

How can a Health and Fitness Mobile App lead you to a healthier life?

by

Cameron Eackles

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Approved by: 

Greg Walsh, Thesis Advisor


Kathryn Summers (Jul 16, 2020 09:19 EDT)

Kathryn Summers, Committee Member

Abstract

While obesity-related diseases are affecting people around the world, health and fitness mobile apps have been developed in the effort for individuals to lose weight and improve their overall health. Throughout the past few years, many weight loss programs have begun, including coaching support either through one-on-one virtual sessions or by using automated coaching. The purpose of this study was to examine the effectiveness of automated coaching versus no interaction with a coach (human or automated) in mobile health and fitness apps on one's motivation to develop healthy habits. Ten individuals between the age ranges of 18-54 were included in the study. The participants were assigned to two different mobile apps; the Lark app, which provided an automated coach (chatbot), and the Centr app, which does not offer a direct means of coaching support. All participants received weekly surveys for a total of four weeks and were encouraged to submit video diaries. The participants' weight was self-reported in the first and final weeks, along with their physical activity and feedback on the app's features throughout the study. At the end of the study, the amount of overall weight loss was minimal. Among the Lark group, only one participant lost weight. However, four out of the five participants from the Centr group lost weight, one of which lost 11 pounds. Even though the results on the scale varied across the two groups, this study also examined the features of each app, frequency of app use, and coaching to determine the impact on motivation to improve one's healthy habits. Participants provided both positive and negative feedback of the Lark and Centr apps that can be applied to design strategies in the future of health and fitness mobile apps.

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Chapter 1: Introduction

Introduction

Health

According to the Centers for Disease Control and Prevention (CDC) (2017), a person's unhealthy eating habits and lack of physical activity are significant contributing factors for becoming overweight or obese, which is linked to decreased quality of life and increased chances of developing life-threatening diseases like diabetes, several types of cancer, and heart disease. It is imperative that we focus on improving our daily habits to reduce our risk of developing life-threatening, potentially preventable, diseases.

The chances that someone you know is affected by, or at-risk of, an obesity-related illness, such as hypertension, cancer, or diabetes, is staggering. Looking at the population around the world, Graziano da Silva et al. (2019) identified that there are 672 million adults who are obese, which breaks down to 1 in every 8 people. Just as eye-opening, is their discovery of the 338 million children and teenagers who are overweight. This epidemic doesn't only affect adults; it is also impacting the environment in which our kids are growing up.

Understanding how much of our health is dependent on our genetics versus our behaviors is essential. In the past, some people have believed that as long as they don't have a family history of cancer, they have zero or very minimal risk of a diagnosis. The American Cancer Society debunked this misconception "Although our genes influence our risk of cancer, most of the difference in cancer risk between people is due to factors that are not inherited" (n.d.). They confirmed that maintaining a healthy weight, avoiding tobacco, making healthy food choices, and being physically active may significantly reduce one's risk of developing cancer or dying from it. This is vital information because it highlights the control we have over our daily habits in preventing disease and living longer, healthier lives.

One challenge we are facing in the United States is growing healthcare costs. It might be difficult to afford a monthly gym membership or fresh ingredients to cook at home every night. However, it could be significantly harder to deal with medications, higher insurance premiums, a decline in productivity and energy, and lost time at work for ongoing doctor visits.

About half of all American adults—117 million people—have one or more preventable, chronic diseases, many of which are related to poor quality eating patterns and physical inactivity. Rates of these chronic, diet-related diseases continue to rise, and they come not only with increased health risks but also at [a] high cost. In 2008, the medical costs linked to obesity were estimated to be \$147 billion. In 2012, the total estimated cost of diagnosed diabetes was \$245 billion, including \$176 billion in direct medical costs and \$69 billion in decreased productivity (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015).

Technology Interventions

Mobile apps might be an inexpensive solution, not only in the United States but all over the world. According to Turner (2019), there are 3.3 billion smartphone users globally today. This shows an incredible opportunity to provide health and wellness guidance to others.

Everett, Kane, Yoo, Dobs, and Mathioudakis (2018) believed that mobile health apps could deliver diabetes prevention programs in a feasible and cost-efficient manner. Several researchers have also evaluated smartphone apps and their impact on increasing healthy lifestyle behaviors (Direito, Jiang, Whittaker, & Maddison, 2015; Schoeppe et al., 2016). Their main objectives were slightly different; one primarily focused on increasing physical activity in teens, and the other evaluated interventions to improve diet, physical activity, and sedentary behavior. However, they came to similar conclusions, providing tailored features to the mobile app user, and identifying the most effective behavior change techniques are fundamental for initial engagement and sustained use of the app.

This thesis aspires to provide solutions to global health issues through mobile health and fitness apps by answering the following questions; **how are two different apps using behavioral techniques?** and **will artificial intelligence help users improve their daily habits?**

The following chapters will explore how others have investigated healthy and unhealthy lifestyle behaviors, behavior change techniques, mobile health and fitness apps, human coaches and coaching with artificial intelligence, and proposed solutions for achieving healthy lifestyle goals. Using video diaries and surveys, I will then research the habits of health and fitness app

users, as well as the features between two apps. I hope to identify if these types of apps can help one live a healthier lifestyle.

Chapter 2: Behavior and Mobile Technology

Behavior and Mobile Technology

Calories

Consuming the right amount of calories is crucial in achieving and maintaining a healthy weight. The Dietary Guidelines for Americans highlighted the importance of acquiring a balance of calories consumed from food/drinks and calories burned from physical activity. They proposed “to determine whether an eating pattern is at an appropriate number of calories is to monitor body weight and adjust calorie intake and expenditure in physical activity based on changes in weight over time” (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015, p.20). Managing this calorie balance equation will allow one to lose weight and keep it off.

Eating Patterns

In a recent analysis of eating patterns across 195 countries, Afshin-Murray et al. (2019) provided evidence connecting poor eating habits to a variety of chronic diseases. They concluded that 1 in every 5 deaths could be prevented by improving one’s diet. Among the highest risk factors were diets high in sodium, low in whole grains, and low in fruits, accounting for over 50 percent of deaths around the world.

Focusing on the United States, most people consume over the recommended amounts of saturated fat, sodium, and added sugars, while 75% are not eating enough vegetables, fruits, [healthy] oils, and dairy (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015). There’s no disputing that most of us need to make healthier eating choices. By doing so, we might not only achieve a healthy weight, but also meet our nutritional needs, reduce our chances of developing preventable diseases, and improve our overall health.

Physical Activity

Physical activity is defined by the World Health Organization (WHO) (2018) as muscle movement that requires energy expenditure, including activities during household chores, work, recreation, and travel. They recommend that adults achieve at least 150 minutes of moderate-intensity physical activity (MVPA) throughout the week. That breaks down to about 22 minutes

a day of moderate movement, yet they reported that 25% of adults and over 80% of teenagers in the world are not achieving enough activity.

WHO offers a list of benefits from consistently achieving satisfactory amounts of physical activity, such as reducing the risk of falls and fractures; improving bone and functional health; reducing the risk of developing diabetes, hypertension, coronary heart disease, different types of cancer, stroke, and depression. Adequate physical activity is vital in achieving energy balance and maintaining a healthy weight (World Health Organization 2018). While many people are not meeting the minimum amount of physical activity, it's important to identify potential factors that may be preventing this.

A lack of physical activity may be due to recent life events, such as changes in one's family dynamic, accepting a telecommuting or desk position, or moving to an area that lacks recreation centers and parks. A shortage of sidewalks and cycling paths, high crime areas, or cost-efficiency of public transportation may also be contributors to sedentary behavior. Finding ways to overcome these barriers by incorporating physical activity into our day is crucial in our quest to improve our health.

According to a study of over 650,000 people led by Moore et al., leisure-time activities (e.g., sports, exercise, walking) were associated with longer life expectancy, regardless of one's weight (as cited in National Institutes of Health, 2012). They determined that even 10 minutes of daily activity was linked to 2 years of longer life expectancy, and 45 minutes of daily activity was linked to a gain of 4 additional years of life. However, individuals that were obese and not physically active lost 7 years of life expectancy compared to active individuals at a healthy weight. Regardless of the numbers on the scale, achieving daily physical activity is imperative in living a longer life.

But, what if the individual spends much of their day sitting but is very active during their free time? A study of over 240,000 people by Matthews et al., showed sitting for prolonged periods impacted one's lifespan, even with consistent exercise (as cited in National Institutes of Health, 2012). Matthews noted, "even those who were exercising a lot, [7 or more hours a week], had an elevated risk for death from all causes or from cardiovascular disease if they also watched a large amount of TV, [more than 7 hours daily]. It suggests that a substantial amount of exercise may not always protect against the adverse effects of prolonged sitting." The solution seems

simple; we should try to sit less, stand up frequently, move around throughout the day, and plan enjoyable physical activities into each week.

Stamatakis-Ding et al. (2019) conducted a study of over 150,000 people to evaluate the links between sedentary behavior, physical activity, and deaths from cardiovascular disease, and to discover the level of physical activity needed to offset health risks from sitting. The results concluded that achieving around 20-40 minutes of daily MVPA (e.g., cycling, brisk walking, raking the yard), eliminated most health risks related to sitting. In comparison to Matthews and Moore, they determined a reduction in sitting time and an increase in physical activity is paramount in reducing one's risk of developing cardiovascular disease, and that any movement was beneficial but replacing sitting with daily walking and vigorous physical activity led to the most significant reduction in risk.

This confirms that we can live healthier lives by sitting less, walking more, and completing high-intensity activities. However, the lack of time may still be a strong barrier for many people. Peterson (2019) pointed out that activity can be done in increments throughout the day to produce the same health benefits. Noting the most beneficial impacts on health were observed in individuals that changed their sedentary behaviors to becoming moderately active. He agreed that MVPA should be achieved throughout the week, but attested that being active only once or twice a week is better than none. Some movement is always better than no movement.

The U.S. Department of Health and Human Services came to a similar realization in 2018. They updated the Physical Activity Guidelines for Americans after reviewing multiple studies that any amount of physical activity provides benefits to one's health, improves sleep quality, reduces anxiety, improves insulin sensitivity, and lowers blood pressure.

Knowing what is necessary to eliminate these health risks is half the battle, following through with it is a whole different story. Robinson, Segal, and Smith highlighted the struggles many of us face, “you already know there are many great reasons to exercise—from improving energy, mood, sleep, and health to reducing anxiety, stress, and depression... [and workout plans...] are just a click away. But if knowing how and why to exercise was enough, we'd all be in shape. Making exercise a habit takes more; you need the right mindset and a smart approach” (Robinson, Segal, & Smith, 2019). Just as it took time for us to develop an unhealthy habit like

sitting in front of the TV instead of walking around the block after dinner, developing a new healthy habit takes time and repetition. Of course, we can become frustrated when we don't see results quickly, experience a decrease in motivation, or a lack of self-confidence in getting started, all of which can all hinder our success. Turning exercise into a habit means incorporating activities you enjoy, staying positive, and sticking with it.

Combining Physical Activity with Nutrition

Since we know that developing healthier eating takes just as much time and effort, let's examine how these two habits can work together. Spring et al. (2012) attempted to determine which combination of eating and physical activity recommendations would maximize healthy changes including 1) decreased fat intake and decreased sedentary behavior, 2) decreased fat intake and increased physical activity, 3) increased fruits/vegetable intake and decreased sedentary behavior, and 4) increased fruits/vegetable intake and increased physical activity. They observed an increase in fruits and vegetables, and a decrease in sedentary activities maximized healthy lifestyle changes over all other interventions. It was also the first study to provide evidence that a reduction in screen time led to decreased fat intake. This provides a clear path to weight loss by limiting our TV time and incorporating fruits and vegetables every day. Next, let's look into the basis for developing a habit—behavior change.

Behavior Change Techniques

Webb, Joseph, Yardley, and Michie (2010) defined behavior change techniques (BCTs) as “specific strategies used in the intervention to promote behavior change.” For example, someone who suffers from emotional eating could monitor their feelings, triggers, and eating to learn how to develop healthier eating habits. Someone who is having difficulty staying motivated to exercise could receive daily reminders to go on a walk and get positive feedback for accomplishing their step goal.

BCTs in Mobile Apps

Michie et al. (2009) assessed BCTs designed to increase healthy eating and physical activity. They focused on techniques that actively engaged the user throughout the behavior change process, rather than ones that only provided advice or information to the user. They found clear support for; 1) prompting of goal setting, 2) specified goals with actions, 3) self-monitoring of behavior, 4) providing feedback on performance, and 5) reviewing past goals; to

promote healthy eating and physical activity. This is noteworthy as we will see multiple researchers experienced similar findings, providing us reasoning to investigate these BCTs, among others.

Chen, Cade, and Allman-Farinelli (2015) investigated 28 mobile apps to determine the BCTs used. Out of a list of 26 BCTs, they found less than a quarter of BCTs were included in the apps, and 93% of the apps integrated less than half of the BCTs. Middelweerd et al. (2014) had a similar eye-opening discovery with a larger review of 64 apps, as an average of 5 BCTs were used, and none of the apps used more than 8. While they concluded that at least 2 BCTs were used in each app, which suggested the mobile app developers attempted to create opportunities for change, they highlighted the inclusion of established BCTs were far from ideal among most mobile apps.

Make Exercise and Healthy Eating a Habit

Sullivan and Lachman (2017) identified primary BCTs that can be extremely helpful in achieving an increase in physical activity and healthy behaviors such as self-monitoring, goal-setting, rewards, feedback, social support, and coaching. Robinson et al. (2019) pointed out 4 keys to making exercise a habit that sticks: 1) set small goals and build on the momentum, 2) use triggers [reminders] to make it automatic, 3) reward yourself after completing short term goals, and 4) choose activities that you enjoy and feel confident doing. They continued to offer tips like pairing exercise with enjoyable activities (like watching your favorite shows while walking on the treadmill), tracking your workouts to build confidence as you see your progress, and adding a social component such as inviting friends to a dance class or joining an online fitness community for competition, accountability, and support. As we can see, this is strongly related to the most efficient BCTs identified by Sullivan and Lachman. Let's look closer at those techniques.

Goal-Setting. Setting small goals is the key to building healthy habits. However, it's important to not set too many goals at once or goals that are too difficult to achieve in that time period. For example, if you want to become a mountain climber, but have no prior experience hiking, setting a goal to climb K2 in the next six months is unrealistic. However, aiming to tackle the Lassen Peak Trail Hike, Mount Fuji, or Pikes Peak in a year is very doable. By setting smaller goals like walking daily and hiking a different trail each week, you will be able to focus on the short-term steps to get you closer to the ideal outcome.

Since we know how easily it can be to become distracted or discouraged from achieving our goals, we must ensure the apps provide ample opportunities to build our motivation. While examining whether BCTs in mobile apps encourage physical activity, Stuckey, Carter, and Knight (2017) discovered that many apps included predetermined goals such as hitting 10,000 steps a day. They believed that goals lacking personalization decreased one's motivation to achieve their goals. By providing the ability for users to choose different goals (e.g., fitness class, water intake goal, steps per day, calories intake, daily vegetable goal), customize the listed goals, or even better, the ability to create our own, we will improve our chances at building healthier habits.

Munson and Consolvo (2012) examined goal-setting, self-monitoring, sharing [support through social networks], and primary and secondary goals. They explained that primary goals are something the individual believes is already part of their weekly routine, while a secondary goal is more of a challenge or a stretch to accomplish. Keeping goals small, easy enough to achieve, while slightly challenging will help build one's self-confidence after following through and accomplishing them. This also builds motivation to continue pushing forward when barriers or self-doubt arises, as you can look back at how far you have come thus far and the efforts you are making daily towards a healthier you.

Self-Monitoring/Tracking. Some may argue that tracking (i.e., self-monitoring) is difficult to learn and to keep up with. After all, we are busy people, right? Nevertheless, if it can lead to increased awareness of what and how much we are eating, how much activity we are getting, then we can improve our daily habits. By tracking our habits and weekly goals, we are able to focus not on the barriers we face, but on the progress and successes we have.

Several researchers have examined the potential benefits as well as the possible negative implications of tracking. Chin et al. (2016) and Michaelides et al. (2016) discovered consistent monitoring of one's weight and diet (as well as exercises in Chin's study) as the primary indicator of weight loss. Noteworthy, Chin found the most crucial factor in weight maintenance or weight loss was the frequency of tracking dinner. This is key to the impact tracking has on our daily eating habits.

Stuckey et al. (2017) believed that using self-monitoring as the sole intervention is likely to fail in effectively changing behavior. They noted the importance of reinforcement [rewards]

and stressed utilizing both self-monitoring and reinforcement would evoke the most significant change in behavior. Similarly, Michie et al. (2009) determined that including self-monitoring with other BCTs is more likely to heighten the effectiveness of interventions designed to promote healthy behaviors.

Controversy to the significant evidence that supports tracking, participants of the 2019 study by Honary et al. described an obsession with tracking that can lead to an increase in unhealthy behaviors. When they went over their calorie intake goal, they had feelings of guilt or failure, which often resulted in excessive exercise and overly restrictive eating. Results like these confirm that we must be cautious to not solely focus on the numbers (e.g., specific weight, calories burned, or our calorie intake goal). Instead, we should focus on becoming more aware of our current calories, our specific dietary and fitness needs, and learn how to develop healthier eating and exercise habits.

Reminders. Being able to remember all of our daily obligations can pose another challenge for many of us. As mobile app creators are working on developing user-friendly apps, receiving reminders to sit less, exercise, track meals, or even to drink water seem to be a desired feature. Participants in Munson and Consolvo's 2012 study stated that, while keeping a journal was helpful, they would have likely been unable to continue that habit without the reminders they received.

Cowan et al. (2012) studied apps that included BCTs, including reminders/notifications to exercise. They defined reminders as visual cues to take action. Unfortunately, they found that only 19% of the apps included these important cues. A few years later, Wang et al. (2017) determined that using only prompts via desktop did not significantly reduce sedentary behavior, but when combined with an educational video, the reminders did significantly impact these behaviors. This is important as it supports prior research that using only one BCT is not enough to impact behavior change.

Personalized Feedback. We all strive for that “attaboy” from others. Whether it is after we track all of our meals for a month, lose 10 pounds, or run a half-marathon. But we want it to feel personalized, not just some canned automated response. Everett was aware of this need as they created Sweetech, an artificial intelligence-based app that applied the user's data into insights for personalized responses (2018).

Middelweerd et al. (2014) noted that self-monitoring and feedback were the most frequently used BCTs. This provides proof that these techniques are not simply put into an app because developers think it might generate more users, but that they are actually desired features.

Sullivan and Lachman (2017) came to a similar conclusion as they explained that feedback from a mobile app can actually be more personalized and received more often than advice than from one's physician or personal trainer. They also demonstrated that this leads to an increase in exercise and self-monitoring of one's physical activities, thereby increasing motivation and self-efficacy.

Social Support. As we work towards a healthier lifestyle, it's important to connect with others. Sharing your goals with those around you can help keep you accountable and increase your motivation to continue pushing forward. It also creates an opportunity for you to motivate and inspire others by sharing your journey. For example, maybe you could organize a weight loss challenge with your coworkers, plan and cook meals with your spouse, or attend yoga classes with friends.

Of course, not everyone will be ready to make healthier lifestyle changes, or they may be unavailable to provide support due to their own circumstances. That is okay. A supportive network does not have to be people you already know well or even at all yet. Robinson et al. (2019) recognized the importance of social support, as he recommended we all “harness the power of the community”, and how it provides an opportunity to not only socialize but also keep you motivated to stick with it. Sites like Facebook (<https://www.facebook.com>), Strava (<https://www.strava.com>), or MyFitnessPal (<https://www.myfitnesspal.com>) have made joining a community an option available to anyone around the world with internet access.

The overuse of social media can cause a number of issues. It can limit our ‘real’ conversations as we give a quick emoji instead of calling or talking in person. You can lose track of time from the never-ending scroll of new posts or find yourself distracted by the screen and not fully present around friends and family.

However, when used in moderation, social media can help us create connections with people outside of our immediate area, be more physically active by joining virtual workout groups, and we might even inspire others through sharing the obstacles we've experienced and the goals we've achieved. In fact, a study published in 2019 by Petersen, Prichard, and Kemps

was proof of that. They discovered fitness apps that provided a public Facebook page or a link to Facebook demonstrated an increase in physical activities and increased user engagement.

It may feel contradictory to use technology to become more active and present, but we need to establish healthy, supportive relationships all around us. That includes on and off of the internet. Mobile apps can help us achieve our personal and professional goals. I believe that Eyal (2015) summed it up best, “we can use habit-forming technology to help people live happier, healthier, more connected, more productive lives. Truly we can use habits for good.”

Weight Loss Programs

For decades, programs like WW (formerly named Weight Watchers), Nutrisystem, and Jenny Craig have been around to help people lose weight and get in shape. Parkman (2020) of the Consumer Affairs research team compared meal plan options, prices, and weight loss results of these three popular programs. WW provided the most freedom as it can be customized for those with dietary limitations such as gluten-free or vegan. However, while it allows for more flexibility, this means it also requires more planning and preparation of each dish. Nutrisystem takes the guesswork out of the equation, likely the reason it ranked as the most popular. They deliver portioned meals, offer a try-before-you-buy option, and hold higher ratings in both taste and quality over other home-delivery meals. Although Jenny Craig is more expensive than the other two programs, starting around \$450 a month for the meals alone, it was ranked as the most convenient. That is likely due to their variety of personalized support as the program includes individualized meal and exercise plans, home-delivery of portion-controlled meals, and one-on-one coaching sessions.

In recent years, programs like Real Appeal and Noom have joined the movement. Real Appeal (2020) is an online weight loss program offered at no cost through certain health plan coverages. They provide customizable workouts and meal plans, food and activity tracker, and support through weekly group meetings and one-on-one coaching. They also send their members a success kit that includes additional resources like workout DVDs, a bodyweight scale, a portion plate, and a food scale for participating in the program (as cited in Real Appeal, 2020). Noom also offers similar features, such as weekly group meetings, one-on-one coaching, personalized plans, and tracking (London et al., 2019). However, Noom, like most weight loss programs, has a

monthly subscription fee. So there are no free tools or added support included with Noom, regardless of one's health plan benefits.

The common theme amongst all of these programs is to lose weight and keep it off by building healthy habits. While each weight loss program may vary in regards to the meal plans, workouts, weight loss tools, or resources, they all offer a support component that regular health and fitness apps do not, wellness coaching. To dive deeper into the current market, we need to explore the different types of coaching interventions used and why they may be helpful.

Human-Based Interventions

In their research of apps that promote physical activity, Direito et al. (2015) recognized very few studies have solely utilized a mobile app-based route to provide interventions [BCTs]. Most include several elements like group classes, one-on-one meetings with the coach, a desktop version/website, and step trackers. That makes it extremely difficult to decipher which precise elements contribute to weight loss or behavior changes.

While researching interventions used in virtual weight loss and diabetes prevention programs, Everett et al. (2018) noticed that most provide a heavy emphasis on human-based coaches. However, they pointed out how relying on human coaches can hinder long-term commitment to a program as it requires significant financial costs from professional coach training in addition to the time commitment from both the coaches and members. Thus, limiting the appeal of the program and use of the app. Tanaka et al. (2018) came to a similar discovery as these standard programs typically require face-to-face meetings, which are costly and time-consuming. A significant part of deciding whether or not to join a weight loss program for many people is a lack of time or high program/membership fees or both.

In 2012, Spring et al. utilized human coaching in a remote environment while allowing participants to reach out on their own time as needed. The coaches set personalized strategies for the participants by reviewing their eating and exercise behaviors. For instance, individuals asked to limit their fat intake were shown the foods they regularly ate that contained high amounts of saturated fat, then the coaches would provide support in decreasing their frequency or portion sizes of those items. The participants were able to contact their coaches (phone or email) to overcome any barriers they faced throughout the study. This illustrates that behavior change can occur when users are able to reach out to their coaches, even with minimal communication.

Everyone could benefit by using more time-and-cost-efficient methods, including the wellness program owners, app creators, and program members/app users. The coaches would also benefit as they could connect with their members on the app through a chat feature as opposed to scheduled face-to-face and group meetings.

Of course, there are numerous apps on the market that offer previously recorded wellness videos with human-instructors, social media groups, and/or specific online group challenges, without any required coaching sessions. One of the newest apps in this realm is Centr, which was created by Chris Hemsworth, along with his team of personal trainers, chefs, wellbeing specialists (Windsor, 2019). The app includes workout videos, recipes with customizable shopping lists, meditation recordings, blogs about wellness, as well as the ability to connect with the team and with other members on their private Facebook page. Accessing these features around your schedule and ensuring you have support available may provide a helpful solution as you work towards developing healthier habits.

Coaching with Artificial Intelligence

While we know that Everett et al. (2018) took notice of the downsides to human coaching, they decided to create an artificially intelligent (A.I.) app that was personalized to each user. They gathered insight into the participants' lifestyle, routines, and habits through advanced algorithms and provided personalized recommendations with minimal user engagement. For example, it would send a push notification to encourage the participant to exercise when they had nothing scheduled on their calendar or suggest a particular physical activity given their current location, such as a walk at the nearby park. They were able to provide evidence that their A.I. coaching method led to weight loss and decreased A1C (blood glucose test for diabetics and prediabetics).

Looking into other apps that provide A.I. coaching, Kleinman (2017) reviewed the Lark app, which provides the user with an automated wellness coach. Lark was developed by a collaborative team of experts in fitness, sleep, nutrition, and behavioral change. The user is able to chat with the A.I. coach about their daily eating, exercise, and sleep, and they receive instantaneous positive feedback or recommendations for healthier habits. This seems particularly useful as the user can check in with their A.I. coach at any hour, saving time and hassle of scheduling and meeting face-to-face with a human.

Bardus, Ali, Demachkieh, and Hamadeh (2019) assessed the quality and user engagement of six weight management apps, My Diet Diary, MyFitnessPal, Spark People, Lark, My Diet Coach, and My Plate. While the features and interventions used in each app differed, they found participants who were obese considered Lark and My Plate as higher quality and more engaging. The techniques included in Lark could promote long-term app use, and would likely lead to weight loss, weight maintenance, and healthy behaviors.

Where to go from here

We all know how quickly the technology industry grows, and as we have discussed from past research, we understand what has worked and what hasn't thus far. Stuckey et al. (2017) highlighted that mobile apps provide a solution for developing healthier behaviors as they allow for a portable way to utilize the most effective BCTs, such as tracking and positive feedback.

Middelweerd et al. (2014) and Sullivan and Lachman (2017) agreed that the development of apps with several BCTs should be created from a partnership between specialists of various fields, [e.g., behaviorists, mobile app developers, and health care professions]. This will likely result in effective long-term behavior change. Piette et al. (2015) suggested further research and development of technologies that focus on addressing global health issues and utilizes advances in A.I. and behavior theory. Being aware of these advances, incorporating BCTs, and collaborating with multiple professionals will allow for improved health and fitness apps.

The following sections will include details of my research that may be applied to the design of future health and fitness apps. I have reviewed academic research outcomes, practical strategies, and examples from the technology field to create a thorough picture. The intent was to have a better understanding of previous research so I can include those findings into my studies and help narrow the scope for the design of future applications. The aim of my research was not solely to recognize successful strategies from past findings but also to highlight elements that should be examined independently. For example, to determine the impact of using BCTs in apps to develop habits and the differences of human-led programs versus A.I. coaching.

The findings on our current global health, mobile health technology, eating and exercise habits, behavior change, and methods of coaching align with my target audience of people who are currently interested in losing weight and establishing healthier habits. My study focused on two separate health and fitness apps that offer opportunities for one to achieve these goals, both

created by a team of professionals, while each provided various BCTs and differing coaching approaches. 1) Centr: a personalized program offering daily workouts, meal plans, meditations, and articles, and a private social media group and 2) Lark: an A.I. based program offering personalized weight loss plans, and automated coaching of one's sleep, exercise, and nutrition behaviors (Figure 1). The purpose of further research was to look closely at these apps to determine the impact of having an A.I. coach to provide analysis and feedback of behaviors versus using a customizable daily plan with the availability of human support.

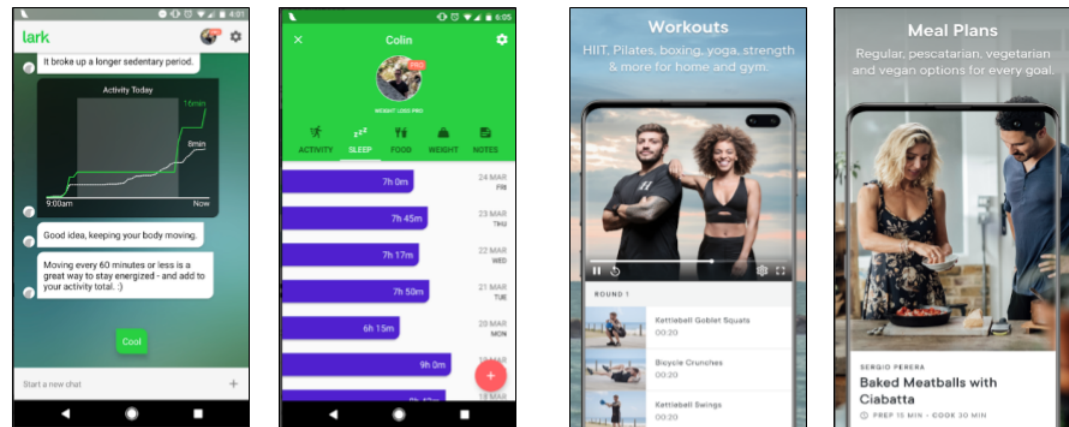


Figure 1. Lark and Centr Screenshots. Note: Left: Lark, Right: Centr, Images from Google Play

Chapter 3: Research Methods

Research Methods

Two research methods were used to investigate the coaching methods; video diaries and surveys. This would lead to a better understanding of the user experiences and the impact of different coaching methods on the development of healthier habits.

Participants

For the surveys and video diaries, a total of 10 individuals participated. Six adults (all female, equal distribution between 25-34, 35-44, and 45-54) were employees of Rally Health, (a health and fitness digital platform), recruited in company channels. Four adults (2 males of the age ranges 18-24 and 25-34, and 2 females between 25-34 and 35-44) were recruited through referrals of an interested individual and prior connections via email (Table 1).

Individuals under 18 years of age, nursing, pregnant, or trying for conception, unable to perform exercise due to medical conditions, or those listed as underweight on the Body Mass Index (BMI) chart, were excluded based on potential physical activity engagement and possible weight loss through the mobile application programs. Inclusion criteria were individuals over the age of 18, owned a smartphone with working audio and camera functions, able to engage in physical activity, and able to lose weight were included. The recruitment message included an overview of these inclusions and exclusions (Appendix A).

After individuals expressed interest, they completed a screener survey (Appendix B), created on Google Forms, which included the questions regarding inclusion/exclusion criteria, demographics, technology requirements, last use of a similar health & fitness app, and desired app features. Additionally, the individuals were asked their preferred email addresses, so the researcher and participant could communicate throughout the study for participation instructions, survey reminders, and follow-up or additional questions.

Table 1

Participant Demographics and Recruitment Method

Participant	Age Range	Gender	Weight	Height	Last Use Similar App	Recruitment Method
P1	35-44	F	181	5'7	Last 30 days	Company
P2	35-44	F	165	5'2	Last 30 days	Connection/email
P3	25-34	F	225	5'5	Last 30 days	Company
P4	35-44	F	206	5'4	Last 30 days	Company
P5	25-34	M	170	5'7	Last 30 days	Referral
P6	25-34	F	136	5'2	Last 30 days	Company
P7	18-24	M	235	6'1	2-4 Months	Connection/email
P8	45-54	F	132	5'2	Last 30 days	Company
P9	45-54	F	166	5'6	Last 30 days	Company
P10	25-34	F	136	5'1	Last 30 days	Referral

Note: 15 individuals initially expressed interest in participation. However, three did not sign the consent form, and two voluntarily withdrew after signing consent due to a medical issue and a family situation. Therefore, the withdrawn individuals are excluded, and a total of ten participants were included in all data analysis.

After reading and signing the consent form (Appendix C), the participants were randomly assigned to one of the two apps; Lark or Centr. Participants were encouraged to log into the app at least once a day for the duration of the study.

Both of the apps used offered a 7-day-free-trial then a monthly payment of \$19.99. Participants were compensated \$20 for reimbursement of the mobile app cost for one-month participation. Participants were informed that should the study expand past the 7-day-free-trial and one-month participation (e.g., participation for 44 days), they would receive reimbursement for a second month, totaling no more than \$40. The participants were informed before downloading that if they voluntarily withdrew from the research before completion, but after occurring the one-month app fee, they would still receive one \$20 gift card.

Materials

The weekly surveys were created using Survey Monkey and were sent to the email provided by each participant. The video diaries logged were the participants' chosen method of recording or screen capturing, then shared via email.

Design

The experiment used a between-subject design. The independent variables were the coaching method: interactions with an automated coach versus no interaction with a coach (human or automated), and the dependent variables were physical activity and motivation levels.

Procedure

The surveys and video diaries were implemented throughout four weeks. Participants received a brief survey, each approximately ten questions, at the end of every week (Appendix D). Each participant was asked to complete a video diary using their smartphone during their first use of the app. They were also encouraged to continue monitoring for the first week of use via video diaries or screenshots with notes. Four participants submitted several diaries, including first initial use and throughout the study, while one participant submitted screenshots with notes.

Week 1. One week after downloading the app, participants received the first survey via Survey Monkey. In this survey, the questions inquired about the user's current habits to establish a baseline, their motivation level since exploring the app, and their thoughts on human versus automated interactions. For example, *"When you are using an app or a website, how important is it to you to converse with a real person (i.e., not an automated chatbot)?"*

Week 2. At the end of their second week in the study, the participants received their next survey. Fogg, B.J. (May 2002) researched over 4,500 individuals to outline the ten guidelines for building the credibility of a website and proved that sites appear more credible if they are useful and easy to use. Therefore, this survey asked questions such as *"How engaging is the design?"*, *"I can easily track my progress"*, and *"I can customize my workouts based on my fitness goals"*. This survey also inquired about the participants' habits and motivation levels since using the app in the previous week.

Week 3. In the 3rd survey, the questions were focused primarily on the participants' thoughts toward the app features, cost, and comparison to similar apps. For example, *"What do you like most about the app"*, *"What do you like least about the app"*, and *"Do you think the monthly subscription fee for this app is too cheap, too expensive, or about right?"*.

Week 4. The questions in the final week of the study were to determine any potential change in the participants' habits and motivation to make healthier choices. For example, *"Since using the app, how did you feel about your motivation to make healthier choices? (e.g. more*

physically active, smaller portions, less fried foods, etc.)”. Additional questions were to identify the likelihood for the participant to recommend their assigned app to gain insight into their overall experience, and self-reporting of their weight to measure any potential weight loss.

Chapter 4: Results

Results

In this chapter, the results from surveys and video diaries are presented. For organizational purposes, the survey results are broken down by specific categories such as the participants' daily habits, any changes in weight, and feedback, suggestions, and ratings of the app.

Survey Results

Desired features. During the screener survey, participants were asked, “Which of the following features would you want in a health & fitness app?”. Nine out of ten participants selected Customizable Goals, while eight out of ten selected Food Tracking, Sleep Analysis, and Stress Relief Tips/Meditations (Figure 2). Three participants provided additional features including, measurement tracking, team/friend competitions, and meal options that do not contain gluten, dairy, or nuts/seeds.

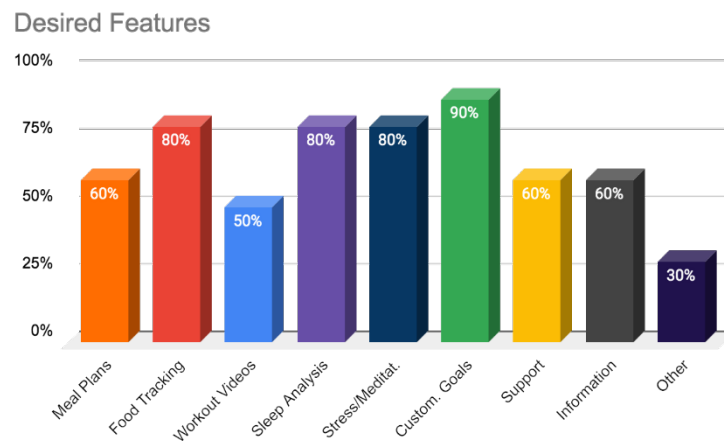


Figure 2. Desired Features in a Health and Fitness app.

Human Connections versus Chatbots. In Survey 1, sent one week after downloading their app, participants were asked, “When you are using a website or an app, how important is it to you to converse with a real person (i.e., not an automated chatbot)?”. As we can see in Figure 3, one participant selected it was extremely important, while four participants stated that it is somewhat important.

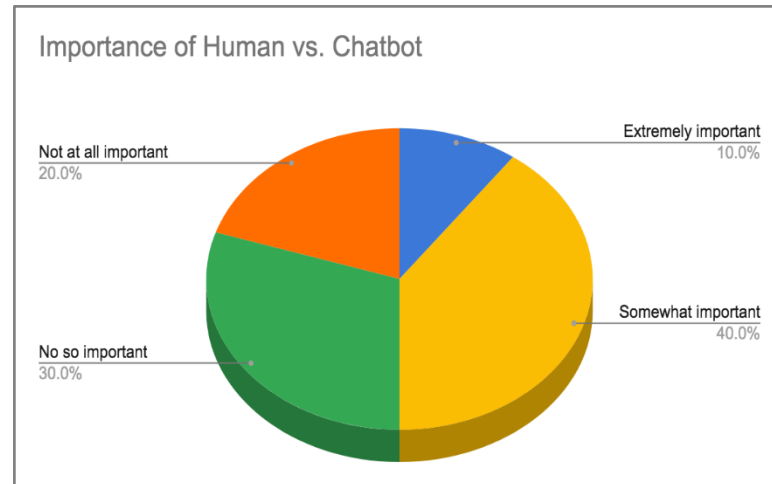


Figure 3. Importance of Human Interactions Versus Chatbot.

Ease of Use versus Need. In Survey 1, participants were asked, “How easy is it to understand the information on the app?”. Figure 4 shows that the Lark and Centr app users provided equal responses for somewhat, very, or extremely easy. However, when asked, “How well does this app meet your needs?” the Centr app met the user’s needs more than Lark (Figure 5).

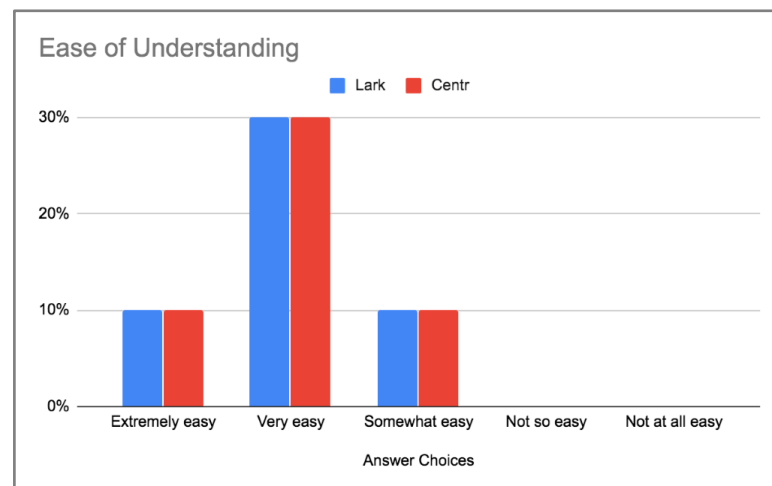
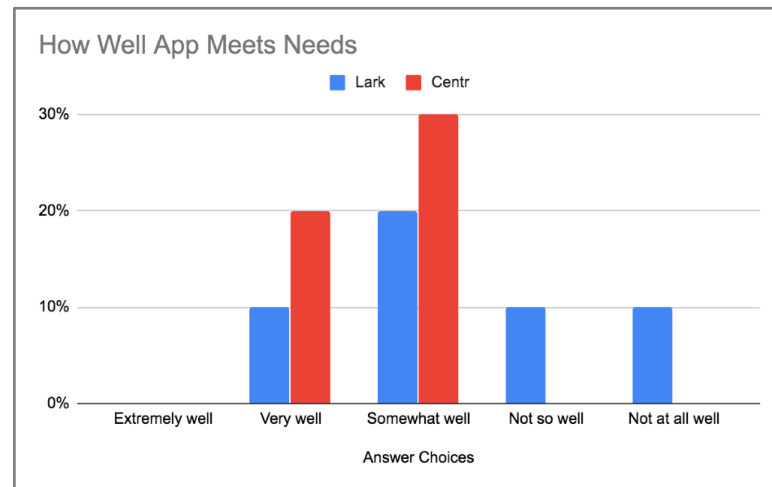
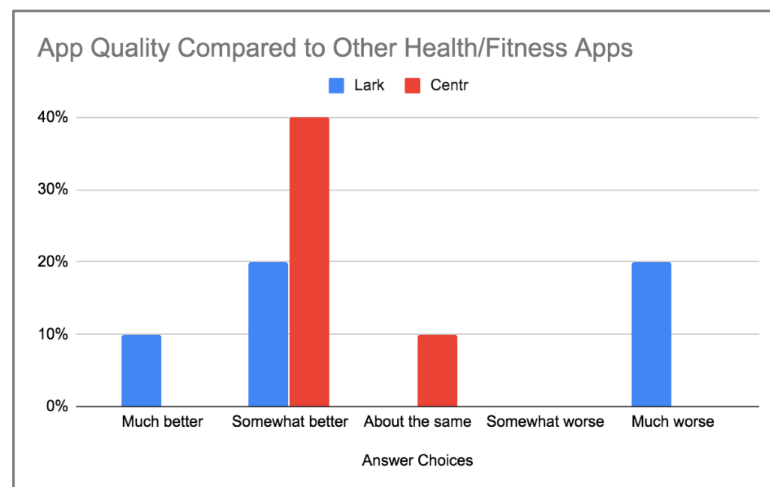


Figure 4. Ease of Understanding.*Figure 5. Does App Meet User Needs.*

During Survey 2, responding to the question, “*Compared to other health and fitness apps, is the quality of this app better, worse, or about the same?*” 40% of Centr users found that the app’s quality was somewhat better than others. Among the Lark group, 10% reported that the app’s quality was somewhat better, and 20% found it was much worse. (Figure 6).

*Figure 6. App Quality Compared to Similar Apps.*

The following question was asked, “*How engaging is the design?*”. As seen in Figure 7, one participant felt the Lark app was not at all engaging. Six participants, three from each group, selected the app’s design was either very or extremely engaging.

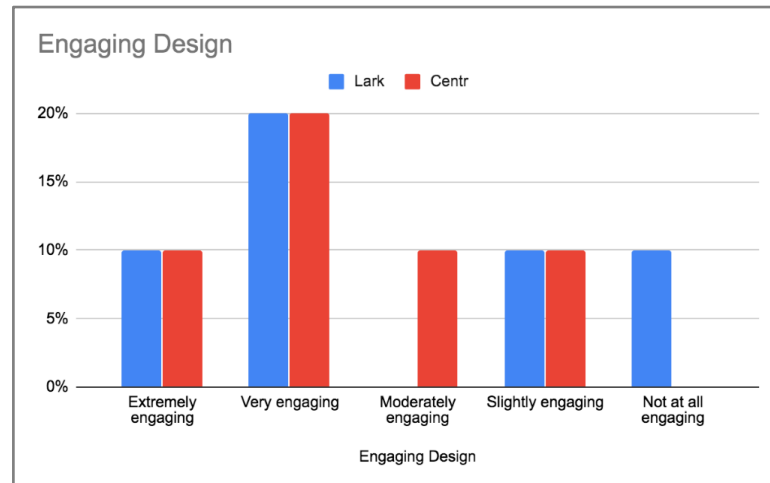


Figure 7. Engaging Design of the App.

In Figure 8, we see that three Centr participants disagreed that they can easily track their progress, and two participants agreed. Lark participants were split between Disagree, Agree, and Strongly Agree.

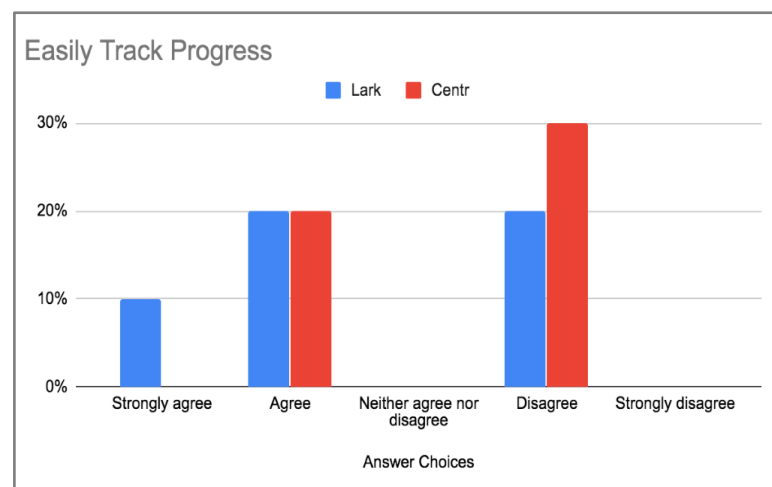


Figure 8. Ability to Track Progress.

Participants were asked about the monthly cost during Survey 3, “*Do you think the monthly subscription fee for this app is too cheap, too expensive, or about right?*”. Participants in both groups felt the app was either slightly, somewhat, or much too expensive (Figure 9).

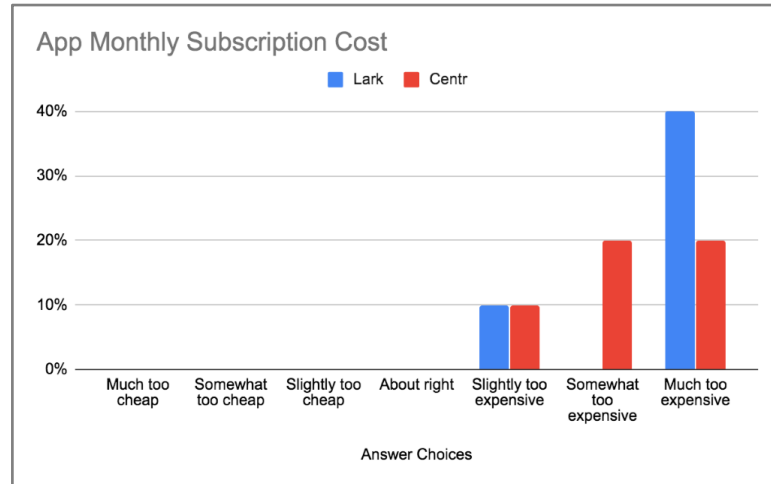


Figure 9. App Monthly Subscription Cost.

During Survey 3, participants were asked, “What do you like most about the app?”, three out of the five participants in the Lark group selected Design (Figure 10). When asked if they would like to expand on this question, two of the participants did so;

“I like the chatbot” -P4

“I like the stats they give you on your norms and averages” -P2

Of the Centr participants, four were split evenly between Design and Content as what they liked most, and one participant chose Features.

“I like that the app includes daily meditation as a goal” -P3

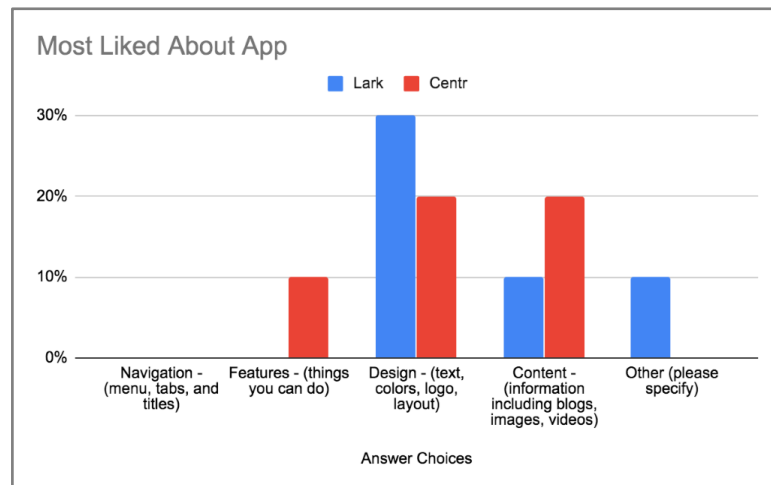


Figure 10. Most Liked About Assigned App.

When asked, *“What do you like least about the app?”* three of the Lark participants selected Features as what they liked least (Figure 11).

“I dislike how slow the text messages come through for Lark. I also think \$20 a month is pretty high”-P2.

“To elaborate on the answer to question #1: [I can customize my meal plan and/or recipes in the app - Participant selected Strongly Disagree] - “you can only input food on the paid version of the app, same with weight...which I think is kind of ridiculous” -P4

One Lark participant selected Navigation as what they liked least but shared additional feedback about an issue with the food tracker. *“People like the ease of tracking food without the calories. Anyone who has used a calorie tracker in the past might find this annoying. I do understand that it’s done for the purpose of behavioral change, not to have anyone feel shame for going over calories. It’s about being mindful of what is consumed”* -P8.

In the Centr group, four participants were divided between Navigation and the Other option. *“Doesn’t motivate as much as other fitness apps”* -P5.

“[There’s] no way to calculate individual caloric/food needs. (Participant shared additional feedback) The Intermediate workouts, specifically the Yoga, was far advanced. The other intermediate workouts gave options to adjust. However, they are definitely all created for those that are already familiar with working out. This is an app for those that [already] know how to work out and want guidance/a push” -P9

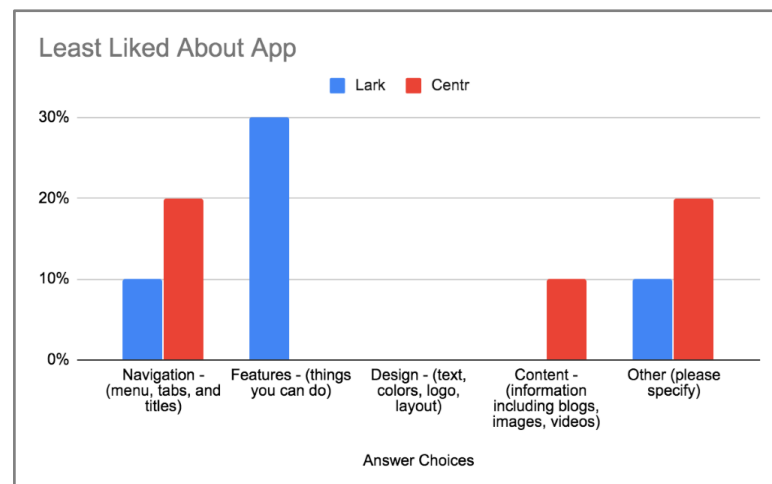


Figure 11. Least Liked About Assigned App.

Physical Activity. During Survey 1, the question was asked about their average physical activity amount “*In a typical week, how many times do you engage in 30 minutes of moderate to vigorous activity (e.g., brisk walking, playing sports, gym or video workouts)?*”.

The majority of participants self-reported getting between three-five times or more of activity a week (Figure 12). However, when asked, “*Do you feel you get too much exercise, too little exercise, or about the right amount of exercise?*” only one participant felt they achieve the right amount, and none felt that they get too much exercise (Figure 13).

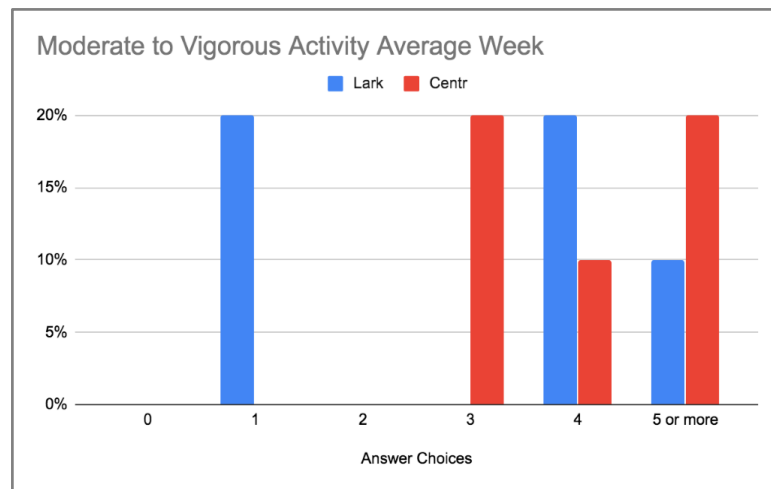


Figure 12. Moderate to Vigorous Activity Times Per Week.

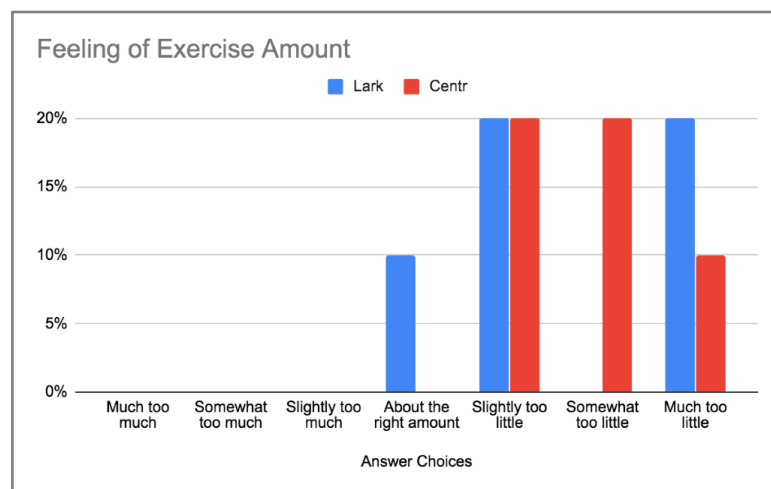


Figure 13. Feeling of Average Weekly Exercise Amount.

In the final survey, the participants were asked about their motivation level. *“Since using the app, how do you feel about your motivation to make healthier choices? (e.g., more physically active, smaller portions, less fried foods, etc.)”*. As seen in Figure 14, out of both groups, only three participants experienced an increase in motivation, which were all Centr users. Participants were asked if they had noticed a difference, to expand on what changes they made.

“Being more mindful of what I need to eat and became more motivated to watch instructor-led exercises, instead of making my own plan” -P5

“I had a physical set back, so not quite what I planned. I have spent more time breathing and following the meditations. It encouraged me to look into a meditation app” -P9

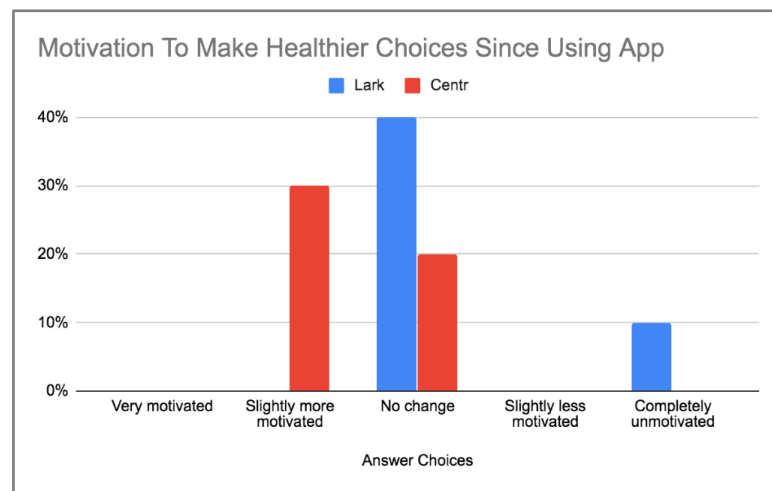


Figure 14. Motivation To Make Healthier Choices Since Using the App.

Weight and BMI. Each participant’s weight was self-reported during the first week and the final week of the study. Additionally, the participants’ baseline and ending BMIs were calculated based on their height and weight. Five out of the ten participants lost weight (Table 2).

One Centr participant experienced no changes in weight, while the other four reported weight loss. The total weight loss for the Centr group was 20 pounds, which was an average of 4 pounds per participant. The participant that reported the most significant weight loss had an 11-pound decrease in weight which lowered their BMI by 1.7.

Two participants in the Lark group reported no change in weight, one lost 2 pounds, and the other two gained weight; 1 and 2 pounds. The total weight difference in the Lark group was a 1 pound gain. The participant who gained 2 pounds increased their BMI by .3, thus moving from

the “Normal” BMI category into the “Overweight” category, according to the Centers for Disease Control and Prevention (2020).

It is worth noting the frequency of app use over the last seven days of the study. The Centr participant that lost 11 pounds reported using the app three-four days, while the Lark participant with the 2-pound gain, indicated not using the app at all over the previous seven days.

Table 2

Weight, BMI, and App Use by Participant

Assigned App	Starting Weight	Ending Weight	Starting BMI ^a	Ending BMI	Weight Loss/Gain ^b	App Use ^c
Centr	181	170	28.3	26.6	-11	3-4 days
Centr	235	230	31	30.3	-5	1-2 days
Centr	170	167	26.6	26.2	-3	3-4 days
Lark	132	130	24.1	23.8	-2	1-2 days
Centr	166	165	26.8	26.6	-1	3-4 days
Centr	225	225	37.4	37.4	0	1-2 days
Lark	165	165	30.2	30.2	0	1-2 days
Lark	206	206	35.4	35.4	0	1-2 days
Lark	136	137	25.7	25.9	1	1-2 days
Lark	136	138	24.9	25.2	2	None

a BMI: Body Mass Index. b The list sorted from most weight lost to weight gained. c Frequency of assigned app use over the previous 7 days when completing Survey 4.

In Table 3, we see the Centr participants mean starting weight was 195.4 pounds, and mean ending weight was 191.4 pounds, while participants in the Lark group had a mean starting weight of 155 pounds and mean ending weight of 155.2 pounds.

Table 3

Weight Differences by Assigned App

	Centr Starting Weight	Centr Ending Weight	Centr Weight Difference	Lark Starting Weight	Lark Ending Weight	Lark Weight Difference
Median	181	170	-3	136	138	0
Mean	195.4	191.4	-4	155	155.2	0.2
SD	32.25368196	33.04996218	4.358898944	31.43246729	31.37992989	1.483239697

Star Ratings. During Survey 1, the participants were asked, “*How many stars would you give this app?*”. As displayed in Table 4, the Lark app received an average rating of 3.2 stars, while the Centr app received an average of 4 stars.

Table 4

Star Rating of Assigned App

					
10%	10%	0%	20%	10%	Lark 3.2
0%	0%	30%	10%	10%	Centr 4.0

Suggestions. In Survey 2, participants were asked, “*What suggestions do you have for improving this app?*”.

Among the Lark Group, participants recommended additional food tracking features, individual calorie goals, increased response time of the chats, removing the “fake texting”, and more features available in the free version.

“Give the option to track different brands of food, barcode scanner, give an estimated calorie goal, get rid of the fake texting, give more workout tracking options, give the option to track different serving size (grams, oz, tablespoons, etc.)” -P6

“The chats on their messages can be faster. I feel like I am waiting too long” -P2

“More features for the free version. The free version of this app does virtually nothing that basic free fitness apps do for a user. If I can't do even basic health tracking in the free version, it doesn't make me want to pay a monthly fee just so I can get that and some extra” -P10

Participants in the Centr Group recommended food and activity tracking, exercise modifications based on physical limitations, adding a guided process during first app use, and individual calorie needs.

“There should be a way to be able to specify modifications based on physical limitations. Some of the exercises I just can't do” -P1

“I still haven't figured out if I can track my calories or exercise on the app. I think it assumes you'll just follow the plan, but that's not always the case” -P3

“Not as intuitive as other fitness apps, add more of a guided process when initially using the app” -P5

“Personal calorie needs. Tracker for workouts or meals completed. I just joined the FB private community. Curious [about] what that will provide” -P9

Interest in Continued Use. In Survey 3, the participants were asked, *“How likely are you to continue your app subscription after this research project ends?”*. Eight out of ten participants had selected not at all likely. The remaining two participants stated they were slightly and moderately likely to continue; both were Centr users.

Recommendations. “The Net Promoter Score [NPS] is an index ranging from -100 to 100 that measures the willingness of customers to recommend a company's products or services to others” (Medallia, n.d.). In the final survey, participants were asked the likelihood they would recommend the app on a scale of 0-10 to determine the NPS (Figure 15). To calculate the NPS, required subtracting the detractors (scores 0 to 6), from the promoters (9 or 10). However, it is essential not to exclude passive scores (7 or 8) in further analysis. “They are so close to being promoters, especially when they give you a score of 8, that any time spent investigating what you could do better/differently to win them over is time well spent” (Formula to Calculate Net Promoter Score (NPS) in Excel. 2020).

Participants	👍 Promoters (10, 9)	👎 Detractors (0-6)	😐 Passives (7, 8)	NPS
Lark	0	4	1	-80
Centr	1	3	1	-40

Figure 15. NPS: Likely to Recommend Assigned App.

Reasoning for Net Promoter Score. Immediately following the NPS question, participants were asked why they selected that number. Their responses are categorized by the assigned app, NPS Categories, and participant number below.

Lark - Detractor Score of 0, two participants. While four participants of Lark selected detractor scores, two of those were a zero.

“This app did not motivate me at all and [it] did not have enough options for tracking. It provides very little information that's actually helpful” -P6.

“The app seems to try and entice people to do a subscription to it via giving the user very little to do in the free model and putting everything, even basic features, in the paid model. With any app, if they have a free version I would want to test it out and see if I like it in its free version before deciding if it is worth investing into. Taking away the most basic of functions and tracking in a fitness app just seemed laughable and pointless to even have a free version of it. I was pretty turned off by the app with how silly it was, particularly prompting you to enter certain metrics it didn't let you keep track of. All around the free version is silly and a waste of time in a world full of fitness tracker apps that give you a lot more for free or less” -P10

Lark - Detractor Score of 6, two participants.

“I, unfortunately, did not put more time to look into what the app can really do for me. Although, if friends or colleagues ask about a health app, I would suggest it. The reason why is because they do have a free version of it and I do know it allows you to track your food and exercise. Also, the ratings/reviews of it are very high” -P2

“This seems to be a great app for people who are starting a lifestyle change. It is great for those who need accountability and encouragement” -P8

Lark - Passive Score of 8, one participant

“It's really user-friendly, it'd be easy for all ages to use, and it's motivating for someone wanting to make healthy changes” -P4

Centr - Detractor Score of 3, 4, and 5, three participants. Three participants selected detractor scores and stated the price of the app, given the features provided, was the reason for the low scores.

“Way too expensive for what it provides” -P1

“Good app but kind of expensive for what you get” -P7

“I could see this app working for some people, but not everyone. It's nice that all the meal plans, exercise, and daily meditations are laid out for you. However, there's no coach to contact so I don't think it's worth the price” -P3.

Centr - Passive Score of 7, one participant.

“Doesn't interact with the user enough to motivate them and remind them of their goals” -P5

Centr - Promoter Score of 9, one participant.

“It is a well-balanced app -- mindfulness; strength, cardio, and flexibility; recipes are delicious and super easy to create grocery lists that suit the number of people you are cooking for; there is also a private FB group for additional support” -P9

Video Diary Results

Lark Registration and First Impressions. After downloading the app, P4 began recording and clicked on the Lark app. It closed abruptly and displayed a message on the screen providing two options: Close app or Send feedback. The participant informed the researcher about the issue and stated they closed the app and were able to open it without additional issues (Figure 16).

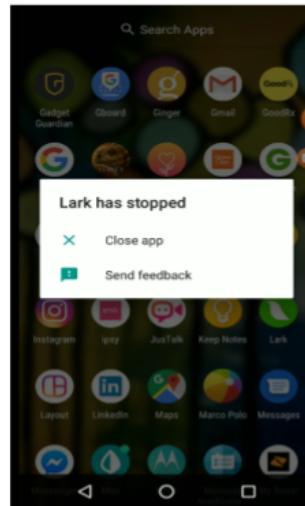


Figure 16. Lark Technical Issues.

“Alright, so basically they have a program, which sounds kind of familiar, it's diabetes prevention. You get a weight scale and have it Fitbit and it's also registered with the CDC” -P4

“I forgot to screenshot the list of insurance carriers that cover this program, but it was like Anthem, Blue Cross,but obviously United Health was not on there” -P4

Participant 4 was referring to their current employment and health insurance carrier at Rally Health; a digital weight loss program that also offers a body weight scale and is approved by the CDC.

“I wanted to show what my profile looks like if you click on my picture at the top. Basically, there are different categories. Obviously, there's no data in here right now. So activity, sleep, food, weight, and note. I like their little motivational notes (participant reads aloud: Track your weight loss journey and get motivation to keep going even when it's tough. Note down every moment when you make a healthy choice for yourself, trust me, it will be rewarding). I think they need an exclamation at the end of that sentence” -P4

“Oh righty let's see if this is working. So this is weird (participant sees Diabetes Prevention Program Includes...on the screen) I don't want any of these. Sorry promotion for prevention includes blah blah. Like I don't want to say yes or tell me more because I don't care about this diabetes thing...I'm like opening this app and I'm thinking, what is this? That's a bit weird. Okay, so it just acts like a chat. (Lark app: “so far I haven't seen much activity from

you"). Rude. Less than a couple minutes. Yeah, that's fair. I haven't been that active. Oh, that's interesting, it includes a premium version with a Fitbit...I have a Fitbit. Is there a way to connect to that on here? So I did a workout today. It was according to my Fitbit for 34 minutes. I guess we'll just pick a random time I suppose. It doesn't matter. Oh, no. Go back. (the activity tracker adjusted total time as the participant entered the specific time of workout). How did, wait, what? Oh, right, because I just changed that. Okay, interesting. Okay, this is super weird. (Lark chat: I'm glad you were able to take a chunk in your day to exercise)" -P10

"So I'm not really digging this kind of buddy chat thing. I personally would prefer just a streamline. Here's your stats and here's what it is I don't need this thingy to do whatever is doing Hmm. Okay, so I guess kind of see those stats you would just do this. So I guess as long as you click on your person here, that's fine. It's just really weird to me that the main page is this bot chat. I got to say I'm not feeling it. This just pretty much tells me my data, so you can add that there. So far the first impressions are that this is rather weird. Maybe I'll warm up to it in the future. Since this is like day one of using it but so far it is strange." -P10

Lark Cost and Features. *"I am trying to challenge it a bit to see what all you can do with the free version, which is not much at all" -P10*

"This is really cool. I just think that they really seem to be really heavy into the support. Not just like the coaching support, but the actual tech support, which is great. They must have some really great tech people because this app just seems very user-friendly. It runs smoothly, except for that very first time I opened it, but other than that. It looks like they're trying to make it as user-friendly as possible. So it's cool" -P4

"It is really funny because I got this message reminding me to input my weight but it won't let me unless I upgrade. Made me laugh" -P10

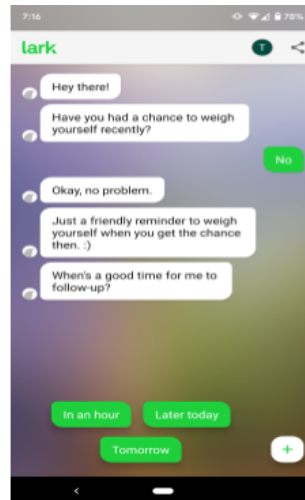


Figure 17. Lark Weigh-in Prompt.

"There's not a whole lot you can do with this free version. (The participant noticed that they can update their weight in the settings, (Figure 18). "I haven't weighed myself in a little bit, but I weighed 136 after finishing another program, I gained some muscle and I'm 5'1", (Participant 10 entered 136 and read Lark's chatbot response: Is this a valid weight for you?). "What a [censored word]. Fine Lark, let's go weigh myself". (Participant 10 weighed and inputted the updated weight, which was 1 pound greater). "Okay, 137. Let's see what happens when I input it (Lark asked again "is this a valid weight for you?"). What is the purpose of that? Like if I just entered it in, why would I lie to my fitness app, like am I afraid you're going to share the data and people are going to think this [censored word] over here is a tubby lumpkin. I feel like it's trying really hard to be like we're so interactive; look at us paying attention to you, but it doesn't make sense. What I was expecting to happen or was interested to happen was when I entered my weight for it to say that seems to be a healthy weight for you, or ask what are your goals or are we building muscle and doing strength training, are we doing cardio, are you losing weight, gaining weight...I was expecting more to happen here then it asking if my weight that I just added is correct and then I'm like yup and it's like okay cool, cool, good talk. So I'm really trying to just use the free version because I feel like other people are using the paid version and I think it would be a good gauge to see if the paid version is really worth the money. So I'm trying to make the most of what I can with this freebie but it doesn't really make me want to use it. It doesn't make sense. But we will keep rolling and see how it goes" -P10

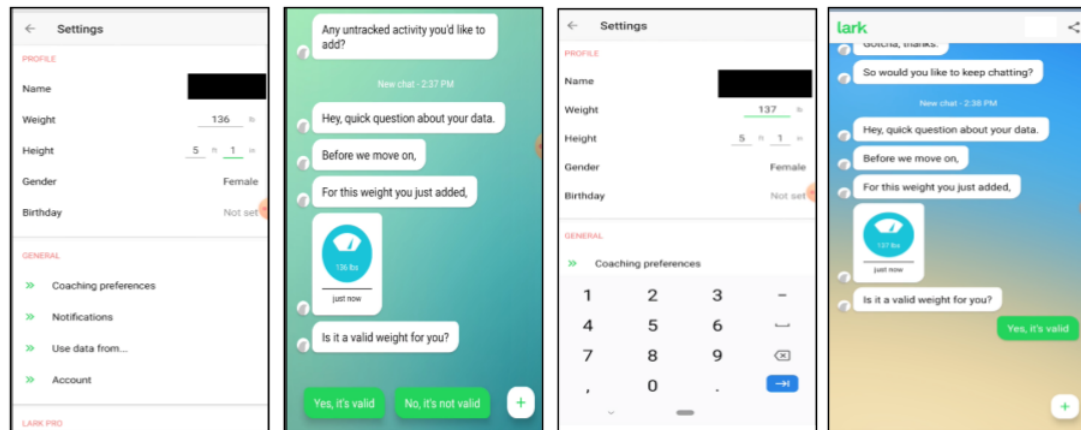


Figure 18. Lark Weight Input and Conversation.

“I had some tech issues with upgrading to the pro version so I’m waiting on tech support. Can’t do anything on the free version, it’s pretty much garbage” -P6

“I just bought the upgraded version. This is where I still wish it would take them a quicker response to reply to these text messages that we’re apparently trying to simulate. I get alerts on my watch at like 10 pm to log my dinner and I kinda think that’s pretty late. By that time, I’m tired and we’re getting ready for bed. I don’t want to do any work that late. Maybe that time works for some people, but not for others. I think maybe Lark should start adjusting their times. I’ve noticed that with the pro version you seem to get more analysis and stats” -P2

Centr Registration and First Impressions. *“I’ve downloaded the app. The download was very easy. I have to admit that I got a little excited because hey, it’s Chris Hemsworth, and he’s pretty fit at fifty. I’m going to start with the 7-day trial. That will give me 7 days to continue using it. It looks a little expensive for my taste, but we’ll see how it goes.” -P9*

Centr Cost and Features. *“Let’s go ahead and set up my goals (Figure 19). It looks pretty easy: lose weight, get fit & toned, or build muscle. I want to get leaner. Which meal plan do you want to follow (Participant reads off options then notices the header) All of our meal plans are gluten-free friendly. That’s actually a huge benefit. This is always a challenge for me personally because I have lots of food sensitivities because of my autoimmune. Alright, planner, looks pretty, looks easy, regular hamburger [menu] sign up at the top, I like that there’s a calendar across the top to easily look at your days. Actually, It really does excite me that this is a combination between nutrition, meditation, and exercise. I’m excited and I’m curious” -P9*

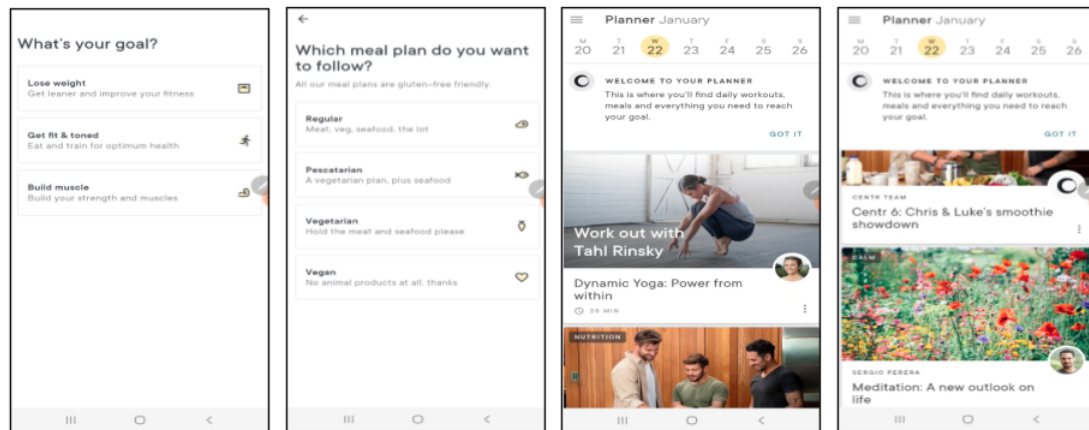


Figure 19. Centr Goal, Meals, and Layout.

“Huge plus - I'm exploring the recipes and I really really like that they have the option to increase or decrease the amount of servings for each and it automatically changes the ingredients (Figure 20). I can add that to my shopping list and those ingredients [specific/adjusted amounts] are added. That is a wonderful feature” -P9

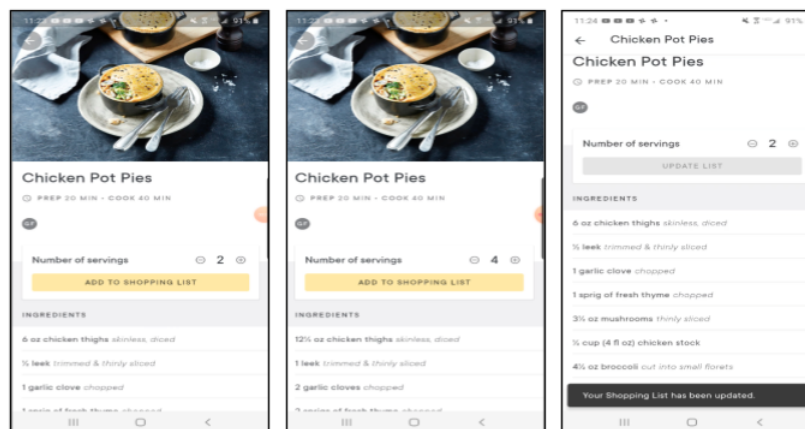


Figure 20. Centr Recipe Adjustments and Addition to Shopping List.

Centr Final Thoughts. *“I am SO impressed by how easy it was to cancel. All I had to do was click on the hamburger sign, come down to account, more, manage subscription. And boom it was right here (Figure 21)...I just had to click cancel and it was done. It didn't bring me through anything; I didn't have to do it 30 days in advance or anything like that. It was so easy. I'm very thankful” -P9*

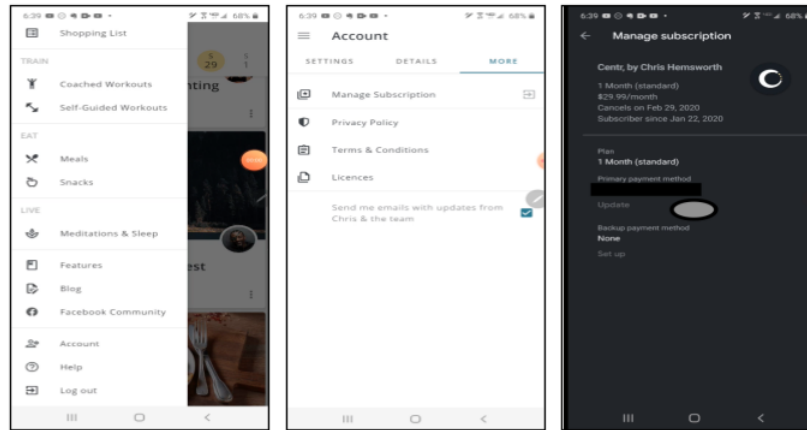


Figure 21. Centr Cancellation Steps.

Chapter 5: Discussion

Discussion

Based on the results from surveys and video diaries, it appeared the Centr participants were more likely to; recommend the app to others, achieve weight loss, and experience an increase in motivation to make healthier choices than the Lark participants. However, two primary themes arose in both groups. These included 1) the monthly app cost, and 2) features that were missing or needed improvements; specifically tracking and coaching. This chapter will discuss these themes in greater detail, compare past research with the results of this study, and explore options for future designs of a health and fitness app.

Themes

The participants in the Centr group shared the monthly cost was too expensive, especially given the inability to track calories/activity, and the inability to contact a coach for additional support or encouragement. Nevertheless, three of the Centr participants did feel slightly more motivated to make healthier choices by the end of the study.

Alternatively, none of the Lark participants experienced a positive change in motivation. The Lark group seemed to have mixed feelings of the chatbot and expressed the features on the free version were extremely limited, e.g. needing to upgrade to the paid plan to track food and weight.

It is imperative to highlight that other apps offer food and activity tracking, many of which are not only free or significantly less expensive, and also seem very popular. For example, the MyFitnessPal app currently has a 4.5 rating by 2 million users on Google Play and a 4.7 rating by 1 million users on Apple Play Store (Figure 22), yet it does not offer a human or automated coach. MyFitnessPal has been ranked as the best overall fitness app by Verywell Fit (Stassen, 2019), the best app for overall health by Men's Health (Matthews & Bay, 2019), and PC Magazine selected it as Editor's Choice (Duffy, 2019).

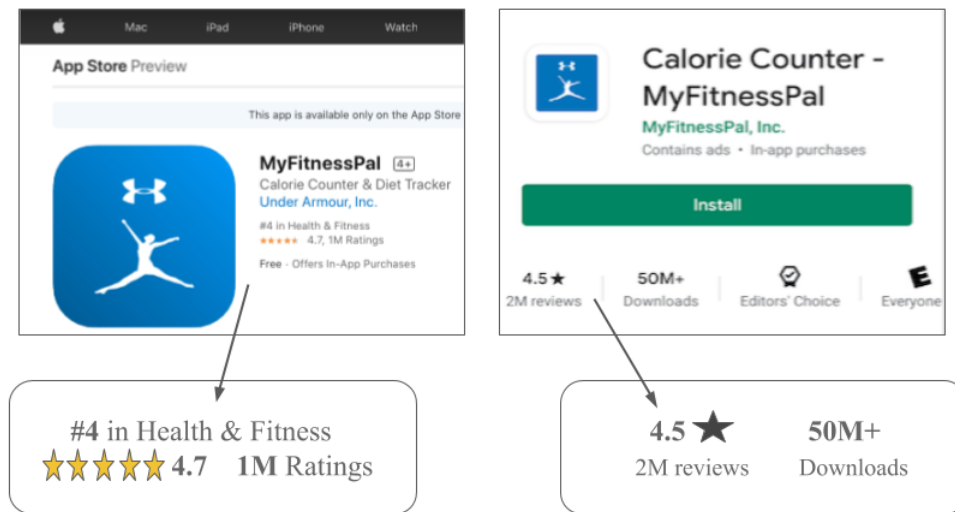


Figure 22. MyFitnessPal App. Note: Images from Apple Store (left), Google Play (right)

While MyFitnessPal does have a free option, Hauptert (2019) highly recommended the Premium plan at \$9.99 monthly or \$49.99 per year, particularly the annual plan; which calculates to approximately \$4.16 a month. Given the cost of Lark and Centr, it is worth exploring the cost of competitor apps such as MyFitnessPal and their features.

Comparing Past to Current Results

By diving deeper into food and activity tracking, we need to examine past research and our results from this study. After all, eight out of ten of this study's participants ranked food tracking as a desired feature during their screener survey, and the majority of Centr and Lark suggestions involved tracking features. While past research such as Honary (2019) advised that tracking can lead to obsessive behaviors, others (Sullivan & Lachman, 2017; Robinson et al., 2019; and Stuckey et al., 2017; Michie et al., 2009) have highlighted the benefits of combining BCTs such as goal setting, rewards, reminders, social support, and tracking.

In a recent article, Brandt (2020) noted the reasons why calorie tracking may be counterproductive. She points out that every app uses a different equation to determine one's caloric needs, which does not take into consideration the individual's muscle mass or genetics, as well as the inaccuracy of food labels. Brandt believes that while we should have an understanding of which foods are higher and fewer in calories, it is essential to pay attention to the food quality and our individual natural body signals.

For healthy behavior changes, it would be beneficial to develop an app with food and activity tracking as well as information on the quality of foods, benefits of exercise, and goals that are customizable to each individuals' wants and needs.

Implications and Design Recommendations

To address the issues found in the Centr and Lark apps during this study, the following are areas for mobile app designers to focus on when designing health and fitness apps.

Cost Comparison and User Research. Participants from both groups in this study expressed discontent with their assigned app's monthly subscription cost. Centr does offer a discount for an annual subscription, which would bring the monthly cost down to \$10 a month. However, this requires the user to pay for the entire year in a one-time payment. Meanwhile, Lark only offers a monthly subscription. Analysis of similar health and fitness apps subscription prices as well as ongoing user research of the amount users would feel comfortable paying would provide a better understanding of appropriate fees for future health and fitness app designs.

Daily Content of Overall Wellness. Centr participants seemed pleased with the app's combined focus on nutrition, exercise, and meditation with everything laid out for the user in a daily format. Three of the five participants felt more motivated to make healthier choices by using the Centr app. On the contrary, participants in the Lark group highlighted missing features like tracking, and nutrition or exercise goals. Furthermore, not one of the five Lark participants experienced an increase in motivation. A design solution is to provide daily content that emphasizes on an overall wellness approach. For example, the quality of different foods, the benefits of increased physical activity, tips for restful sleep, and meditation. This daily content would entice the user to check in to the app frequently and likely increase their motivation to focus on improving their overall health.

"Getting Started" Page or Guided Tour. Centr participants were unclear on how to track their meal plans and workouts two weeks into the study. Similarly, participants in the Lark group expressed feelings of discontent during their initial app use, and an uncertainty of the features available beyond the trial. A design solution is to provide a "Getting Started" page or a guided tour as this would ensure the user is easily walked through the app during their first use.

Combine Automated Coaching with Human Coaching. One Lark participant shared positive feedback of the chatbot and felt the app seemed very user-friendly. Others in the Lark

group voiced concerns of slow responses or unsupportive comments from the chatbot. When designing an app with automated coaching, it's imperative the responses are fast and intuitive for a better user experience. A design solution is to allow the user to interact with the chatbot for simple tasks by providing a text box as well as selection options based on the user's needs. Additionally, similar to Everett (2018), it is essential to design an app that automatically interprets the user's information and their responses to gain insights for personalized feedback from the chatbot.

While the Centr app offers instructor-led workouts, the participants seemed discontent with not having a coach to contact for support. It's also important to note that only one participant joined the apps' private Facebook community. A design solution is to provide a coach page with a button to set up a time to speak with a human coach if additional support or guidance is needed. It would also be beneficial to research other wellness apps, such as Ginger.io (<https://www.ginger.io/app>), that offer only human coaching via text-based chats for free. Combining both coaching methods in the design would offer a level of support that few other apps can provide at a cost-efficient price.

Reminders. A Centr participant shared the app did not motivate or remind the user of their goals. On the other hand, a Lark participant felt the app sent reminders (i.e. notifications) too late at night. A design solution is to provide notifications of the user's goals that can be adjusted based on their schedule. For example, *"Friendly reminder, your goal is to drink water before each meal. Track your progress towards your goal"* or *"Check out our latest article: Best Foods to Upgrade your Nutrition"*. This will allow users to find resources that are specific to their needs, and increase app engagement as they feel motivated and supported in achieving their goals.

Tracking. Participants in both groups expressed dissatisfaction when attempting to track their meals and activity, or if tracking was even possible. Two Lark participants felt the app's trial version should include food and weight tracking as a basic function, as other free health and fitness apps do. Among the Centr group, one participant shared being pleasantly surprised by the ability to adjust a recipe by serving size. However, food tracking, even a Centr recommended recipe, is not a feature currently available in the app. Other Centr participants revealed feeling unsure of how to track their completed workouts and meals, despite these being part of their

recommended daily plan. Design solutions include providing food, activity, weight tracking, as well as other areas (e.g., macronutrients, body measurements, and personalized calorie goals). Additionally, it may be beneficial to design a calendar in the app to view upcoming suggested workouts and meals, and the ability to sync to the user's personal tracking devices such as smartwatches or other health and fitness apps.

Customizable Plans and Individual Goals. A participant in the Centr group expressed positive feedback regarding the meal plan options due to their dietary restrictions. Another Centr participant shared that they were unable to do some exercises, and suggested the app include workouts for different physical limitations. Lark participants made recommendations for goals specific to each user. The design solutions include offering customization of the meals, exercises, and individual goals (e.g., select workouts based on activity level and any physical limitations, meals based on dietary preferences, and goals to lose weight, build muscle, improve overall health, or a self-created goal). This will ensure that users are able to truly personalize their goals and wellness plan.

Chapter 6: Conclusion

Conclusion

This study set out to investigate the effectiveness of automated coaching versus no coaching interaction in health and fitness mobile apps on the user's motivation to develop healthier habits. Due to the Net Promoter Scores, star ratings, weight loss, and motivation levels among participants, it can be hypothesized that the Centr app had a greater positive impact on the user's behavior change than the Lark app. However, only two participants that stated they might continue using the app after the study ended, both gave the Centr app detractor scores due to the app's cost for what it provides. One of which, specifically mentioned the lack of a coach to contact. Additionally, Lark participants seemed to have divided feelings about the chatbot, and none voiced an increase in motivation to make healthier choices.

Overall, this study suggests that providing one method of coaching support may not be enough to keep the user engaged and motivated to make healthier choices. The research also points to the users' needs for individualized goals, customizable plans, reminders, tracking features in both free and paid versions, and for appropriate monthly subscription costs.

Although this study was completed with a small number of participants over a brief period, there were powerful insights gained regarding the strengths and weaknesses of each app. Further research of the Lark and Centr apps could be done over an extended period to determine if the motivation levels waver and if additional insights are gained. Alternatively, research of other health and fitness apps that offer automated coaching versus apps with human coaching would allow for a greater understanding of the user's experience.

Limitations

While Lark provides consistent interaction with a chatbot, the Centr app does not provide a human or an automated coach. Centr users can reach out to the team, (i.e. nutritionists, personal trainers, and wellness/mediation coaches) and other Centr members on a private Facebook page. Since automated coaching has its own limitations and human support requires the user to proactively reach out to the community for guidance, this could be a limitation in this particular study.

It may be beneficial to investigate health and fitness apps that offer a more hands-on approach. The problem seems to be that many weight loss programs that offer 1-on-1 or weekly sessions with a human coach can be extremely pricey. However, the mental health app Ginger.io (<https://www.ginger.io/>), has a team of certified coaches available through messaging or video sessions 24 hours a day for free. The app users are encouraged to set up an initial consultation so their team can provide personalized care to each member. If health and fitness apps could create this level of proactive and ongoing coaching support, the users may feel more comfortable seeking guidance.

Moving forward

Further research is needed to understand the user's perspective on a combined approach of human coaching with automated coaching, as well as to provide design solutions to meet the user's needs. The insights gained from this study can be applied to the design of future health and fitness mobile apps.

References

- Afshin, A., Sur, P. J., Fay, K. A., Cornaby, L., Ferrara, G., Salama, J. S., ... Murray, C. J. L. (2019). Health effects of dietary risks in 195 countries, 1990–2017: A systematic analysis for the Global Burden of Disease Study 2017. *The Lancet*, 393(10184), 1958–1972. [https://doi.org/10.1016/S0140-6736\(19\)30041-8](https://doi.org/10.1016/S0140-6736(19)30041-8)
- American Cancer Society. (n.d.) ACS Guidelines on Nutrition and Physical Activity for Cancer Prevention. <https://www.cancer.org/healthy/eat-healthy-get-active/acs-guidelines-nutrition-physical-activity-cancer-prevention.html>
- Bardus, M., Ali, A., Demachkieh, F., & Hamadeh, G. (2019). Assessing the Quality of Mobile Phone Apps for Weight Management: User-Centered Study With Employees From a Lebanese University. *JMIR MHealth and UHealth*, 7(1), e9836. <https://doi.org/10.2196/mhealth.9836>
- Brandt, S. (2020, March 17). Should I be counting my calories? La Crosse Tribune. https://lacrossetribune.com/lifestyles/food-and-cooking/recipes/sarah-brandt-should-i-be-counting-my-calories/article_c162532a-fb5d-5aee-b9b1-ef10fc87f038.html
- Centers for Disease Control and Prevention. Adult Obesity Causes & Consequences. (2017, August 29). <https://www.cdc.gov/obesity/adult/causes.html>
- Centers for Disease Control and Prevention. Defining Adult Overweight and Obesity. (2020, March 25). <https://www.cdc.gov/obesity/adult/defining.html>
- Chen, J., Cade, J. E., & Allman-Farinelli, M. (2015). The Most Popular Smartphone Apps for Weight Loss: A Quality Assessment. *JMIR MHealth and UHealth*, 3(4), e104. <https://doi.org/10.2196/mhealth.4334>
- Chin, S. O., Keum, C., Woo, J., Park, J., Choi, H. J., Woo, J., & Rhee, S. Y. (2016). Successful weight reduction and maintenance by using a smartphone application in those with overweight and obesity. *Scientific Reports*, 6, 34563. <https://doi.org/10.1038/srep34563>
- Cowan, L., Van Wagenen, S., Brown, B., Hedin, R., Seino-Stephan, Y., Hall, P., & West, J. (2012). Apps of Steel: Are Exercise Apps Providing Consumers With Realistic Expectations? A Content Analysis of Exercise Apps for Presence of Behavior Change Theory. *Health Education & Behavior*, 40(2), 133–139. <https://doi.org/10.1177/1090198112452126>

Direito, A., Jiang, Y., Whittaker, R., & Maddison, R. (2015). Apps for IMproving FITness and Increasing Physical Activity Among Young People: The AIMFIT Pragmatic Randomized Controlled Trial. *Journal of Medical Internet Research*, 17(8), e210.

<https://doi:10.2196/jmir.4568>

Duffy, J. (2019, December 20). MyFitnessPal Review. PCMag.

<https://www.pcmag.com/reviews/myfitnesspal>

Everett, E., Kane, B., Yoo, A., Dobs, A., & Mathioudakis, N. (2018). A Novel Approach for Fully Automated, Personalized Health Coaching for Adults with Prediabetes: Pilot Clinical Trial. *Journal of Medical Internet Research*, 20(2), e72. <https://doi:10.2196/jmir.9723>

Eyal, N. [TED Institute]. (2015, December 10). *What makes some technology so habit-forming?* [Video]. YouTube. https://www.youtube.com/watch?v=1ldYx_rW_Ks

Fogg, B.J. (May 2002). "Stanford Guidelines for Web Credibility." A Research Summary from the Stanford Persuasive Technology Lab. Stanford University.

<https://credibility.stanford.edu/guidelines/index.html>

Formula to Calculate Net Promoter Score (NPS) in Excel. (2020, February). Hot Jar.

<https://www.hotjar.com/net-promoter-score/how-to-calculate/>

Graziano da Silva, J., Hounbo, G., Fore, H., Beasley, D., & Ghebreyesus, T. (2019, July 15). World hunger is still not going down after three years and obesity is still growing – UN report. World Health Organization. <https://www.who.int/news-room/detail/15-07-2019-world-hunger-is-still-not-going-down-after-three-years-and-obesity-is-still-growing-un-report>

Haupt, T. (2019, January 13). Is MyFitnessPal Premium Worth the Cost? Carrots “N” Cake. <https://carrotsncake.com/is-myfitnesspal-premium-worth-the-cost/>

Honary, M., Bell, B. T., Clinch, S., Wild, S. E., & McNaney, R. (2019). Understanding the Role of Healthy Eating and Fitness Mobile Apps in the Formation of Maladaptive Eating and Exercise Behaviors in Young People. *JMIR MHealth and UHealth*, 7(6), e14239.

<https://doi:10.2196/14239>

Kleinman, A. (2017, December 6). This App Thinks Conversations Are The Key To Better Fitness And Sleep. HuffPost. [https://www.huffpost.com/entry/lark-](https://www.huffpost.com/entry/lark-app_n_7152178?guccounter=1)

[app_n_7152178?guccounter=1](https://www.huffpost.com/entry/lark-app_n_7152178?guccounter=1)

London, J. (2019, December 16). What Is Noom? Here's What a Nutritionist Really Thinks About the Trendy Weight-Loss App. *Good Housekeeping*.

<https://www.womansday.com/health-fitness/a26113129/noom-diet-plan-review/>

Matthews, M., & Bay, S. (2019, October 31). 10 Best Apps for Your Overall Health. *Men's Health*. <https://www.menshealth.com/health/g22842908/best-health-and-fitness-apps/>

Medallia. (n.d.). Net Promoter Score. <https://www.medallia.com/net-promoter-score/>

Michaelides, A., Raby, C., Wood, M., Farr, K., & Toro-Ramos, T. (2016). Weight loss efficacy of a novel mobile Diabetes Prevention Program delivery platform with human coaching. *BMJ Open Diabetes Research and Care*, 2016;4:e000264. <http://dx.doi.org/10.1136/bmjdr-2016-000264>

Michie, S., Abraham, C., Whittington, C., McAteer, J., & Gupta, S. (2009). Effective techniques in healthy eating and physical activity interventions: A meta-regression. *Health Psychology*, 28(6), 690–701. <https://psycnet.apa.org/doi/10.1037/a0016136>

Middelweerd, A., Mollee, J. S., van der Wal, C. N., Brug, J., & Velde, S. J. (2014). Apps to promote physical activity among adults: A review and content analysis. *Int J Behav Nutr Phys Act*, 11(1), 97. <https://doi.org/10.1186/s12966-014-0097-9>

Munson, Sean & Consolvo, Sunny. (2012). Exploring Goal-setting, Rewards, Self-monitoring, and Sharing to Motivate Physical Activity. 6th International Conference on Pervasive Computing Technologies for Healthcare and Workshops, Pervasive Health 2012. San Diego, CA, USA. <http://dx.doi.org/10.4108/icst.pervasivehealth.2012.248691>

National Institutes of Health. (2012, December). Don't Just Sit There! (H. Wein & T. Hicklin, Eds.). NIH News in Health. <https://newsinhealth.nih.gov/2012/12/dont-just-sit-there>

Office of Disease Prevention and Health Promotion. (2018) Top 10 Things to Know About the Second Edition of the Physical Activity Guidelines for Americans. Health.gov. <https://health.gov/paguidelines/second-edition/10things/>

Parkman, K. (2020, January 10). Jenny Craig vs. Nutrisystem vs. Weight Watchers: Compare pricing, meal options, and weight loss results. *Consumer Affairs*. <https://www.consumeraffairs.com/health/jenny-craig-vs-nutrisystem-vs-weight-watchers.html>

Petersen, J. M., Prichard, I., & Kemps, E. (2019). A Comparison of Physical Activity Mobile Apps With and Without Existing Web-Based Social Networking Platforms: Systematic Review. *Journal of Medical Internet Research*, 21(8). <https://www.jmir.org/2019/8/e12687/>

Peterson, D. M. (2019, September). Patient education: Exercise (Beyond the Basics). Up To Date. <https://www.uptodate.com/contents/exercise-beyond-the-basics>

Piette John D., List Justin, Rana Gurpreet K., Townsend Whitney, Striplin Dana, & Heisler Michele. (2015). Mobile Health Devices as Tools for Worldwide Cardiovascular Risk Reduction and Disease Management. *Circulation*, 132(21), 2012–2027. <https://doi.org/10.1161/circulationaha.114.008723>

Real Appeal. (2020). A Healthy Weight-Loss Program That Works. <https://realappeal.com/how-it-works>

Robinson, L., Segal, J., & Smith, M. (2019, June). *How to Start Exercising and Stick to It*. Help Guide. <https://www.helpguide.org/articles/healthy-living/how-to-start-exercising-and-stick-to-it.htm>

Schoeppe, S., Alley, S., Lippevelde, W., Bray, N., Williams, S., Duncan, M., & Vandelanotte, C. (2016). Efficacy of interventions that use apps to improve diet, physical activity and sedentary behaviour: a systematic review. *Int J Behav Nutr Phys Act*, 13. <https://doi.org/10.1186/s12966-016-0454-y>

Spring, B., Schneider, K., McFadden, H. G., Vaughn, J., Kozak, A. T., Smith, M., ... Lloyd-Jones, D. M. (2012). Multiple Behavior Changes in Diet and Activity: A Randomized Controlled Trial Using Mobile Technology. *Archives of Internal Medicine*, 172(10), 789–796. [doi:10.1001/archinternmed.2012.1044](https://doi.org/10.1001/archinternmed.2012.1044)

Stamatakis, E., Gale, J., Bauman, A., Ekelund, U., Hamer, M., & Ding, D. (2019). Sitting Time, Physical Activity, and Risk of Mortality in Adults. *Journal of the American College of Cardiology*, 73(16), 2062–2072. <https://doi.org/10.1016/j.jacc.2019.02.031>

Stassen, A. (2019, October 18). The 10 Best Fitness Apps to Download in 2020. Verywell Fit. <https://www.verywellfit.com/best-fitness-apps-4173707>

Stuckey, M., Carter, S., & Knight, E. (2017). The role of smartphones in encouraging physical activity in adults. *International Journal of General Medicine*, 10, 293–303. <https://doi.org/10.2147/IJGM.S134095>

Sullivan, A. N., & Lachman, M. E. (2017). Behavior Change with Fitness Technology in Sedentary Adults: A Review of the Evidence for Increasing Physical Activity. *Frontiers in Public Health*, 4. <https://doi.org/10.3389/fpubh.2016.00289>

Tanaka, K., Sasai, H., Wakaba, K., Murakami, S., Ueda, M., Yamagata, F., ... Takekoshi, K. (2018). Professional dietary coaching within a group chat using a smartphone application for weight loss: *A randomized controlled trial*. *Journal of Multidisciplinary Healthcare*, 11, 339–347. <https://doi.org/10.2147/JMDH.S165422>

Turner, A. (2019, November 1). How Many Smartphones Are in the World. Bank My Cell. <https://www.bankmycell.com/blog/how-many-phones-are-in-the-world>

U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015–2020 Dietary Guidelines for Americans. 8th Edition. December 2015. <http://health.gov/dietaryguidelines/2015/guidelines/>

U.S. Department of Health and Human Services. Physical Activity Guidelines for Americans, 2nd edition. 2018. https://health.gov/paguidelines/second-edition/pdf/Physical_Activity_Guidelines_2nd_edition.pdf

Wang, Y., Wu, L., Lange, J.-P., Fadhil, A., & Reiterer, H. (2018). Persuasive technology in reducing prolonged sedentary behavior at work: A systematic review. *Smart Health*, 7–8, 19–30. <https://doi.org/10.1016/j.smhl.2018.05.002>

Webb, T. L., Joseph, J., Yardley, L., & Michie, S. (2010). Using the internet to promote health behavior change: a systematic review and meta-analysis of the impact of theoretical basis, use of behavior change techniques, and mode of delivery on efficacy. *Journal of Medical Internet Research*, 12(1), e4. <https://doi.org/10.2196/jmir.1376>

Windsor, P. (2019, June 14). Chris Hemsworth Worked With Elite Team of Trainers To Create “Centr” Health & Fitness App. Forbes. <https://www.forbes.com/sites/pamwindsor/2019/06/14/chris-hemsworth-worked-with-elite-team-of-trainers-to-create-centr-health--fitness-app/>

World Health Organization (2018, February 23) Physical activity. <https://www.who.int/news-room/fact-sheets/detail/physical-activity>

Appendix A: Recruitment Messages

Subject Line

Provide your feedback to help people build healthy habits

Message

Have you used mobile apps to help develop healthier eating and exercise habits? As the health and fitness market continues to grow, I am interested in getting feedback to learn how well mobile apps support you in achieving your goals. This evaluation is very important because it will result in the necessary insight to improve mobile apps, so we can become our healthiest selves.

If you own a smartphone, are over the age of 18, and able to engage in physical activity that may lead to weight loss, then your participation is welcomed for this project!

Those that have been advised against weight loss and/or physical activity, (such as pregnant, nursing, medical condition preventing exercise, underweight, or those under the age of 18), I appreciate your time and will keep your interest in mind for future studies upon request.

Appendix B: Screener Survey

Introduction

Hi there! Thank you so much for your interest in helping us complete research on health and fitness mobile apps. In order to understand a little bit more about you before our study activities, we have prepared this quick 3-5 minute survey for you to fill out. There are no right or wrong answers. Your responses will be kept confidential and only used for the purpose of this research project. Any questions? Email cameron.eackles@ubalt.edu

1. Do you have daily access to a smartphone that has working audio and camera functions?
2. When was the last time you used a health & fitness mobile app? (examples: MyFitnessPal, Fitbit, Real Appeal, Weight Watchers, Noom, RunKeeper)
3. Are you currently pregnant, nursing, or trying to conceive?
4. Has your physician advised AGAINST weight loss for any reason?
5. Are you physically & medically ABLE to engage in exercise?
6. What is your age?
 - ☐ under 18
 - ☐ 18-24
 - ☐ 25-34
 - ☐ 35-44
 - ☐ 45-54
 - ☐ 55-64
 - ☐ 65+
 - ☐ Prefer not to answer
7. What is your current weight (lbs)?
8. What is your gender?
 - ☐ Female
 - ☐ Male
 - ☐ Transgender Female

☐ Transgender Male

☐ Prefer not to answer

9. What is your height (feet & inches)?

10. Which of the following features would you want in a health & fitness app?

☐ Meal plans

☐ Food tracking

☐ Stress relief tips and/or Meditations

☐ Workout videos

☐ Sleep analysis

☐ Customizable goals

☐ Support and/or Accountability

☐ Information on nutrition, exercise, & health

☐ None of the above

☐ Other

Confirmation Message

Thank you so much for taking the time and for your willingness to help us with our research! We will be in touch with you within 72 hours.

Appendix C: Surveys and Diary Studies Consent Form

Consent form for Participation in Research Activities

Introduction/Purpose

I am being asked to participate in a research study for a master's thesis. The purpose of this study is to determine the impact of artificial intelligence or human coaching in health and fitness mobile apps. I am being asked to volunteer because I am over the age of 18 years old, able to engage in physical fitness, and interested in living a healthier lifestyle. My involvement in this study will begin when I agree to participate and will continue until approximately 30-42 days from that time.

Procedures

As a participant in this study, I will be asked to download a health and fitness mobile application. The app offers a 7-day free trial, but it will cost \$19.99 per month after the trial expires. I will be incurring costs until the time of reimbursement. I will provide my feedback and interactions with the application by completing a short video diary and 4 brief surveys (approximately 8-10 questions each). My participation in this study will last for no more than 6 weeks. I will be able to participate in these activities and use the application at home. Audio/video recordings will occur via video diaries. No personal identifying information will be written down from my responses to the study questions.

Risks and Benefits

My participation in this study does not involve any risks. While my participation in this research may not benefit me individually, it is possible for participants to achieve weight loss, an increase in energy/stamina, self-confidence, improved medical assessments/lab results, and other behavior, mental, and physical benefits upon completing the fitness/nutritional plans.

Confidentiality

Any information learned and collected from this study in which I might be identified will remain confidential and will be disclosed ONLY if I give permission. All information collected will be on a password-protected computer and no notes will be written down on physical paper. Only the investigator will have access to these records. If any information learned from this study is published, I will not be identified by name. By signing this form, however, I allow the

research study investigator to make my records available to the University of Baltimore Institutional Review Board (IRB) and regulatory agencies as required to do so by law. My information collected as part of the research, even if identifiers are removed, will not be used or distributed for future research studies.

Check if images or video are recorded during the research study:

- ☐ Yes, I do give permission to use my transcribed video recordings in this project
- ☐ No, I do not give permission to use my transcribed video recordings in this project

Check if voice recordings are used during the research study:

- ☐ Yes, I do give permission to use my transcribed voice recordings in this project
- ☐ No, I do not give permission to use my transcribed voice recordings in this project

Compensation/Costs

I will receive a \$20 gift card reimbursement for my one-month participation of the selected application. Should the study expand past the 7-day trial and one-month time frame, I will be reimbursed with an additional \$20 gift card, totaling no more than \$40. It will be upon my responsibility and decision to either cancel the application, thus discontinuing costs, or continuing with any monthly fees after the final survey/research activities end. Should my participation end due to my voluntary withdrawal before the research study is concluded, but after occurring the one-month cost, I will still receive my \$20 reimbursement for my participation.

Contacts and Questions

The principal investigator, Cameron Eackles, has offered to and has answered any and all questions regarding my participation in this research study. If I have any further questions, I can contact Cameron Eackles at cameron.eackles@ubalt.edu. For questions about rights as a participant in this research study, contact the UB IRB Coordinator: 410-837-4057, irb@ubalt.edu.

Voluntary Participation

I have been informed that my participation in this research study is voluntary and that I am free to withdraw or discontinue participation at any time.

I will be given a copy of this consent form to keep.

Signature for Consent

The above-named investigator has answered my questions and I agree to be a research participant in this study. By signing this consent form, I am acknowledging that I am at least 18 years of age.

Participant's Name: _____ Date: _____

Participant's Signature: _____ Date: _____

Investigator's Signature: _____ Date: _____

Appendix D: Surveys 1 - 4

Invitation Message

Hey there! Thank you so much for helping with this project. I'm looking forward to learning more about you and your experiences with [Assigned App]. This survey should take about 2 minutes to complete. Remember, there are no right or wrong answers. Thanks again for your participation!

Survey 1

1. When you are using a website or app, how important is it to you to converse with a real person (i.e. not an automated chatbot)?
2. In a typical week, how many times do you engage in 30 minutes of moderate to vigorous activity? (e.g. brisk walking, playing sports, gym or video workouts)
3. Do you feel you get too much exercise, too little exercise, or about the right amount of exercise?
4. In a typical day, how many of your meals or snacks include vegetables?
5. In a typical week, about how many of your meals are home-cooked?
6. How easy is it to understand the information on the app?
7. How well does this app meet your needs?
8. Have you taken any screenshots with notes or videos to share your feedback on the app?
9. How many stars would you give this app? [1 - 5]

Survey 2

1. Compared to other health & fitness apps, is this app quality better, worse, or about the same?
2. In the past 7 days, about how many cups of vegetables did you eat each day? If you don't know for certain, please provide an estimate.
3. Was this an increase, decrease, or about the same as the week prior?
4. In the past 7 days, how many days did you engage in 30 minutes of moderate to vigorous activity (i.e. brisk walking/jogging, playing sports, yardwork, gym, workout video)?
5. Was this an increase, decrease, or about the same as the week prior?

6. Which of the following have you interacted with either through social media, via email, or in your assigned app? [Options: My automated coach (chatbot), a Coach or personal trainer, Other members/users of my assigned app, N/A - I have not interacted or conversed with any of the above]
7. How engaging is the design?
8. I can easily track my progress
9. I can customize my workouts based on my fitness goals
10. What suggestions do you have for improving this app?

Survey 3

1. I can customize my meal plan and/or recipes in the app
2. What do you like most about the app? [Options: Navigation, Features, Design, Content, Other]
3. What do you like least about the app? [Options: Navigation, Features, Design, Content, Other]
4. Is there anything more you'd like to share about your likes or dislikes?
5. Using the app is helping me improve my eating and exercise habits
6. Do you think the monthly subscription fee for this app is too cheap, too expensive, or about right?
7. How likely are you to continue your app subscription after this research project ends?
8. Have you explored the app's website and/or social media pages?

Survey 4

1. How many days over the past 7 days did you sign in to the app?
2. Since using the app, how do you feel about your motivation to make healthier choices? (e.g. more physically active, smaller portions, less fried foods, etc.)
3. If you have noticed a difference, please expand on what changes you have made...
4. How many days over the past 7 days, did you eat 2 cups or more of vegetables?
5. How many days over the past 7 days, did you engage in moderate to vigorous activity? (e.g. brisk walking/jogging, playing sports, yardwork, gym, workout video)
6. How likely is it that you would recommend this app to a friend or colleague?
7. You selected that score because...

8. What is your current weight (pounds)?
9. If you would like me to keep you in mind for any future user experience studies, please provide the following... [first and last name and phone number]