disrupting habitual behaviour. The sustained awareness makes the user capable of inhibiting impulses. Participants also feel that the mHealth applications are supporting them in making adjustments in their behaviour. For example, when the participant filled in a type of food to consume, the application would warn them to eat something else because of high-fat levels. One participant claims that this is the most valuable way the application supports the user. To quote this participant: "The most valuable way that the app helps me is by identifying unhealthy foods and showing me what to eat instead. It also provides me comfort to know that the food consumed was healthy". Participants state that such warnings make them choose something different. "The warning makes that you are going to look for an alternative". By being a master of the application, the participants integrate the application to its full extent into their lifestyle. Therefore, they are also more capable of maintaining new habits. The change in habitual behaviour is sustained over a more extended period of time. The following quote illustrates this: "Through the application, I am building a sustainable pattern. And I can maintain my current fitness levels". Because of the application's sustainable use, the app can fully substitute unwanted behaviour with new wanted habitual behaviour.

Chapter 5 Discussion and conclusions

5.1 Interpretation results

The research started with a growing concern about lifestyle-related diseases (Peterson et al., 2018; Lascar et al., 2018). Therefore, habitual change is required to build and sustain a healthier lifestyle. Although the potential of mHealth for changing habitual behaviour is substantial, it is often not realized as mHealth applications fail to engage users in the long run. This lack of engagement could be related to the experience of using mHealth applications. The experience of the mHealth applications has positive and negative consequences that could co-occur. This makes the experience paradoxical (Mick & Fournier, 1998).

Therefore, is the application's experience when aiming for habitual change investigated in this research. The research has followed three steps to fulfil its objective. These three steps were: identifying paradoxical tensions when users aim for habitual change, establishing how the user copes with the tensions and looking into the effects of the paradoxical experience on habitual change. The research uses a qualitative approach to explore the user experiences in-depth through semi-structured interviews.

The research has found ten paradoxical tensions with using mHealth applications. These paradoxes relate to the paradoxes identified in earlier studies.

The paradoxical tensions found regarding workload, and feature usability relates to the paradox integration/disintegration identified by Klintwort (2018) and Mick & Fournier (1998). The integration/disintegration paradox entails the ease of adoption. The tensions found add two experience indicators regarding the ease of adoption.

The paradoxical tensions found regarding the sense of control over lifestyle and the decision to interact with the application relate to the paradox of self-control/ external control identified by Klintwort (2018) and Mick & Fournier (1998). The paradox of self-control/ external control entails the extent to which the application controls a user's lifestyle. The paradoxical tensions indicate how experience is affected by controlling mechanisms in the application. The tension in the decision to interact with the application confirms pre-existing thoughts on the paradoxical experience of push notifications (Bidargaddi et al., 2018).

The paradoxical tensions regarding the confirmation of experience and match between reality and expectations relate to the paradox of confirmation/ disconfirmation identified by Klintwort (2018). The two tensions concern: the match between the expectation of the app itself and reality; the match between the users' feelings and the results. The match regarding the app itself regards whether the app's experience matches their suspicions before adoption. The match of results and feeling entails whether the exercise experience matches the application's overview.

The paradoxical tension regarding competition relates to the paradox of individual/community identified by Klintwort (2018). The paradox of individual/community entails sharing achievements through the mHealth app with a community. The paradoxical tension between self-

competition/community-competition confirms the tensions that may occur in forms of community competitions (Mick & Fournier, 1998; Jarvenpaa & Lang, 2005). This tension adds a perspective on self-competition.

The paradoxical tensions regarding the response to an application and managing fitness relate to the paradox motivating/ demotivating found by Klintwort (2018). The paradox of motivating/ demotivating concerns how a mHealth app helps the motivation to remain a user of the mHealth application. The two tensions add two indicators of how the application experience could affect the motivation to remain a user. The tension regarding the response entails whether the application activates the user to address their fitness. The tension regarding managing fitness describes the role of planning and goal setting.

The paradoxical tension regarding personal data relates to the public/private paradox found by Chae et al. (2010). This paradox was intended to reflect the level at which the user was public with the use of mobile technologies. At this time, the concern regarding public use of the application has shifted to data use. Participants struggled with the publication of their personal info in this application.

The study by Chae et al. (2010) formulated six coping strategies for using mobile technologies. In this study, all coping mechanisms have occurred for mHealth applications. Most paradoxical tensions in the experience of mHealth applications have multiple coping strategies. This is influenced by the level at which the user experiences the negative or positive consequences. The difference between negative and positive consequences experienced by users is remarkable. One participant would master the application the other would abandon the application while experiencing the same tension.

The studies on habit disruption and habit creation indicate multiple ways to change habitual behaviour (Gardner et al., 2021; Verplanken et al., 2018; Quinn et al., 2010). This study finds that the experience of the mHealth applications impacts the disruption and creation of habits. The participants who showed avoidant behaviour to the application had little impact on their habits. However, in rare cases, the educational aspect of the mHealth application affects the user's conscious awareness after the avoidance. This slightly impacts habit inhibition positively outside the application. On the other hand, when participants confront the application, the forms of habit disruption are impacted substantially and positively. Also, the newly created are more sustainable in the long term.

5.2 Managerial implications

This research provides multiple stakeholders in the field of mHealth applications with new insights. Health care practitioners and policymakers are better informed on the experience of mHealth applications when aiming for habitual change. Policymakers could use the insight in the experience to promote the use of mHealth in a more relatable and informed manner.

Participants have addressed in this research a need for more coaching elements inside and outside the application. Participants feel that combining online and offline support in habitual change

is beneficial. Health care practitioners could therefore place themselves in a more coaching role when the patient/client uses an application to change habits. This coaching would help the user to remain engaged with the application in the long term.

The research also provides the (potential) user with a deeper understanding of what using a mHealth application brings. The user will know what tensions may occur in the experience of mHealth applications. In addition, insight into paradoxical experiences' effects on habitual behaviour change is also helpful when the user aims for habitual change. Therefore, users could be better prepared to use the mHealth applications.

At last, mHealth application developers could learn from this research. This research shows how experience influences habitual change. The mHealth application developers should look into the paradoxical tensions found in this research to improve user engagement. The tensions could decrease user engagement because nine out of ten paradoxical tensions could lead to avoidant coping strategies. The application designer could address the application's design so that the user experiences less tension or the positive consequences of a paradoxical tension when using the application. For example, participants have suggested that app designers could add more coaching elements, educational information and automatizations. The app developer could also adjust the interface to be more suitable for behavioural change techniques like goal setting. This has been found as a stimulant for habitual change.

Furthermore, the application designers could look into the integration of multiple applications into one to create more informative overviews. The integration of multiple applications does not need to have a priority since participants have mentioned not minding the use of multiple applications.

5.3 Theoretical implications

The research is designed to add to two knowledge gaps. The first knowledge gap concerns the experience of the mHealth application when aiming for habitual change. The findings of this research indicate that the experience of the application is paradoxical. Therefore, the research extends the body of literature regarding paradoxical experiences. The findings of this research have also identified ten paradoxical tensions when using the mHealth applications for habitual change. These paradoxical tensions are relatable to earlier defined paradoxes by Mick & Fournier (1998), Chae et al. (2010) and Klintwort (2018). The paradoxical tensions in this research are often more specified than the paradoxes defined in earlier studies. Therefore, the identified tensions also serve as an indicator for the earlier defined paradoxes. This makes the research extend on earlier found paradoxes and provides fresh and more specific insights into the paradoxical experience of mHealth applications.

The second knowledge gap concerns the effects of the experience with the use of mHealth applications on habitual change. This research is unique in addressing this knowledge gap. The research has found that the identified paradoxical tensions impact the effects of habitual change. This makes the research creates a new perspective in the body of literature on the experience of mHealth

applications. Therefore, future research on the experience of mHealth applications and habitual change can incorporate this perspective to have a broader overview of possible effects. The findings in this interview also provide insights into how the experience of the mHealth application impacts forms of habit disruption.

5.4 Limitations

By specifying the context of the thesis, an insight into the research's limitations is formulated. This formulation helped to determine some boundaries of the research. This research focussed on participants that used the mHealth application to change habitual patterns. This particular aim limits the transferability toward a different kind of user.

This research also focused on users of healthy living applications that track health metrics such as diet, exercise, heart rate, and sleep. The research focused on the consumer's lifestyle. For example, popular mHealth apps like MyFitnessPal, Fitbit, Headspace, Pillow, Strava or Streaks. As shown in the overview in table 3, all participants used healthy living applications. This creates a boundary for the transferability toward another kind of mHealth application (e.g. diabetes buddy).

Furthermore, the fact that the respondents are found in the circle of acquaintances makes the sample less representative for multiple reasons. Most participants were male, students and below thirty. This could mean that the research is less representative for elders, employed people and females. However, the researcher is confident that the sample offers enough different viewpoints and experiences. This confidence is primarily based on the variety and amount of applications discussed with the participants.

5.5 Methodological reflection

The researcher concludes that time has impacted decisions and performance when looking back on the research process. Due to reduced time, the decision is made to transcribe and analyse the interview shortly after conducting it. The researcher felt that this impacted the bias in the following interview. For example, the researcher would think about answers from the previous interview while conducting another interview. Nevertheless, did the shortly followed analysis provide for constant evaluation; this evaluation brought valuable lessons in the formulation of the research guide. The researcher believes that the lessons learned from earlier interviews outweigh the bias in value.

When the researcher reflects on the insights from the interviews, the researcher establishes that answers on the relationship between the experience and forms of habit disruption tend to lean toward how the application helps the user. Therefore the analysis of the effects of the experience was more difficult. The researcher believes in hindsight that the answers could be more direct with some adjustments to the formulation of the questions. The researcher also felt that the participants tended to derail from the subject of the experience since the conclusion could be hard to accept.

5.6 Recommendations for future research

This research is the first that addresses the knowledge gap between the experience of using mHealth applications and habitual change. The research has found that the experience of paradoxical tensions can affect habitual change. Future research could use this research and deep dive into the experience of using the mHealth application effect on habitual change. Future research could, with the assistance of this research, formulate more detailed effects on habitual change.

In the later stage of the interviewing process, the researcher noticed that there could be a disparity between the age groups of consumers. The few participants thirty years of age or above have integrated the technology more profoundly than the other participants. Other participants would have the application for a shorter time and were quick to forfeit the application or reduce the use. In contrast, the participants above thirty years of age fully integrated them into their lifestyle. So the researcher sees potential for research comparing the older consumer with the younger ones' experience and establishing whether there is disparity.

Another recommendation would be to research the combination of the mHealth application with offline coaching. One participant mentioned the positive effects of the experience. The researcher would advise exploring the possibilities of personal training with a mHealth application; maybe this is the way forward to create sustainable healthy habits.

5.7 Conclusions

The research concludes on the experience of using the mHealth application for habitual change. This research, therefore, answers the following research question: *How does the user experience of mHealth applications affect habitual change?* To give a complete answer to this question, three sub-questions have been answered.

The first sub-question is: *What paradoxical tensions do the users of mHealth applications experience?* The research has identified ten paradoxical tensions. These paradoxical tensions are: push interaction vs pull interaction, self-competition vs community competition, goals vs agenda, self-control vs application control, active vs passive use of features, expected effort vs actual effort, confirmation of expectations vs doubts on functioning, activated response vs passive response, own experience vs app statistics and acceptance of data usage vs uncomfortable of data sharing. The found paradoxical tensions are more specific in comparison with earlier found paradoxes. Therefore, paradoxical tensions could also be used as an indicator of these paradoxes. Participants can experience multiple tensions at the same time. This experience of multiple tensions means that the experience per individual is likely to be different.

The second sub-question is: *How do the users of mHealth applications cope with paradoxical tensions?* The research has found that the six coping strategies formulated by Chae et al. (2010) are all relevant to the ten paradoxical tensions identified in this research. These coping strategies are distancing, neglection, abandonment, accommodation, partnering and mastering. Most paradoxical tensions have multiple coping strategies. This makes that experiencing tensions can have multiple

outcomes for the adoption of the application. Experiencing these paradoxical tensions can differ heavily per user. Users who experience the negative consequences of the application could potentially abandon the application, while the user who experiences the positive consequences could master the application. These significant differences make the effect of the paradoxical tensions hard to determine on a large scale. The paradoxical tensions should therefore be looked at per individual regarding coping strategies.

   The third sub-question is: *How do the paradoxical tensions impact habitual change?* The paradoxical tensions lead to different coping strategies by users. The research found that users who show avoidant coping mechanisms have little to no impact on habitual change. This lack of impact is because the avoiding coping mechanisms block the user from behavioural change techniques in the application. Therefore, the disruption of old habitual behaviour is hard to imagine. Nine out of the ten paradoxes could lead to an avoidant coping strategy. In some cases, the educational part of the application can provide an awareness that could lead to a habitual change outside the application. Users who showcase confrontative coping strategies are able to impact change of their habits. These coping strategies enable behavioural change techniques. Through behavioural change techniques (e.g. goal setting), the application can support the user in disrupting and creating new habits. These habits could be sustained long-term because the experience of the mHealth application allows the user to be confronted by behavioural change techniques.

References

Bidargaddi, N., Almirall, D., Murphy, S., Nahum-Shani, I., Kovalcik, M., Pituch, T., Maaieh, H., & Strecher, V. (2018). *To Prompt or Not to Prompt? A Microrandomized Trial of Time-Varying Push Notifications to Increase Proximal Engagement With a Mobile Health App*. JMIR mHealth and uHealth, 6(11), 1–15.

Bleijenbergh, I. (2015). *Kwalitatief onderzoek in organisaties (2nd ed.).* Den Haag: Boom Lemma.

Boam, E. & Webb, J. (2014) *The qualified self: going beyond quantification*. Retrieved from: http://designmind.frogdesign.com/2014/05/qualified-self-going-beyond-quantification/.

Boddy, C. R. (2016). *Sample size for qualitative research*. Qualitative Market Research: An International Journal, *19*(4), 426–432.

Burns, S. P., Jaimee; Terblanche, Madeleine; Lillard, Hannah; De La Pena, Catalina; Grinage, Noelle. (2020). *mHealth Apps: Examining the Difference Between Availability and the Evidence*. Journal of Medical Internet Research. https://doi.org/https://doi.org/10.1016/j.apmr.2020.09.005

Braun V, Clarke V. *Using thematic analysis in psychology*. Qual. Res. Psych. 2006; 3: 77–101.

Chae, M. Yeum, D., Myungsin, C.,. & Daesung, Y. (2010). *The Impact of Mobile Technology Paradox Perception and Personal Risk-Taking Behaviors on Mobile Technology Adoption*. International Journal of Management Science, Vol 16.

Compernolle, S., Cardon, G., Van der Ploeg, H. P., Van Nassau, F., De Bourdeaudhuij, I., Jelsma, J. J., Brondeel, R., & Van Dyck, D. (2020*). Engagement, Acceptability, Usability, and Preliminary Efficacy of a Self-Monitoring Mobile Health Intervention to Reduce Sedentary Behavior in Belgian Older Adults: Mixed Methods Study*. JMIR mHealth and uHealth, 8(10), e18653. https://doi.org/10.2196/18653

Cropley A. (2011) *Qualitative Forschungsmethoden*. Eine praxisnahe Einführung. Magdeburg: Verlag Dietmar Klotz.

Dounavi, K., & Tsoumani, O. (2019). *Mobile Health Applications in Weight Management: A Systematic Literature Review*. American Journal of Preventive Medicine, 56(6), 894–903. https://doi.org/10.1016/j.amepre.2018.12.005

Edwards, L.C., Bryant, A.S., Keegan, R.J., Morgan, K. and Jones, A.M. (2017), "*Definitions, foundations and associations of physical literacy: a systematic review"*, Sports Medicine, Vol. 47 No. 1, pp. 113-126, doi: 10.1007/s40279-016-0560-7.

Farage, M. A., Miller, K. W., Ajayi, F., & Hutchins, D. (2012). *Design Principles to Accommodate Older Adults.* Global Journal of Health Science, 4(2). https://doi.org/10.5539/gjhs.v4n2p2

Flick, U. (2007). *Designing Qualitative Research* https://doi.org/10.4135/9781849208826

Free, C., Phillips, G., Galli, L., Watson, L., Felix, L., Edwards, P., Patel, V., & Haines, A. (2013). *The Effectiveness of Mobile-Health Technology-Based Health Behaviour Change or Disease*

Management Interventions for Health Care Consumers: A Systematic Review. *PLoS Medicine*, *10*(1), e1001362. https://doi.org/10.1371/journal.pmed.1001362

Gardner, B., Arden, M. A., Brown, D., Eves, F. F., Green, J., Hamilton, K., Hankonen, N., Inauen, J., Keller, J., Kwasnicka, D., Labudek, S., Marien, H., Masaryk, R., McCleary, N., Mullan, B. A., Neter, E., Orbell, S., Potthoff, S., & Lally, P. (2021). *Developing habit-based health behaviour change interventions: twenty-one questions to guide future research*. Psychology & Health, 1–23. https://doi.org/10.1080/08870446.2021.2003362

Gardner, B., Richards, R., Lally, P., Rebar, A., Thwaite, T., & Beeken, R. J. (2021). *Breaking habits or breaking habitual behaviours? Old habits as a neglected factor in weight loss maintenance.* Appetite, 162, 105183. https://doi.org/10.1016/j.appet.2021.105183

Gardner, B., Rebar, A. L., & Lally, P. (2020a). Habit interventions. In M. S. Hagger, L. D. Cameron, K. Hamilton, N. Hankonen, & T. Lintunen (Eds.), *The handbook of behavior change* (pp. 599–616).Cambridge University Press

Gardner, B., Lally, P., & Rebar, A. L. (2020b). Does habit weaken the relationship between intention and behaviour? Revisiting the habit-intention interaction hypothesis. *Social and Personality Psychology Compass*, *14*(8). https://doi.org/10.1111/spc3.12553

Griffin, A., & Hauser, J. R. (1993). *The Voice of the Customer*. Marketing Science, 12(1), 1–27. https://doi.org/10.1287/mksc.12.1.1

Jarvenpaa, S. L., & Lang, K. R. (2005). *Managing the Paradoxes of Mobile Technology. Information Systems Management*, *22*(4), 7–23.

Kelders, S. M., Kok, R. N., Ossebaard, H. C., & Van Gemert-Pijnen, J. E. (2012). *Persuasive System Design Does Matter: a Systematic Review of Adherence to Web-based Interventions.* Journal of Medical Internet Research, 14(6), e152. https://doi.org/10.2196/jmir.2104

Klintwort, L. (2018). *Blessing or Curse: The Paradoxical Impact of Mobile Health Applications on the Consumer* (Master thesis)

Korinek, E.V., Phatak, S.S., Martin, C.A., Freigoun, M.T., Rivera, D.E., Adams, M.A. and andHekler, E.B. (2018), *"Adaptive step goals and rewards: a longitudinal growth model of daily steps for a smartphone-based walking intervention",* Journal of Behavioral Medicine, Vol. 41 No. 1, pp. 74-86, doi: 10.1007/s10865-017-9878-3.

Lascar, N., Brown, J., Pattison, H., Barnett, A.H., Bailey, C.J. and Bellary, S. (2018), *"Type 2 diabetes in adolescents and young adults"*, The Lancet Diabetes & Endocrinology, Vol. 6 No. 1, pp. 69-80.

Liew, M. S., Zhang, J., See, J., & Ong, Y. L. (2019). *Usability Challenges for Health and Wellness Mobile Apps: Mixed-Methods Study Among mHealth Experts and*

Consumers. JMIR mHealth and uHealth, 7(1), e12160. https://doi.org/10.2196/12160

Maher, J. P., & Conroy, D. E. (2016). *A dual-process model of older adults' sedentary behavior. Health Psychology*, 35(3), 262–272. https://doi.org/10.1037/hea0000300

Maher, C., Ryan, J., Kernot, J., Podsiadly, J. and andKeenihan, S. (2016), *"Social media and applications to health behavior"*, Current Opinion in Psychology, Vol. 9, pp. 50-55, doi: 10.1016/j.copsyc.2015.10.021.

Mercuur, R., Dignum, V., & Jonker, C. M. (2021). *Do habits fade out? Discerning between twotheories using agent-based simulation*. In P. Ahrweiler & M. Neumann (Eds.), Advances in social simulation (pp. 361–374). Springer Proceedings in Complexity

Mick, D. G., & Fournier, S. (1998). *Paradoxes of Technology: Consumer Cognizance, Emotions, and Coping Strategies*. Journal of Consumer Research, 25, 123-143.

Molina, M.D. and Myrick, J.G. (2020), *"The 'how' and 'why' of fitness app use: investigating user motivations to gain insights into the nexus of technology and fitness",* Sport in Society, pp. 1-16.

Myers, M. D., & Myers, M. W. (2013). *Qualitative Research in Business and Management (2nd edition)*. SAGE Publications.

Neal, D. T., Wood, W., & Quinn, J. M. (2006). Habits—A Repeat Performance. Current Directions in Psychological Science, 15(4), 198–202. https://doi.org/10.1111/j.1467-8721.2006.00435.x

Orbell, S., & Verplanken, B. (2010). *The automatic component of habit in health behavior: Habit as cue-contingent automaticity*. Health Psychology, 29(4), 374–383. https://doi.org/10.1037/a0019596

Paluska, S. A., & Schwenk, T. L. (2000). *Physical Activity and Mental Health*. SportsMedicine, 29(3), 167–180. https://doi.org/10.2165/00007256-200029030-00003

Payne, H.E., Lister, C., West, J.H. and Bernhardt, J.M. (2015), *"Behavioral functionality of mobile apps in health interventions: a systematic review of the literature",* JMIR MHealth and Uhealth, Vol. 3 No. 1, p.20, doi: 10.2196/mhealth.3335.

Peterson, N.E., Sirard, J.R., Kulbok, P.A., DeBoer, M.D. and Erickson, J.M. (2018), *"Sedentary behavior and physical activity of young adult university students",* Research in Nursing & Health, Vol. 41 No. 1, pp. 30-38.

Quinn, J. M., Pascoe, A., Wood, W., & Neal, D. T. (2010). *Can't Control Yourself? Monitor Those Bad Habits*. Personality and Social Psychology Bulletin, 36(4), 499–511. https://doi.org/10.1177/0146167209360665

Sharon, T. (2017). *Self-Tracking for Health and the Quantified Self: Re-Articulating Autonomy, Solidarity, and Authenticity in an Age of Personalized Healthcare*. Philosophy and

Technology, 30(1), 93–121. https://doi.org/10.1007/s13347-016-0215-5

Soni, M., Jain, K., & Jajodia, I. (2021). *Mobile health (mHealth) application loyalty in young consumers. Young Consumers*, 22(3), 429-455. https://doi.org/10.1108/yc-10-2020-1236

Stappers, P. J., Guldner, S., & Veelen, J. Van. (2010). *Context Mapping put into practice*. Delft.

Tobias, R. (2009). Changing behavior by memory aids: *A social psychological model of prospective memory and habit development tested with dynamic field data*. Psychological Review, 116(2), 408–438. https://doi.org/10.1037/a0015512

Verplanken, B., Roy, D., & Whitmarsh, L. (2018). *Cracks in the wall: Habit discontinuities as vehicles for behaviour change.* In B. Verplanken (Ed.), The psychology of habit (pp. 189–206).Springer-Verlag.

Walsh, J.C., Corbett, T., Hogan, M., Duggan, J. and Mcnamara, A. (2016), *"An mHealth intervention using a smartphone app to increase walking behavior in young adults: a pilot study"*, JMIR MHealth and Uhealth, Vol. 4 No. 3, p. e109, doi: 10.2196/mhealth.5227.

Wood, W., & Neal, D. T. (2016). *Healthy through habit: Interventions for initiating & maintaining health behavior change.* Behavioral Science & Policy, 2(1), 71–83. https://doi.org/10.1353/bsp.2016.0008