The Pennsylvania State University

The Graduate School

College of Information Sciences and Technology

THE HEALTH JOURNEY OF COLLEGE WOMEN WITH EATING DISORDER BEHAVIORS: A QUALITATIVE STUDY ON THE USE AND UNINTENDED CONSEQUENCES OF MOBILE WEIGHT LOSS APPLICATIONS

A Dissertation in

Information Sciences and Technology

by

Elizabeth Victoria Eikey

Submitted in Partial Fulfillment
of the Requirements
for the Degree of

Doctor of Philosophy

August 2017

The dissertation of Elizabeth Victoria Eikey was reviewed and approved* by the following:

Lynette (Kvasny) Yarger
Associate Professor of Information Sciences and Technology
Academic Program Coordinator of Information Sciences and Technology B.S.
Dissertation Advisor
Chair of Committee

Andrea H. Tapia
Associate Professor of Information Sciences and Technology
Director of Graduate Programs for the College of Information Sciences and Technology

Eun Kyoung Choe
Assistant Professor of Information Sciences and Technology

Kathleen L. Keller
Assistant Professor in the Department of Nutritional Sciences and Food Science

Madhu C. Reddy
Professor of Communication Studies, Northwestern University
Special Member

*Signatures are on file in the Graduate School.

ABSTRACT

College can be a stressful time for students. During this transitional phase, many young women face new challenges, including unique social and academic stressors, which increase the risk of developing eating disorders and eating disorder behaviors. In fact, it is estimated that 7% to 18% of college women screen positive for eating disorders. College women are also increasingly using mobile health applications for diet, physical activity, and weight loss (weight loss apps) even when weight loss may be unnecessary. These apps support dieting and promote the thin ideal, which are related to the development of eating disorders. Thus, the combination of the college environment and use of weight loss apps may further exacerbate eating disorder behaviors among this population. However, the usage and consequences of weight loss apps in the context of eating disorders is not well known.

Some aspects of weight loss apps may be helpful for eating disorder recovery while others may inhibit recovery and even harm users. Significant research exists on weight loss apps and the quantification of health behaviors, known as the quantified self, in Human-Computer Interaction (HCI). However, most of these studies view weight loss apps as a positive influence on users and a way to combat the obesity epidemic in the United States. While the negative effects of social media and pro-eating disorder communities have been well studied, this research tends to ignore the potential negative implications of weight loss apps. In terms of positive use and impact, research tends to focus on online eating disorder support communities and treatment apps and often neglects potential positive aspects of non-eating disorder specific technologies, such as weight loss apps.

In this dissertation study, I address these limitations in existing research by conducting a qualitative study, which includes think-aloud exercises and semi-structured interviews, with

college women with eating disorder behaviors. The bulk of this research rests on the main study, which aims to understand the usage and unintended consequences of weight loss apps among this population. Through this research, I provide an understanding of why college women with eating disorder behaviors use weight loss apps, descriptions of how weight loss apps are used, and descriptions of unintended negative and positive consequences.

This dissertation study is important because it is among the first research to consider the role of weight loss apps in the context of eating disorders. Findings from this research contribute to our understanding of eating disorders and app design. Specifically, I present *a conceptual understanding* of an individual's *health journey*, which includes the changing nature of app use and the mutual influence between an individual and technology. Then I provide *an identification of problematic aspects of design*, which challenges the current narrative about weight loss apps. Based on problematic aspects of design, I make *design suggestions*, which are important for designing future weight loss apps and other similar health technologies to focus more on promoting healthy behaviors. This research emphasizes the need for a fundamental shift in how we think about and design for health within apps.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

As I sit on my couch with a sleepy puppy on each side of me and Andrew McMahon playing through my speakers (as I have many days prior), I try to find the words to explain how I feel about the last five years here. While growing as a researcher, teacher, mentor, and person is a notable part of this process, the people you meet and connect with along this journey truly make the experience. I would like to take this time to thank some of those people.

First, I would like to thank my closest grad school friends for their continuous support, advice, and love. In particular, I would like to thank one of my best friends, officemate, and colleague (the first graduate student I met sitting in my advisor's office), Kayla Booth, for always being there to share my life and work through both professional and personal triumphs and challenges. Kayla, you have shown me true friendship. I always laugh when I think about how we took our friendship to the "next level" after a late night craft session. From then on, we've spent so much time not only working together, but also enjoying life – from State College to Pittsburgh and back again. You made the good moments better and the bad ones bearable. "That's what friends are for!" Love you!

I would also like to acknowledge Tristan Endsley for her support and love. Although we spent a lot of time working together in class, our friendship really blossomed after bocce. Tristan, some of my fondest memories are of you making us food while we worked in our pajamas. You helped me find my love for avocados! I'm so thankful for our adventures, and I can't wait for more girls' trips to Boston.

I also want to thank Joslenne Peña. Joslenne, our friendship grew from school to snapchats. Thank you for being there and always offering me much needed coffee during your daily SB trip. Kayla, Tristan, Joslenne, and I spent countless hours working together either in my apartment or at coffee shops and still made time for non-work-related adventures. Being surrounded by this group of strong, intelligent, independent, and caring women has changed my life for the better. I will miss those days, but I know I have made lifelong friendships.

Thank you to the many other friends I have made during my time at Penn State, including but not limited to Alison Murphy, Tamara Peyton, Jake Weidman, Nathan Aileo, Evan Friedenberg, and Rob Chatt, as well as those with which I shared various lab spaces.

I would also like to acknowledge my longtime friends Johnna Blair (my random freshman roomie turned lifelong friend), Kristina Piscitelli (one of my best friends from undergrad), Amanda (Valenti) Rhinehammer (my OR!), Sarah (Bercik) Russell (my oldest friend – since elementary school), and Randy Stein (one of my closest friends since I was 13), to name a few. You helped to ground me to the outside world and have shown your support many times over.

In addition to my friends, I am grateful for my mentors, Madhu Reddy, Lynette (Kvasny) Yarger, and Erika Poole. Each played a pivotal role in either my being in the program or my getting through it. Madhu, thank you for your guidance and advice along this journey – even at a distance. Lynette, you have been a true advocate for me, and I could never thank you enough for your support. I would also like to thank the other members of my committee, Andrea Tapia, Eun

Kyoung Choe, and Kathleen Keller, for their help and time throughout this process. Additionally, I want to acknowledge Mary Beth Rosson for her support.

Many at Penn State as well as other institutions have had an influence on me and my path to and through graduate school. However, I must acknowledge Kathleen Moore, who I met by chance while working a retail job. Without our serendipitous encounter, I would not be writing this now. As a graduate student herself at the time, she helped me navigate the world of academia. I will forever be grateful for your guidance.

I would like to thank my family, especially my mom, my sister (Emily), and my dad for their support not only through my PhD but also through my life. Mum, you have always done everything in your power to give Emily and me the best life possible and maybe more importantly, the confidence to go get it ourselves. I owe my independent mindset to your strength and tenacity. (3 butt hearts)

Sister girl, we have always been incredibly close and that will never change. I have known you almost my entire life, and you don't know a world without me. That sister bond is something so special, and I'm so thankful to have you in my life. From the good and bad, fun (like road-tripping to get our babies, playing school and making you write real book reports, sled riding in our backyard, pretending to be dogs, blasting post-hardcore music in my car, playing the float game, and so many more) and not so fun memories (like when you fell off the yellow slide in South Park), you are and always will be my best friend. With you, I always know someone is in this with me. "1. I love you. 2. You're my sister."

Dad, you help me to remember to see the positivity in life. You are intelligent and creative. You have always supported my love and passion for writing, and I know I have that talent in part because of you. All three of you have always expressed how much you believe in me, and even at a distance, I can feel your love. I love you all.

I have to thank my two pups, Tesla and Juno, and my sister's pup, Maci. Although it may not seem like much to some, I cannot express how a dog's unconditional love can help one overcome the most trying obstacles. I spent many days working on my couch with my puppies cuddled on my lap. More than anyone, they have seen me at my best and worst, and regardless of my successes, failures, and moods, they always welcome me with puppy kisses and wagging tails and nubs. They played a substantial role in my happiness and anxiety relief, and they witnessed me grow into a more confident and capable person. I love you, little babies (also known as schlups, noons, loolies, noodies).

Finally, I would like to thank my love, Andrew Stout. He was there before I even applied to graduate school. He is strong and kind. Although it was not always easy, he continuously supported me through the ups and downs. He often found ways to show his love from surprising me with food or a smoothie to buying me flowers. When I was too busy, he picked up the slack. In fact, I cannot count how many times he went to the grocery store for me or cooked us dinner. Those things may seem insignificant, but little things matter. Not everyone would put in the time and effort to support someone else's dreams. Andrew, I am so lucky to have you in my life, and I'm excited for our next adventure together.

There are many more people who have had an impact on me, and I thank you. I would not be here without all of you, and I could never fully express my gratitude and love.

This process has been both trying and extremely rewarding. Reflecting on my life thus far, I see the pieces are starting to come together, the story starting to make sense. Good and bad memories seep into my thoughts, from the highs of life to feeling so low, so broken. I think about my need to connect with, understand, and even help others (sometimes to my own detriment) and my will to always push forward. I think about myself - how I've changed and how I've stayed the same. I think about how sometimes the things you learn when you're younger play a pivotal role in where you end up – even if you have to remind yourself of them from time to time.

> *I used to fear what I didn't know. I would avoid things that I didn't know everything about. As a result, I've missed out on a lot. I will remember everything, but I'll never regret. Now, I'm not afraid. I know that people are better than I am at certain things. To be successful, you have to realize that you aren't always going to be the best at everything. Some things will be difficult to achieve. I know that. Because I have opened my eyes to the things that I have been blind to for so long, I am different. Not everybody will look at this and think that I am right. But that's just an opinion. I am my toughest critic, and I have learned to accept myself when I'm less than perfect. I have also learned to take chances. If no one ever took a risk, we would never have gotten anywhere. I know how hard it is to take a risk, especially if you know that you could lose something, but that risk may be an important thing that needs to be considered. Although I may be different from how I used to be, deep down inside, I will always be me. The moral of my story: There is a big difference between being "the best" and being "your best." It was hard for me to accept this, and then I opened my mind to new things. When I finally realized it, so many doors opened up, and I became aware of things that had been there all the time. – 14 year old me (Tuesday, March 16, 2004)*

All of these things have made me who I am. I'm starting to see the connections, finally able to draw the lines, and I'm interested to see what's next. Now, I have found meaning in my research and its ability to impact people. I have found my passion in empowering people and helping to give them a voice. And I will carry that with me forever.

In addition to my personal connections, I would like to acknowledge my participants. This research would not be possible without them. I would also like to thank the National Science Foundation for their generous support.

This material is based upon work supported by the National Science Foundation under Grant No. DGE1255832. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Portions of this dissertation are based on material from the following publications:

Eikey, E.V. & Madhu Reddy. 2017. "It's Definitely Been a Journey": A Qualitative Study on How Women with Eating Disorders Use Weight Loss Apps. Proceedings of the *ACM CHI Conference on Human Factors in Computing Systems (CHI '17)*. Denver, CO. (Acceptance rate: 25%)

Eikey, E.V. 2016. Privacy and Weight Loss Apps: A First Look at How Women with Eating Disorders Use Social Features (Poster). ***Best Poster Award.*** Proceedings of the *ACM 2016 Conference on Supporting Group Work* (*GROUP '16).* Sanibel Island, FL. November 13-16, 2016.

Eikey, E.V. 2016. The Use of Weight Loss Apps by Users with Eating Disorders (Doctoral Consortium). *SIGMIS-CPR '16: Proceedings of the 2016 ACM SIGMIS-CPR Conference on Computers and People Research*. Washington, D.C. June 2-4, 2016. p.3-4.

Eikey, E.V. 2016. Providers' Perceptions of the Impact of Weight Loss Apps on Users with Eating Disorders (Poster). *SIGMIS-CPR '16: Proceedings of the 2016 ACM SIGMIS-CPR Conference on Computers and People Research. Washington, D.C.* June 2-4, 2016. p.19-20.

Eikey, E.V. *In Press.* "Unintended Users, Uses, and Consequences of Mobile Weight Loss Apps". Book chapter in *Mobile Health: Adoption, Implementation and Use of Current and Emerging Technologies.* Springer.

Eikey, E.V., Booth, K., Reddy, M.C., Kvasny, L., Blair, J., Li, Victor, Poole, E.S. Desire to be Underweight: An Exploratory Study on a Weight Loss App Community & User Perceptions of the Impact on Eating Disorder Behaviors. (Journal Paper). *Under Review.*

So, I guess we are who we are for a lot of reasons. And maybe we'll never know most of them. But even if we don't have the power to choose where we come from, we can still choose where we go from there. We can still do things. And we can try to feel okay about them.

—Stephen Chbosky, *The Perks of Being a Wallflower*

1 INTRODUCTION

1.1 Problem Motivation

College can be a stressful time for students. During this transitional phase, many young women face new challenges, including unique social and academic stressors, which may increase the risk of developing eating disorder behaviors[1] (Berg, Frazier, & Sherr, 2009). Not only do women experience a great deal of independence for the first time, but they also are thrust into a new environment with more opportunities to compare themselves to other women, which can increase body dissatisfaction, a risk factor for eating disorders (Rodgers, McLean, & Paxton, 2015). This drastic life event can trigger eating disorder behaviors (American Psychiatric Association, 2013). Thus, it is no surprise eating disorders and eating disorder behaviors are more prevalent among women in college (Berg et al., 2009; D. Eisenberg, Nicklett, Roeder, & Kirz, 2011; V. M. Quick & Byrd-Bredbenner, 2013; Schwitzer, 2012; Schwitzer & Choate, 2015).

Some researchers have found that 13.5% of undergraduate women have positive screens for eating disorders (D. Eisenberg et al., 2011), and 40% to 49% of college women engage in eating disorder behaviors at least once a week (Berg et al., 2009). These behaviors need more attention as they have serious implications. For example, eating disorder behaviors are associated with poor dietary quality (Woodruff, Hanning, Lambraki, Storey, & McCargar, 2008), depression, anxiety, self-injury, and substance use (D. Eisenberg et al., 2011; Gillen, Markey, & Markey, 2012), and eating disorders can lead to malnutrition, amenorrhea, organ failure, depression, suicide, and death (American Psychiatric Association, 2013).

Smartphone and mobile application (app) use are also pervasive in this group (Fox, 2013; Fox & Duggan, 2012; "Mobile Fact Sheet," 2017; Smith, 2015). In fact, Pew Research found

[1] Please see section 2.1.1 for more information about eating disorder behaviors.

that 92% of 18 to 29 year olds own a smartphone as of 2017 ("Mobile Fact Sheet," 2017), and 75% use their smartphone for health-related purposes (Smith, 2015). Although this includes searching for health information, the use of health apps is also on the rise (Fox, 2013; Kamanga, 2016). One study found that 52.3% of college students use health apps (Kamanga, 2016). In particular, mobile health apps that allow users to track their diet, physical activity, and weight are especially popular (Fox & Duggan, 2012; Krebs & Duncan, 2015). These apps are often viewed as a way to help combat the obesity epidemic in the United States with little attention to their actual impact. Given that college women represent a large portion of app users and are at increased risk of developing eating disorders, it is crucial to understand the use of these types of health apps among this population.

These types of apps often are touted as a means to improve users' health. However, upon closer look, these apps often overwhelmingly focus on weight loss (see Appendix A for an example). Using weight loss as a proxy for health is problematic because it may increase the risk of or exacerbate eating disorder behaviors in an already susceptible group. Although these types of health apps are referred to by different terms (especially in research[2]), due to their heavy weight loss focus, I refer to any mobile health app that allows users to track their diet, physical activity, and weight as a *weight loss app*.

This emphasis on weight loss within these apps is consistent with and feeds into Western cultures' obsession with thinness and dieting. Weight loss is not just a means to improve health; especially among young adults, much of the motivation for weight loss is appearance (LaRose, Leahey, Hill, & Wing, 2013), underscoring society's expectations of how young women are supposed to look. In the United States, many women feel immense pressure to adhere to these

[2] Please see Chapter 2 for a description of other terms for weight loss apps.

beauty standards, which can lead to body image distortion, body dissatisfaction, and drive for thinness. All of these are risk factors for eating disorders (Boero & Pascoe, 2012; Lawler & Nixon, 2011; Liechty, 2010; Low et al., 2003; Peñas-Lledó, Bulik, Lichtenstein, Larsson, & Baker, 2015; Rohde, Stice, & Marti, 2015).

Additionally, weight loss apps not only support dieting behaviors, but they also encourage them. This is problematic because dieting behaviors and unhealthy weight control methods are also risk factors for developing an eating disorder (Ackard, Croll, & Kearney-Cooke, 2002; Neumark-Sztainer et al., 2006; Shisslak, Crago, & Estes, 1995). In fact, it is estimated that 35% of "normal dieters" develop eating disorder behaviors, and of those, 20% to 25% develop partial or full eating disorders (Shisslak et al., 1995). Many women who are of healthy weight and even underweight diet to lose weight (Fayet, Petocz, & Samman, 2012; Yaemsiri, Slining, & Agarwal, 2011), and some women engage in unhealthy weight control methods as part of "normal" dieting (Neumark-Sztainer, 2005; Neumark-Sztainer, Wall, Larson, Eisenberg, & Loth, 2011; Reba-Harrelson et al., 2009; Wade, Keski-Rahkonen, & Hudson, 2011).

In summary, weight loss apps support messages and behaviors that are known to relate to the development of eating disorders, and they are popular among college women, who are already at a higher risk for developing eating disorder behaviors and eating disorders. Thus, it becomes increasingly important to understand the use and consequences of weight loss apps among college women with eating disorder behaviors.

1.2 Research Motivation

While studies examining weight loss apps in the context of eating disorders are lacking, considerable amounts of research have focused on how technology can be helpful and harmful to

users with eating disorders. Studies related to the positive role of technology mostly focus on eating disorder recovery technologies, such as online support groups and treatment apps (Juarascio, Manasse, Goldstein, Forman, & Butryn, 2015; Keski-Rahkonen & Tozzi, 2005; Tregarthen, Lock, & Darcy, 2015). Only recently have researchers begun to examine both the positive and negative uses and impacts of the same technology in the context of eating disorders (Stevie Chancellor, Mitra, & De Choudhury, 2016; Choudhury, 2015; Eikey & Booth, 2017; Tan, Kuek, Goh, Lee, & Kwok, 2016). However, few researchers have studied how the role of technology may change even for a single user.

While some researchers have investigated technology as a beneficial tool for those with eating disorders, the majority of research focuses on the negative uses and influences of technology on eating disorder behaviors and users with eating disorders. Much of the research on the negative impact of technology on eating disorders has emerged from the psychology domain and the sociocultural perspective of eating disorders. This perspective is used to understand how social and cultural factors, such as traditional media and now new media, affect an individual's mental processes and behaviors (Sanderson, 2010). In the past, research has focused mostly on conventional mass media, such as magazines and television. However, the impact of new media, such as online content, on the thin-ideal, body image, drive for thinness, and eating disorder symptomology is of increasing concern (Perloff, 2014). Therefore, recent work has considered the role of social media. Findings show that social media is associated with poor body image and eating disorders, especially among women and girls (Andsager, 2014; Fardouly, Diedrichs, Vartanian, & Halliwell, 2015; Mabe, Forney, & Keel, 2014; Meier & Gray, 2014; Stronge et al., 2015). Recently, some Human-Computer Interaction (HCI) researchers have examined eating

disorder content on social media (S. Chancellor, Pater, Clear, Gilber, & De Choudhury, 2016a; Stevie Chancellor, Lin, & De Choudhury, 2016; Pater, Haimson, Andalibi, & Mynatt, 2016).

With the growing interest in weight loss and fitness spaces on social media, more research is now being devoted to understanding how "health" content relates to eating disorders. Researchers have found many online weight loss and fitness communities either overtly or subtly promote eating disorders, and this negatively affects users who are trying to address their eating disorder issues (Stover, 2014; Tiggemann & Zaccardo, 2015). The vast majority of this research views technology as acting on the user, rather than exploring the mutual influence the user and technology may have on one another. Although researchers have recognized the importance of understanding the effects of new media on eating disorder symptomology, their focus has largely been on social media with little consideration to other types of technologies, like weight loss apps.

Although weight loss apps have not been studied thoroughly in the context of eating disorders, there is significant research on weight loss apps and the quantified self movement in HCI. Current research tends to view these apps and the quantification of behaviors as a way to positively impact users' health. Thus, the focus is on designing apps to motivate users to eat less or healthier, exercise more, or use these apps long-term (Berkovsky, Freyne, & Coombe, 2012; Choe, Lee, Lee, Pratt, & Kientz, 2014; Cordeiro, Bales, Cherry, & Fogarty, 2015; Hsu et al., 2014; Mueller, Marshall, Khot, Nylander, & Tholander, 2014; Rooksby, Rost, Morrison, & Chalmers, 2015; Stawarz, Cox, & Blandford, 2015; Vyas et al., 2015; Walsh & Golbeck, 2014) and understanding how this technology contributes to users' ability or their perception of their ability to achieve health goals, such as weight loss and increased physical activity (Choe, Lee, Munson, Pratt, & Kientz, 2013; Neve, Morgan, Jones, & Collins, 2009). While these apps can be

useful tools (Fox & Duggan, 2012; Smith, 2015), negative aspects of weight loss apps are not well understood. Although some HCI researchers have challenged the idea that these apps are always positive or appropriate (Cordeiro et al., 2015; Purpura, Schwanda, Williams, Stubler, & Sengers, 2011), to date, the potential unintended negative consequences of weight loss apps in the context of eating disorders have not been thoroughly investigated.

My research aims to address these gaps by examining how college women with eating disorder behaviors use weight loss apps and the unintended consequences of using them. The term "unintended consequences" refers to unforeseen or unpredicted results to a specific action (Campbell, E. M., Sittig, D. F., Ash, J. S., Guappone, K. P., Dykstra, 2006). This terminology is common in discussing technological impact, especially related to health information technology. These consequences can be positive, negative, or neutral. Additionally, I take a mutual shaping approach, highlighting the influence between the user and the app and how it impacts both use and consequences. By doing so, I also shed light on the changing role weight loss apps play for college women.

1.3 Research Objectives, Questions, and Contributions

In order to address the limitations of existing research, I have three objectives for this dissertation study: 1) provide *an understanding* of why college women with eating disorder behaviors use weight loss apps, 2) provide *descriptions* of how college women with eating disorder behaviors use weight loss apps, and 3) provide *descriptions* of the unintended negative and positive consequences.

Prior to beginning my main study, I identified three research questions to help me address these research objectives. These questions are based on the gaps in the existing literature and informed by my preliminary study (see Table 1-1). Due to the limited research on weight loss

apps in the context of eating disorders, my research questions are broad. This is intentional in order to try to capture as much information about users' experiences with weight loss apps as possible. While the preliminary study showed that users with unhealthily low weight goals use weight loss apps and they post about eating disorders and eating disorder behaviors in forums associated with a weight loss app, the findings did not provide a thorough understanding of usage and consequences nor did they answer why users choose weight loss apps (see Chapter 4 for more about the preliminary study). Therefore, the contributions of this research primarily come from the main study.

Research Gaps	Research Questions	Research Objectives
There is limited understanding of why college women with eating disorder behaviors use weight loss apps.	***RQ1: Why do college women with eating disorder behaviors use weight loss apps?***	Provide *an understanding* of why college women with eating disorder behaviors use weight loss apps
Most research considers the negative use of technology for eating disorders and the positive use of weight loss apps. There is limited understanding of the positive and negative uses of weight loss apps in the context of eating disorders.	***RQ2: How do college women with eating disorder behaviors use weight loss apps?***	Provide *descriptions* of how college women with eating disorder behaviors use weight loss apps
Most research considers the negative impact of social media and online communities for eating disorders, the positive implications of eating disorder recovery technology, and the positive impact of weight loss apps. Research is lacking on the impact of weight loss apps in the context of eating disorders.	***RQ3: What are the unintended consequences (positive and negative) of weight loss apps for this population?***	Provide *descriptions* of unintended consequences experienced

Table 1-1. Research gaps, questions, and objectives

My research makes three primary intellectual contributions in HCI and psychology, as shown in Table 1-2. The first intellectual contribution is *a conceptual understanding* of an individual's health journey, which includes the changing nature of app use and the mutual influence between an individual and technology. The second and third contributions are related. Through the think-aloud exercises and semi-structured interviews with college women with eating disorder

behaviors, I also provide *an identification of problematic aspects of design*, which challenges the current narrative about weight loss apps. Based on problematic aspects of design, I make *design suggestions*, which are important for the future of weight loss apps and other similar health technologies. In the next section, I describe my approach to answering my research questions.

Research Community	Existing Research	My Contributions to Existing Research
HCI, Psychology	Views social media as problematic in the context of eating disorders	Provides *a conceptual understanding of an individual's health journey*, highlighting the changing nature of weight loss apps and mutual influence between an individual and technology
Psychology	Focuses on the negative uses and influences of social media and online communities and the positive uses and influences of eating disorder recovery technologies From the sociocultural perspective, views social media as acting on users	
HCI	Provides details on weight loss app design and views weight loss apps as a positive influence on users	Provides *an identification of problematic aspects* of weight loss app design Makes *design suggestions* based on problematic aspects of design

Table 1-2. My contributions to research communities based on existing research

1.4 Research Approach

In order to address the research gaps and answer my research questions, I used qualitative methods to identify the reasons college women with eating disorder behaviors use weight loss apps, how they use weight loss apps, and the unintended consequences from using them. While the preliminary study provided a first look at the use and impact of weight loss apps by women with eating disorder behaviors, the bulk of the research (including the findings and discussion points) is from the main study. As part of the main study, I conducted think-aloud exercises and semi-structured interviews to observe how college women use weight loss apps and gain insights into their experiences with, perceptions of, and reflections about not only their eating disorder behaviors, but also weight loss apps.

It is important to note that the goal of this research is not to prevent users with eating disorders or eating disorder behaviors from using weight loss apps nor is it to find ways to identify users with eating disorders in order to prohibit access to the app. Banning these users may be more harmful than helpful. I do not want to isolate these individuals or increase the stigma around eating disorders. Instead, I want to understand their experiences and challenges as well as open a discussion around ways to promote healthy behaviors through technology. This approach helped me gain valuable insights about women with eating disorder behaviors as well as the design of weight loss apps.

1.5 Dissertation Overview

This dissertation has the following structure:

Chapter 2 Background describes eating disorders and eating disorder behaviors. It also summarizes literature from HCI and psychology related to the use and effects of technology in the context of eating disorders, the quantified self, and weight loss apps.

Chapter 3 Methodological Approach provides an overview of my qualitative approach to both the preliminary study and the main study as well as quality criteria.

Chapter 4 Preliminary Study presents the data collection, methodology, analysis, findings, discussion, and limitations of the preliminary study. This chapter describes a first look at eating disorder behaviors of weight loss app users by showing the prevalence of underweight goals and example posts about the impact of weight loss apps in relation to eating disorders.

Chapter 5 Main Study: Part 1 - Preliminary Study Connection, Methods, & Analysis first explains how the main study addresses the limitations of the preliminary study. Then it focuses on the methods and analysis of the main study.

Chapter 6 Main Study: Part 2 - Findings provides a description of the main study's findings, including information about the participants, why they use weight loss apps, how they use them, and the unintended consequences.

Chapter 7 Discussion: Part 1 – Comparing and Contrasting Preliminary and Main Study Findings is a short chapter that compares and contrasts the findings from the preliminary study and the main study.

Chapter 8 Discussion: Part 2 – Insights from the Main Study focuses on insights from the main study. This chapter provides the conceptual understanding of the *health journey*, identifies *problematic design aspects*, and provides *design suggestions*.

Chapter 9 Conclusion includes a final summary of the contributions of this dissertation study, limitations, and directions for future research.

2 BACKGROUND

The structure of this chapter is as follows: I first describe eating disorders and eating disorder behaviors as well as risk factors for eating disorders. Then I move to technology related to eating disorders. Primarily focusing on literature from psychology and HCI, I present research on the negative influence of technology in the context of eating disorders, which focuses on social media and online communities, and the positive influence of technology, which tends to focus on technology specific for eating disorder support and recovery, including online communities and mobile apps. Next, I discuss the popularity, terminology, and current research on weight loss apps. From there, I explain the mutual shaping approach, which is contrasted with the focus of most studies on technology and eating disorders. Finally, I describe current perspectives for understanding individuals' health, which cannot fully capture the relationship between eating disorders and weight loss app use and impact.

2.1 Eating Disorders and Eating Disorder Behaviors

2.1.1 Eating disorders vs. eating disorder behaviors

Eating disorders and eating disorder behaviors are mental health and psychological conditions, but they also deal with diet, nutrition, and exercise. The prevalence of eating disorders has been continuously increasing (Engel, Reiss, & Dombeck, 2007). While approximately 20 million girls and women in the United States have an eating disorder, many more have undiagnosed eating disorders, subclinical or subthreshold eating disorders, or eating disorder behaviors (Reba-Harrelson et al., 2009; Wade et al., 2011). People with subclinical or subthreshold eating disorders can display many of the same symptoms of clinical eating disorders. However, the degree of the behaviors often distinguishes these from clinical eating disorders. The prevalence of subclinical eating disorders is not well known.

According to the *Diagnostic and Statistical Manual of Mental Disorders-V* (*DSM-V)*, which provides standard criteria for the classification of clinical mental disorders, including eating disorders:

> *"Eating and feeding disorders are characterized by a persistent disturbance of eating or eating-related behavior that results in the altered consumption or absorption of food and that significantly impairs physical health or psychosocial functioning"* (p. 329) (American Psychiatric Association, 2013).

The types of eating and feeding disorders covered in the *DSM-V* include pica, rumination disorder, avoidant/restrictive food intake disorder, anorexia nervosa, bulimia nervosa, and binge-eating disorder[3]. There are also two categories in the *DSM-V* for eating disorders that do not meet the criteria for one of the aforementioned disorders: other specified feeding or eating disorder (OSFED) and unspecified feeding or eating disorder (UFED)[4]. Although many eating disorders do not qualify as a specific eating disorder, individuals would still benefit from treatment (D. Eisenberg et al., 2011).

While eating disorders are increasing among boys and men (Strother, Lemberg, Stanford, & Turberville, 2012), girls and women are more likely to develop eating disorders (Fairburn & Harrison, 2003). Some studies have reported that anorexia and bulimia nervosa are more likely to affect white women and girls in Western societies (Fairburn & Harrison, 2003); however, other research has reported similar rates of eating disorders among non-Hispanic whites, Hispanics, African Americans, and Asians with the exception of anorexia nervosa, which occurs more

[3] Body dysmorphic disorder, or a preoccupation with perceived defects of flaws in physical appearance, is distinct from eating disorders. In people with eating disorders, concerns about being fat are considered a symptom of the eating disorder not body dysmorphic disorder. However, in body dysmorphic disorder, weight concerns can occur, and eating disorders and body dysmorphic disorder can be comorbid. It is also important to note that obesity is not included as a mental disorder. However, obesity can be related to eating disorders, such as binge-eating disorder.

[4] Prior to the *DSM-V*, eating disorder not otherwise specified (EDNOS) was a category for eating disorders that did not meet the criteria for a specific eating disorder. Thus, I may refer to EDNOS throughout this dissertation.

frequently among non-Hispanic whites (Hudson, Hiripi, Pope, & Kessler, 2007; Wade et al., 2011).

In order to obtain a diagnosis of a clinical eating disorder in the United States, women must be seen by a healthcare professional and meet certain criteria as denoted in the *DSM-V*. However, many women never seek treatment even if they exhibit eating disorder symptoms and have positive eating disorder screens (D. Eisenberg et al., 2011). In fact, Eisenberg et al. (D. Eisenberg et al., 2011) found that college women with positive screens for eating disorders were unlikely to have received a diagnosis or any form of mental health treatment. Additionally, before meeting full criteria for an eating disorder, many people go through a period of changed eating behavior (American Psychiatric Association, 2013).

Therefore, I discuss both eating disorders and eating disorder behaviors. For the purposes of this research, *eating disorder behaviors* are behaviors associated with anorexia and bulimia nervosa. These include excessive calorie or food restriction, intense fear of gaining weight, obsession with weight and consistent behavior to prevent weight gain, self-esteem overly related to body image, bingeing, feeling of being out of control during bingeing, purging, dramatic weight loss, preoccupation with weight, food, calories, fat grams, and dieting, refusal to eat certain foods, comments about feeling "fat", hunger denial, excessive exercise regimen, and development of food rituals (American Psychiatric Association, 2013).

Although people with eating disorders benefit from treatment, many never get treatment for their eating disorder (D. Eisenberg et al., 2011; Hudson et al., 2007). There are a number of reasons why people do not get or complete treatment, including health beliefs, social factors, financial barriers, healthcare provider's attitude, and access to care (V. M. Quick & Byrd-Bredbenner, 2013; Thompson & Park, 2016). Additionally, healthcare providers may not

recognize there is a problem unless their patient explicitly mentions it, especially when there are no easily identifiable symptoms. Studies have found that eating disorders often go unrecognized (Becker, Thomas, Franko, & Herzog, 2005; Mond, Hay, Rodgers, & Owen, 2007; Thompson & Park, 2016). Individuals themselves may also not recognize their behaviors as disordered but rather view them as typical of dieting. It is culturally acceptable to diet, so eating disorder behaviors may become normalized. Finally, people with eating disorder behaviors may be hesitant to seek treatment due to the fear and anxiety associated with talking about their disorder and the stigma related to eating disorders (Bannatyne & Stapleton, 2016; Hackler, Vogel, & Wade, 2010; Livingston & Boyd, 2010). This may explain why some people turn to technology (Kummervold et al., 2002). Even if those with eating disorders do get treatment, dropout rates are high (Campbell, 2009).

Because many women do not see a professional for their symptoms and thus never receive a diagnosis, eating disorder behaviors in this context may or may not indicate full clinical eating disorders (in this case, anorexia or bulimia nervosa) or qualify to be categorized as OSFED or UFED. The women in this study self-identify as having an eating disorder. Therefore, in the remainder of this dissertation, I use eating disorder behaviors and eating disorders interchangeably to emphasize women's own perspectives and experiences with eating disorders and the importance of studying eating disorders even in the absence of a clinical diagnosis.

2.1.2 Anorexia nervosa, bulimia nervosa, and OSFED/UFED

For this research, I focus on behaviors associated with anorexia and bulimia nervosa, which could qualify to be categorized as OSFED or UFED, because a number of behaviors associated with anorexia and bulimia nervosa are related (American Psychiatric Association, 2013). Additionally, it is estimated that up to 41% of people who have anorexia nervosa develop

bulimia nervosa (Bulik, Sullivan, Fear, & Pickering, 1997). In this section, I describe the clinical criteria for anorexia and bulimia nervosa (see Table 2-1) as well as OSFED and UFED.

Eating Disorder	Criteria	Types	Example Behaviors
Anorexia nervosa	• Fear of gaining weight • Body image disturbances • Low body weight	Restricting type	Lose weight by dieting, fasting, excessive exercise
		Binge-eating/purging type	Binge eat and purge by self-induced vomiting, misuse of laxatives, diuretics, or enemas
Bulimia nervosa	• Recurrent episodes of binge eating • Recurrent inappropriate behaviors to prevent weight gain • Evaluate themselves by their weight and body shape • Typically weigh in healthy or overweight range	N/A	Binge eat and purge by self-induced vomiting, misuse of laxatives, diuretics, other medications, fasting, excessive exercise

Table 2-1. Overview of anorexia and bulimia nervosa

The lifetime prevalence of anorexia nervosa for females is 0.9% and for bulimia nervosa is 0.5% (Hudson et al., 2007). Approximately 1 out of 200 women and girls will develop anorexia nervosa, and 1 to 3 out of 100 will develop bulimia nervosa (Neumark-Sztainer, 2005). Anorexia and bulimia nervosa are associated with an increased risk of mortality (American Psychiatric Association, 2013). For instance, the mortality rate for anorexia nervosa is 12 times higher than that of all causes of death for 15 to 24 year old females (Sullivan, 1995). Mortality rates reported vary considerably across studies. One of the issues is that individuals with eating disorders may die from heart failure, other organ failure, malnutrition, or suicide. However, medical reports often only report those complications rather than the underlying condition that caused them. Eating disorders are associated with functional impairment and suicide and often co-occur with other mental health conditions, such as depression (American Psychiatric Association, 2013). Unfortunately, the prevalence of OSFED and UFED is not well known.

Anorexia nervosa is categorized by three criteria: significantly low body weight due to restrictive diet, strong fear of gaining weight or becoming fat, and body image disturbances.

Severely low body weight is determined by Body Mass Index (BMI) for adults and percentiles for children and adolescents. For example, mild anorexia nervosa is determined by a BMI of 17 kg/m^2 or greater (underweight BMI for adults is said to be under 18.5 kg/m^2), moderate is a BMI of 16 to 16.99 kg/m^2, severe is a BMI of 15 to 15.99 kg/m^2, and extreme is a BMI of less than 15 kg/m^2. However, healthcare providers can increase the level of severity based on clinical symptoms. There are two subtypes of anorexia nervosa, restricting type and binge-eating/purging type. For restricting type, people lose weight primarily through dieting, fasting, and/or excessive exercise. For binge-eating/purging type, people binge eat and/or purge by self-induced vomiting or the misuse of laxatives, diuretics, or enemas (American Psychiatric Association, 2013). People with anorexia nervosa often feel isolated, which may interfere with their academic or career pursuits and lead to depression and even suicide (American Psychiatric Association, 2013). The average age of onset is 19 years (Hudson et al., 2007).

Bulimia nervosa is categorized by recurrent episodes of binge eating and recurrent inappropriate behaviors to prevent weight gain, such as self-induced vomiting, misuse of laxatives, diuretics, or other medications, fasting, or excessive exercise. On average, these behaviors occur at least one time a week for 3 months. People with bulimia nervosa evaluate themselves by their weight and body shape. Mild bulimia nervosa is 1 to 3 episodes of offsetting behaviors per week, moderate is 4 to 7, severe is 8 to 13, and extreme is 14 or more. However, level of severity may be increased depending on symptoms. Unlike those with anorexia nervosa, people with bulimia nervosa usually have a body weight in the healthy or overweight BMI range ($\geq$18.5 and <30 in adults). There is increased suicide risk in individuals with bulimia nervosa (American Psychiatric Association, 2013). The average age of onset is 20 years (Hudson et al., 2007).

Even when people do not meet the clinical criteria for a specific eating disorder diagnosis, such as anorexia or bulimia nervosa, their eating behaviors can still be disordered. For instance, research has shown that there is a large portion of people who suffer from all the symptoms of anorexia nervosa but are not underweight (Fielder-jenks, 2013). These disorders may fall under the OSFED or UFED categories. According to the *DSM-V,* the OSFED category

> *"…applies to presentations in which symptoms characteristic of a feeding and eating disorder that cause clinically significant distress or impairment in social, occupation, or other important areas of functioning predominate but do not meet the full criteria for any of the disorders in the feeding and eating disorders diagnostic class"* (p. 384) (American Psychiatric Association, 2013).

There are five subtypes of OSFED: atypical anorexia nervosa (i.e., anorexic features without low weight), bulimia nervosa of low frequency and/or limited duration, binge eating disorder of low frequency and/or limited duration, and purging disorder (a person purges but does not binge) (American Psychiatric Association, 2013). Healthcare providers use OSFED when they wish to provide the reason the disorder does not meet the criteria for a specific eating disorder. UFED, on the hand, applies when healthcare providers do not wish or cannot specify the reason the symptoms do not meet the criteria.

2.1.3 Risk factors for the development of eating disorders

Eating disorders and eating disorder behaviors are complex; one sole factor cannot be implicated in their cause and development. While biological and psychological factors play a role in an individual's predisposition to and development of eating disorders (Culbert, Racine, & Klump, 2015), researchers in psychology have highlighted the sociocultural perspective, which states

that social and cultural factors play a significant role in the development and prevalence of eating disorders (Smolak & Levine, 2015).

The sociocultural perspective describes "people's behavior and mental processes as shaped in part by their social and/or cultural contact" (p. 19) (Sanderson, 2010). This perspective has been widely used in psychology research to understand how society's standards and media influence body image and related concepts (including body image distortion, body dissatisfaction, and drive for thinness) and eating disorder behaviors of girls and women. From this perspective, media, technology included, is a negative influence on eating disorders. According to the sociocultural theory of eating disorders "the mass media creates and promotes a standard of beauty that leads many adolescent and adult females to experience significant body dissatisfaction" (p. 17) (Spettigue & Henderson, 2004).

A great deal of research has sought to examine the impact of sociocultural influences on the development and maintenance of eating disorder behaviors (Smolak & Levine, 2015). The sociocultural model of eating disorders posits that "disordered eating is a result of internalizing the increasing pressures for women in Western society to achieve an ultra-slender figure/the thin ideal, which current cultural trends emphasize as an essential component of beauty" (p. 1225) (Fitzsimmons-Craft, 2011). Fitzsimmons-Craft (2011) developed an elaborated sociocultural model that better integrates social psychology theories of eating disorders. In this elaborated sociocultural model of eating disorders,

> *"A woman's motive for exposing herself to appearance media and the manner in which she chooses to interact with those media will moderate the impact of the sociocultural pressures on proposed downstream outcomes such as body dissatisfaction and eating pathology. Thus, exposure to appearance media and media pressures for thinness may*

more negatively impact a woman who intentionally uses that information in an inappropriate manner" (p. 278) (Smolak & Levine, 2015).

In the United States, the thin ideal is pervasive. Thus, many women have poor body image, including distorted body image and body dissatisfaction, and a high drive for thinness and engage not only in dieting, but also unhealthy weight control methods. Much of the work examining sociocultural influences of eating disorders has focused on how traditional mass media, such as television and magazines, may contribute to eating and body disturbances and body dissatisfaction (Smolak & Levine, 2015). Studies looking at the sociocultural influence of media on eating disorders have considered the decreasing weight and size of the ideal women's body through the portrayal of models, actresses, and beauty pageant contestants, an increase in diet foods and diet products especially directed at women, and the emphasis on the importance of appearance and beauty for women (Spettigue & Henderson, 2004).

When women feel as though they do not live up to society's picture of how they should look, which is unattainable for most women, some develop a distorted view of their body. One study found 27% of women consider themselves overweight or obese while only 11% actually fall into these categories (Fayet et al., 2012). Another study found that 23.4% of healthy weight women perceive themselves as overweight (Yaemsiri et al., 2011). Those who are underweight also mislabel their weight. Fayet et al. (2012) found that only 4.6% of women correctly classified themselves as underweight despite 10.6% actually being underweight. Even when viewing images of other women, women have skewed perceptions of what qualifies as "normal" weight, often referring to models who are underweight as "average" (Ahern, Bennett, Kelly, & Hetherington, 2011).

Because of these unreachable standards and constant comparison to others, many women are dissatisfied with their bodies and have negative body image. In North America, there is such a pervasive body dissatisfaction and preoccupation with weight that psychologists have developed the term "normative discontent", which describes the "normalcy" of being unhappy with one's weight as a woman (Spettigue & Henderson, 2004). This is now compounded by the prevalence of image filters on social media and "photoshopping[5]". Research has also shown that exposure to the media is correlated with body dissatisfaction (Spettigue & Henderson, 2004). Especially for girls and women, body dissatisfaction increases from middle school to high school and further increases during the transition to young adulthood (M. Bucchianeri & Neumark-Sztainer, 2014). For example, Juarascio et al. (2011) found that weight, eating disorder behaviors, and body image dissatisfaction increased during the first year of college.

These body issues negatively impact psychological health (M. Bucchianeri & Neumark-Sztainer, 2014). In fact, almost two-thirds of women report their happiness is negatively affected by their body and weight concerns (Reba-Harrelson et al., 2009). Additionally, body dissatisfaction is linked to mental health conditions, such as depression, and eating and weight problems, such as eating disorders (M. Bucchianeri & Neumark-Sztainer, 2014). Studies have shown body dissatisfaction is associated with internalization of the thin ideal (Lawler & Nixon, 2011; Low et al., 2003), and the internalization of the thin ideal, body image distortion, and body dissatisfaction are risk factors for eating disorder behaviors and eating disorders (Benowitz-Fredericks, Garcia, Massey, Vasagar, & Borzekowski, 2012; Liechty, 2010; Rohde et al., 2015).

This unattainable idea of beauty, pressures to be thin, distorted body image, and constant discontent with one's body partially explain why dieting is so prevalent among girls and women

[5] Photoshopping is the act of editing photos, often to remove "flaws" in order to make women look thinner and younger.

in the United States. A study using data from 2003 to 2008 found that 73% of adult women want to weigh less, 57.1% are pursuing weight control, and 46.2% are trying to lose weight (Yaemsiri et al., 2011). While dieting and desire to lose weight are common for overweight and obese women, women who are in the healthy weight range and even underweight also want to lose weight or are pursuing weight control. Researchers have found that 48.2% of healthy weight women want to weigh less and 46.3% of healthy weight women and 13.5% of underweight women are pursuing weight control (Yaemsiri et al., 2011). These results are similar to another study that showed 43.2% of college-aged women diet and 32.3% actively avoid weight gain even though 78% are in a healthy weight range (Fayet et al., 2012). Of women trying to lose weight, 81.5% were in the healthy range and 50% were underweight (Fayet et al., 2012). This desire to lose weight is also common among adolescents. Approximately 61% of adolescent girls try to lose weight (Eaton et al., 2012). This reflects the pervasive culture of dieting and weight loss in the United States.

Although dieting may include healthy behaviors, often people view unhealthy weight control methods as part of dieting (Ackard et al., 2002). Researchers have found that 31% of women without a history of anorexia nervosa or binge eating reported having purged to control weight (Reba-Harrelson et al., 2009). Other studies have found 25% of college women have engaged in bingeing and purging as a weight loss method (Wade et al., 2011), and over 50% of adolescent girls have skipped meals, fasted, smoked cigarettes, vomited, or taken laxatives to manage their weight (Neumark-Sztainer, 2005). Research shows that these behaviors persist into adulthood (Neumark-Sztainer et al., 2011). Dieting behaviors and unhealthy weight control methods are also risk factors for developing an eating disorder (Ackard et al., 2002; Neumark-

Sztainer et al., 2006; Shisslak et al., 1995). For example, "normal dieters" develop eating disorder behaviors and even partial or full eating disorders (Shisslak et al., 1995).

College women in particular are at an increased risk of developing eating disorders and eating disorder behaviors (Berg et al., 2009; D. Eisenberg et al., 2011; V. M. Quick & Byrd-Bredbenner, 2013; Schwitzer, 2012; Schwitzer & Choate, 2015). In fact, it is estimated that 8% to 17% of college-aged students have an eating disorder, and 20% of college students believe they have had an eating disorder in their lifetime (D. Eisenberg et al., 2011; Hoerr, Bokram, Lugo, Bivins, & Keast, 2002; Reinking, Alexander, & Louis, 2005). Additionally studies have shown that many college students' eating disorder symptoms persist and reoccur (D. Eisenberg et al., 2011). This may be partly due to the age of onset of some eating disorders during college years; however, those who attend college are more likely to develop eating disorder behaviors than similar women who do not attend college (Berg et al., 2009). Thus, some have suggested the college environment itself poses a number of challenges, including new academic and social pressures, which may contribute to the development of eating disorder behaviors and eating disorders (Berg et al., 2009).

2.2 Negative Influence of Technology in the Context of Eating Disorders

In recent years, researchers have been calling for more work in understanding the impact of new media, such as online content, on the thin ideal, body image, and eating disorder behaviors (Perloff, 2014). Much of this research has focused on how Instagram, Twitter, Facebook, and websites that promote eating disorders (pro-eating disorder sites) impact factors associated with eating disorders (Andsager, 2014; Fardouly et al., 2015; Mabe et al., 2014; Meier & Gray, 2014; Stronge et al., 2015). In these studies, technology is viewed as a negative influence on users.

While a number of researchers in psychology have recognized the importance of understanding the effects of new media on eating disorder symptomology, their focus has largely been on social media. This is also true of HCI researchers who study eating disorders (S. Chancellor, Pater, et al., 2016a; Pater et al., 2016). For example, recent work has shown that social media use is associated with eating disorders and risk factors for eating disorders, especially among women (Andsager, 2014; Fardouly et al., 2015; Mabe et al., 2014; Meier & Gray, 2014; Stronge et al., 2015). In this section, I discuss the research on how social media and online communities has exacerbated and contributed to eating disorder risk factors and eating disorder behaviors.

2.2.1 Social media

Research has focused on how social media may unintentionally negatively impact users' body image and eating disorder behaviors and contain eating disorder content. A great deal of this research has examined the ways in which social media can influence eating disorder risk factors and eating disorder behaviors (Andsager, 2014; Fardouly et al., 2015; Mabe et al., 2014; Meier & Gray, 2014; Stronge et al., 2015). For example, using Facebook is correlated with drive for thinness (Kim & Chock, 2015) and body dissatisfaction (Fardouly et al., 2015; Fardouly & Vartanian, 2015; Stronge et al., 2015). Kim and Chock (2015) conducted an online survey to examine Facebook's impact on drive for thinness and found engaging in social behaviors such as checking friends' profiles, leaving messages, and commenting on profiles is correlated with drive for thinness in both women and men (Kim & Chock, 2015). Fardouly et al. (2015) studied the effects of Facebook on college women's body image and found frequency of Facebook use was related to body image concerns. Stronge et al. (2015) found that both women and men Facebook

users tend to have poor body satisfaction. Similarly, Mabe et al. (2014) found that frequency of Facebook use was related to eating disorder behaviors.

Other researchers have studied health and fitness content on social media and its relationship to eating disorders. For instance, some researchers have investigated how hashtags and photos on sites such as Instagram and Twitter promote eating disorder behaviors. Tiggeman and Zaccardo (2015) discuss how "fitspiration" can have unintended negative effects on college-aged girls. In her analysis of fitness blogs and media culture, Stover (2014) argues that "fitspiration" is dangerous in that the images and text are more "culturally acceptable" than those that showcase emaciated subjects. However, "fitspiration" still promotes a narrative that encourages users to compare and monitor their bodies. While these sites and communities do not overtly support eating disorders, their messages subtly promote negative associations with food and weight gain while promoting the value of thinness. Boepple and Thompson (2014) argue that while "health" blogs and their content are not as overly problematic at pro-eating disorder sites, their disordered content may be "even more problematic, as they may reach a wider audience and serve to normalize disordered behavior" (p. 366). Research suggests that disordered content is often disguised or conflated as "healthy" and that this disconnect can have negative impacts on users, especially those already suffering from eating disorder behaviors (Stover, 2014; Tiggemann & Zaccardo, 2015).

Even HCI researchers who study eating disorders have primarily focused on social media (S. Chancellor, Pater, et al., 2016a; Pater et al., 2016). These researchers have also found that social media promotes eating disorder behaviors. For example, Chancellor et al. (2016) found that despite Instagram's strategies to reduce pro-eating disorder content, pro-eating disorder

communities still exist and are thriving. Similarly, Pater et al. (2016) analyzed hashtags on Tumblr, Instagram, and Twitter and found pro-eating disorder-related hashtags, images, and text.

Social media continues to perpetuate the thin ideal, dieting, exercise, appearance, and comparison. This content is now constantly available, and people can easily and at any time access it on their smartphones, tablets, and computers. Furthermore, social media sites consist of both media and peers, which may contribute to eating disorder behaviors and poor body image. On social media sites and apps, users have access to photos, videos, and other information about not only their friends, but also celebrities and other influential people, which can drive users to compare their appearance to others'. Users can also find other people and communities that may support unhealthy habits in order to become thinner.

2.2.2 Online communities

Although still studied, before social media, research tended to focus on online communities and sites that promote eating disorder behaviors, or pro-eating disorder sites like "pro-ana" or "pro-mia" communities (short for pro-anorexia and pro-bulimia). Pro-eating disorder sites are communities that view and understand eating disorders often as a lifestyle choice rather than a serious disorder requiring treatment (Sharpe, Musiat, Knapton, & Schmidt, 2011). On pro-eating disorder sites and forums, users share information on how to lose weight and essentially maintain the symptomology of eating disorders, such as anorexia and bulimia nervosa (Sharpe et al., 2011). While pro-eating disorder communities can offer emotional support and a sense of community, the messages and content focus on sustaining eating disorders not recovery (Csipke & Horne, 2007; Sharpe et al., 2011).

Many researchers have found that pro-eating disorder communities have negative effects on their users. Some researchers believe that these sites are a façade of "support" but actually are

anti-help-seeking and anti-recovery (Rouleau & Von Ranson, 2011). While users report an increase in perceived support, these communities actually exacerbate their symptoms (Csipke & Horne, 2007; Rouleau & Von Ranson, 2011) and perpetuate unhealthy habits (Ransom, La Guardia, Woody, & Boyd, 2010). For instance, Csipke and Horne (2007) found pro-eating disorder communities worsen eating disorder symptoms of users who are "silent browsers" (i.e., users who do not actively interact within the community). Pro-eating disorder communities have been associated with higher levels of body dissatisfaction (Grimes & Harper, 2008; Jett, La Porte, & Wanchisn, 2010), higher levels of eating disturbance (Harper, Sperry, & Thompson, 2008; Jett et al., 2010; Peebles et al., 2012), greater negative affect (Bardone-Cone & Cass, 2006, 2007), lower social self-esteem (Bardone-Cone & Cass, 2006, 2007), lower appearance self-efficacy (Bardone-Cone & Cass, 2006, 2007), decreased perceived attractiveness (Bardone-Cone & Cass, 2006, 2007; Custers & Van den Bulck, 2009), perception of being overweight (Bardone-Cone & Cass, 2006, 2007), higher drive for thinness (Custers & Van den Bulck, 2009), perfectionism (Custers & Van den Bulck, 2009), increase in harmful activities (such as diet pill abuse and self-injury) (Peebles et al., 2012), lower quality of life (Peebles et al., 2012), and increased hospitalization rates (Peebles et al., 2012). While these spaces were once the primary areas promoting disordered behaviors and content, extant literature suggests that the line between "healthy" eating and exercise content and disordered content is continuously becoming less distinct (Stover, 2014; Tiggemann & Zaccardo, 2015). Even online weight loss and fitness communities can negatively affect users by promoting eating disorders (Stover, 2014; Tiggemann & Zaccardo, 2015). However, to date, research on the negative uses and effects of weight loss apps in the context of eating disorders is lacking.

2.3 Positive Influence of Technology in the Context of Eating Disorders

The majority of research on the positive influences of technology in the context of eating disorders has focused on eating disorder-specific technology, such as online support communities and recently, treatment apps. In this section, I discuss research on online communities and apps for eating disorder recovery and support.

2.3.1 Online communities

Some researchers have focused on the positive influences of online communities in the context of eating disorders (Flynn & Stana, 2012; Gulec et al., 2011; Johnsen, Rosenvinge, & Gammon, 2002; Keski-Rahkonen & Tozzi, 2005; Kummervold et al., 2002; Ljotsson et al., 2007; McCormack, 2010; W. Stommel & Koole, 2010; Wyke Stommel, 2008; Wyke Stommel & Meijman, 2011; Walstrom, 2000; White & Dorman, 2001). Online communities have the potential to be therapeutic for those with eating disorders (Keski-Rahkonen & Tozzi, 2005). Researchers have studied how groups on online forums and social media provide essential social support for isolated individuals with eating disorders (Bowler, Oh, He, Mattern, & Jeng, 2012; Whitlock, Powers, & Eckenrode, 2006), where the majority of users tend to be younger women (Kummervold et al., 2002).

There is often stigma with eating disorders, so these communities provide a space for users to discuss their issues and concerns often with some level of anonymity. Research has shown that users find it easier to discuss their issues online as opposed to face-to-face (Kummervold et al., 2002). The main function of these communities is often to communicate encouragement, promote self-esteem, and provide information and support related to diagnosis, treatment, and interaction with healthcare professionals and clinicians (McCormack, 2010). In their qualitative analysis of online forums for eating disorders, Johnsen et al. (2002) found that

the majority of thread topics were constructive or positive even though most posts were negative. However, they did not delve deeper into what was being discussed on these forums.

Eating disorder discussion groups are particularly helpful during early stages of recovery (Keski-Rahkonen & Tozzi, 2005). Because there is a high chance of relapse with eating disorders, some form of social support is necessary to recover, especially after individuals leave treatment centers (McCormack, 2010). Eating disorder forum participation is useful for both informational needs and social contact and support (Kummervold et al., 2002). However, one major issue is users' need for healthcare professionals to take a more active role in these forums (Kummervold et al., 2002).

There are some online treatment programs that use forums and message boards as part of their services (Gulec et al., 2011; Ljotsson et al., 2007). Gulec et al. (2011) used an internet-based treatment program for eating disorder not otherwise specified (EDNOS), which had a group chat and peer support boards. They found that users were satisfied with the treatment and adherence was high. Similarly, Ljotsson et al. (2007) conducted internet-based cognitive behavioral therapy with discussion boards for bulimia nervosa (and binge eating disorder) and found that users showed significant clinical improvements.

In addition to online communities specific to eating disorder recovery, some argue that pro-eating disorder communities may actually have some positive effects on their users. Some researchers have found that pro-eating disorder communities and sites offer support, a sense of community, and a coping mechanism for users with a stigmatizing condition (Csipke & Horne, 2007; Mulveen & Hepworth, 2006; Sharpe et al., 2011). Users who interact with other users and seek emotional support reported increased positive mental states after visiting those sites (Csipke & Horne, 2007). Some of these communities can also have positive effects on behaviors by

promoting healthy eating (Ransom et al., 2010). User exposure to these communities can also reduce the impact from potentially harmful content (Csipke & Horne, 2007). However, because pro-eating disorder content is controversial, some have called for censorship of these sites and their content, but others have cautioned that censorship may actually be harmful (Casilli, Pailer, & Tubaro, 2013; Ferreday, 2003; Sharpe et al., 2011). In addition to potential positive effects on users, banning pro-eating disorder sites and content would make it more difficult for clinicians, researchers, families, and charities to reach out to pro-eating disorder communities (Casilli et al., 2013) and would limit people from creating their own online spaces and communities (Shade, 2003), which may function as key support in their lives.

2.3.2 Eating disorder recovery and treatment apps

Mobile apps may be an effective standalone or supplemental tool for eating disorder management and recovery and improve accessibility to treatment and therapy (Kazdin, Fitzsimmons-Craft, & Wilfley, 2017; Tregarthen et al., 2015). For example, Tregarthen et al. (2015) developed an evidence-based app for eating disorder self-monitoring and treatment. Not only was this app used by over 100,000 users in 2 years, but it also was used by many people not receiving other types of eating disorder treatment (Tregarthen et al., 2015). While this means that the app is potentially improving access for underserved groups, it also means that some users are using it as a replacement when further treatment may be needed. Although this app has had success, the feasibility of many eating disorder apps (and mental health apps generally) is not known.

Many apps suffer from a number of issues, including lack of scientific evidence (Donker et al., 2013), low popularity (Fairburn & Rothwell, 2015), and unknown mental health outcomes (Mohr, Burns, Schueller, Clarke, & Klinkman, 2013). For example, in a clinical appraisal of

eating disorder apps, Fairburn and Rothwell (2015) found only 39 apps designed for those with eating disorders, and of those apps, over 80% were barely used (≤5,000 downloads). The majority of these apps offered users advice, ranging from helpful to harmful (Fairburn & Rothwell, 2015). Additionally, of 5 apps that included self-assessment tools, only 2 used reliable methods, and for apps that included eating self-monitoring, entering and viewing information was often difficult (Fairburn & Rothwell, 2015), suggesting usability issues, which may inhibit long-term usage.

Despite these shortcomings, researchers have recognized the potential of mobile apps in the mental health domain (Price et al., 2014), especially for eating disorders (Kazdin et al., 2017; Tregarthen et al., 2015). However, more research is needed to understand how technology may be used for and impact recovery - not only regarding recovery-specific apps, but also non-eating disorder specific technology, such as weight loss apps.

2.4 Weight Loss Apps

In this section, I explain the popularity of weight loss apps and the many terms used to refer them. I also describe current research on weight loss apps.

2.4.1 Popularity and terminology

As of 2017, Pew Research Center found that 92% of people 18 to 29 own a smartphone ("Mobile Fact Sheet," 2017). With the increasing prevalence of smartphones, health apps are also becoming increasingly popular (Fox & Duggan, 2012; Smith, 2015). In their 2015 publication, Krebs and Duncan (2015) surveyed 1,604 people and found 58.23% of participants downloaded at least one health app. While people of different ages use these apps, younger people are more likely to download one than older adults (Fox & Duggan, 2012; Krebs & Duncan, 2015). Although this category includes apps for numerous health-related purposes from disease

management to pregnancy, apps for physical activity tracking, food logging, and weight loss are the most popular (Fox & Duggan, 2012; Krebs & Duncan, 2015). Because of the weight loss focus of these types of apps and the fact that many apps allow users to track diet, exercise, and weight simultaneously, I refer to these apps as weight loss apps.

In terms of research, weight loss apps may fall under many different areas, including the quantified self, self-tracking, food journaling, lifelogging, personal informatics, personal analytics, mHealth, mobile health, and persuasive technology. Some weight loss apps may also be known as diet, nutrition, calorie counting, fitness, exercise, or physical activity apps, and some even qualify as activity trackers given the use of smartphone accelerometers to automatically track some physical activities as well as the ability to synchronize wearables with popular weight loss apps. These many terms reflect the pervasiveness of these types of tools in everyday life and the complexities of studying these technologies when they do not clearly fit into one research domain or discipline. Because of this, trying to cover all of the research in these areas is not possible. Therefore, I review research primarily in the area of HCI on the quantified self for health (also referred to as self-tracking). Then I review other HCI research on apps for diet, physical activity, and weight loss.

2.4.2 Quantified self for health

The quantified self movement refers to utilizing digital technologies to quantify and track aspects of one's life or body in order to make meaningful insights from data often for self-improvement or self-reflection (Choe et al., 2014; Lupton, 2016; "Quantified Self: Self Knowledge through Numbers," 2015). The quantified self community believes in "self knowledge through numbers" ("Quantified Self: Self Knowledge through Numbers," 2015), meaning through numeric data, people can gain insights about themselves. Other terms for quantified self include self-tracking,

lifelogging, personal informatics, and personal analytics (Lupton, 2016). Even though the quantified self is not specific to health, the quantified self movement for health has grown in popularity (Lupton, 2016). Although tracking personal data is not new, digital technologies like wearables, apps, and activity trackers have revitalized the practice. Weight loss apps are related to the quantified self because they tend to be numerically driven, allowing users to track weight in pounds, food in calories and grams of macronutrients, exercise in minutes and calories burned, and number of days logged.

In terms of health, there has been a significant amount of research on the quantified self and self-tracking technologies. Researchers have focused on understanding users' needs and usage, including why people start, continue, and stop self-tracking (D. A. Epstein et al., 2016; Khovanskaya, Baumer, Cosley, Voida, & Gay, 2013; Li, Dey, & Forlizzi, 2010, 2011; Rooksby, Rost, Morrison, & Chalmers, 2014), finding ways to reduce abandonment (D. A. Epstein et al., 2016; Lazar, Koehler, Tanenbaum, & Nguyen, 2015), investigating design features and assessing self-tracking technology prototypes (Bentley, Tollmar, & Stephenson, 2013; D. Epstein, Cordeiro, Bales, Fogarty, & Munson, 2014; Fan, Forlizzi, & Dey, 2012), and understanding where personal informatics meets the clinical setting (Mentis et al., 2017; West, Giordano, Van Kleek, & Shadbolt, 2016). While much self-tracking has centered on individual practices, more research is recognizing self-tracking as a social practice (Kamal, Fels, & Ho, 2010; Pina et al., 2017; Y. Wang, Weber, & Mitra, 2016). Some researchers have even studied the use of self-tracking technologies for specific conditions (Mentis et al., 2017). There are numerous benefits of self-tracking for health, such as feeling in control of one's health (Choe et al., 2014; Li et al., 2011; Lupton, 2014) and increased physical activity (de Vries, Kooiman, van Ittersum, van Brussel, & de Groot, 2016).

2.4.3 Apps for diet, physical activity, and weight loss

In addition to the quantified self movement as a whole, many researchers view apps as positive influences on users. These technologies are often viewed as a way to help people combat obesity and obesity-related health conditions. Thus, there has been a great deal of research on apps for diet and physical activity (Berkovsky et al., 2012; Brown, Chetty, Grimes, & Harmon, 2006; Choe et al., 2014; Cordeiro et al., 2015; Goudarzi & Tomic, 2006; Hsu et al., 2014; Mueller et al., 2014; Rooksby et al., 2015; Stawarz et al., 2015; Toscos, Faber, An, & Gandhi, 2006; Vyas et al., 2015; Walsh & Golbeck, 2014). The focus is often on how to design apps to better support managing weight, eating healthier, and exercising more.

For physical activity apps, many researchers have been exploring novel and entertaining ways to promote exercise often through games or leveraging social interactions (Berkovsky et al., 2012; Goudarzi & Tomic, 2006; Nguyen, Modak, Dias, Yu, & Huang, 2014; Rooksby et al., 2015; Toscos et al., 2006; Vyas et al., 2015; Walsh & Golbeck, 2014). For instance, Rooksby et al. (2015) developed a mobile app game that allows users to track, reflect on, and share physical activity with others. Through their iterative design process, they found the game promoted discussions around their own physical activity as well as others'. However, the game did not lead to users encouraging one another and favored those who were more active, which was problematic from a behavior change perspective. While it is promising that users find these apps enjoyable (Berkovsky et al., 2012; Rooksby et al., 2015), more work is needed to understand the best ways to promote physical activity, motivate users, and positively affect health outcomes through design.

For apps with a diet component or focus, much of the work is on the design and evaluation of apps to either increase healthy eating or decrease unhealthy eating. While many popular apps focus heavily on the quantification of behaviors, researchers are also studying new

ways to encourage healthy eating habits (Brown et al., 2006; Cordeiro et al., 2015; Hsu et al., 2014). For example, Cordeiro et al. (2015) explored lightweight photo-based food journaling where users took photos of their meals and reflected on the context and experience around eating (not the numbers around eating). Hsu et al. (2014) described the design of an app to reduce excessive and unhealthy snacking and cravings and found through imagery they were able to reduce overall snacking and unhealthy snacking. Since many popular apps include both food and physical activity tracking, researchers also study apps with both diet and exercise tracking components (Brown et al., 2006). More researchers are recognizing the importance of studying the impact of diet, physical activity, and weight loss apps on users' behaviors (Freyne, Brindal, Hendrie, Berkovsky, & Coombe, 2012); however, the use and effects of these apps are mostly seen as positive.

In opposition to this narrative, some HCI researchers have challenged the idea that these apps are always positive or appropriate. For example, Cordeiro et al. (2015) considered the use and problematic aspects of food journaling for a general population, where the focus is to encourage logging. Self-tracking and quantifying behaviors are pervasive but not always appropriate because of user goals (Cordeiro et al., 2015). In reference to the fictional Fit4Life technology, Purpura et al. (2011) discussed problems of persuasive technology and called for an expansion of health criteria and exploration of unintended negative consequences. For instance, they discuss the issues with BMI as an indicator of health (Purpura et al., 2011). Although there has been some HCI research questioning the constant positive perspective of weight loss apps and the quantified self as well as research on the application of self-tracking for specific health conditions, research is lacking on the use of self-tracking technologies, like weight loss apps, for eating disorders and the potential negative impacts of these technologies in this context.

2.4.4 Similarities between weight loss apps and other technologies

Weight loss apps are similar to other types of technologies that have been shown to be beneficial and harmful to users with eating disorder behaviors. Thus, there may be aspects of weight loss apps that are helpful for eating disorder recovery and aspects that trigger or exacerbate eating disorder behaviors (Tan et al., 2016). Most weight loss apps consist of not only diet and physical activity tracking tools, weight loss goals, and progress visualizations, but also connections to a community of users with similar goals (Riaz & Sykes, 2015). Having social support could be useful for recovery. However, similar to social media, weight loss apps and their communities often have photos, videos, and other information about other users but the emphasis is even more on weight and appearance. This ability for increased comparison could be problematic. Weight loss apps have a heavier focus on dieting behaviors, which could contribute to eating disorder behaviors, in a community that sees these behaviors as the norm. Users track food and exercise habits as well as weight, body measurements, and other factors.

In addition to the ability for comparison, interaction, and personal tracking, there is an added component of personalization. Users can customize weight loss plans based on how much they want to weigh or how much weight they want to lose. Research has shown that these types of apps increase awareness of the relationship among food, exercise, and overall health (Toscos et al., 2006). This could be helpful for recovery but could also cause users problems. Prior to weight loss apps, some people (including those with eating disorders) tracked their diet and exercise on paper. Weight loss apps are more personalized, discreet, mobile, and quicker to use. They also provide users with precise values for food and exercise and visualizations of weight loss and calories consumed and burned with an added component of the app "rewarding" them for eating less, exercising more, and losing weight, which could exacerbate eating disorder behaviors.

2.5 Mutual Shaping

A significant amount of research in these domains, especially from the sociocultural perspective of eating disorders, tends to view technology as acting on the user. This perspective is known as technological determinism (Friedman, 2005; Smelser & Baltes, 2001). Technological determinism is a well-known and controversial theory that assumes:

> *"...the development of technology proceeds in an autonomous manner, determined by an internal logic independent of social influence; and technological change determines social change in a prescribed manner"* (p. 15495) (Smelser & Baltes, 2001).

In terms of research on the relationship between technology and eating disorders, a great deal of research states that social media negatively *impacts* users. This is consistent with technological determinism because it ignores the user's agency. While certain aspects of technology may indeed inevitably affect college women with eating disorder behaviors, it is important to understand the user's role. Particularly for college women, eating disorder behaviors, social pressures, and cultural influences may all influence the use and impact of weight loss apps, and weight loss apps may influence the interaction and impact. This idea that technology shapes society and society shapes technology is known as mutual shaping, which emerged from the theories of technological determinism and social constructivism of technology (Bijker, Hughes, & Pinch, 1987; Fulk, 1993; Hofkirchner, 2010; Kling, 1994; Williams & Edge, 1996). My research aims to take this mutual shaping approach to examine both the users' role (usage) and the impact (unintended consequences) of weight loss apps.

2.6 Understanding an Individual's Health Over Time

It is important to have conceptualizations in order to understand the changing nature of an individual's health. One such conceptualization is the Corbin and Strauss Model, also known as

the Chronic Illness Trajectory Model (CITM) (Corbin, 1998). While studying the care of dying patients in the 1960s, Anselm Strauss, Barney Glaser, and Jeanne Quint Benoleil applied the term "trajectory" to conceptualize the management of a changing illness and encapsulate the strategies that individuals, families, and healthcare providers take to shape the patient's course (Pierre Woog, 1992). Over the next few decades, the idea of a trajectory for chronic illness was expanded through various studies (Pierre Woog, 1992). In order to turn this concept into a useable and practical framework, grounded theory, which resulted from Glaser's and Strauss' research on dying (Pierre Woog, 1992), was used to further develop concepts related to a patient's trajectory (Pierre Woog, 1992). As a result, in the 1990s, Strauss and Corbin introduced the CITM (Corbin, 1998).

The CITM is meant to capture the varying and altering course that chronic illness takes and the idea that this course can be shaped and managed, where shaping does not necessarily change the direction of the course but can in some cases (Pierre Woog, 1992). The model is not only about the illness, but also the actions around the illness, including those related to the patients, their families, and healthcare providers (Pierre Woog, 1992). The updated model includes nine stages: pre-trajectory, trajectory onset, stable, unstable, acute, crisis, comeback, downward, and dying (Corbin, 1998). Well-established for chronic illnesses, the CITM has been applied to numerous health contexts, including cancer, multiple sclerosis, diabetes, cardiac illness, and HIV/AIDS (Pierre Woog, 1992). However, its applicability to mental health conditions is less understood.

In a chapter of *The Chronic Illness Trajectory Framework: The Corbin and Strauss Nursing Model*, Rawnsley discusses the validity and utility of the CITM for "major" mental health conditions but does not define what is meant by "major mental disorders" (Pierre Woog,

1992). Although there are areas of discrepancy and aspects that need explication to be applicable to mental health conditions, she concludes that "it seems reasonable to claim a partial degree of correspondence between the central premises of the trajectory model and salient characteristics of chronic mental disorders" (p. 62) (Pierre Woog, 1992). However, this model may not be an appropriate fit for eating disorders because it focuses on the individual as a patient and cannot accommodate the role of technology. Thus, one contribution of this dissertation study is to provide a conceptualization that is better suited.

2.7 Approach to Address Gaps

In this dissertation study, I use the sociocultural perspective as a framing mechanism. I examine weight loss apps as a sociocultural influence on users with eating disorder. Using the sociocultural perspective as a lens has an inherent bias: it views sociocultural factors as contributing to eating disorder behaviors (these factors negatively *impact* eating disorders). This has allowed me to question the impacts of weight loss apps as a "health" technology. However, in order to overcome this bias, I also aim to consider not only how weight loss apps may contribute to or exacerbate eating disorder behaviors, but also how these apps may help college women during eating disorder recovery. Not only do I consider the unintended consequences (both positive and negative) of weight loss apps, but I also investigate the various types of usage. In contrast to the sociocultural perspective, this means I take a mutual shaping approach to highlight the influence between the user and technology, and I examine individuals' experiences as a health journey.

2.8 Chapter Summary

This chapter presented literature mainly from the psychology and HCI domains. Specifically, it provided a summary of studies on technology in the context of eating disorders and weight loss

apps. There have been many studies on the negative impact of social media and pro-eating disorder communities on eating disorders and body image (Andsager, 2014; Csipke & Horne, 2007; Fardouly et al., 2015; Mabe et al., 2014; Meier & Gray, 2014; Sharpe et al., 2011; Stronge et al., 2015), yet they fail to include weight loss apps, which often contain the same types of content and are coupled with a tool that puts a heavy focus on numbers and control related to diet, calories, weight, body measurements, and physical activity. Most researchers have only considered the positive influences of technology specifically intended for treatment and recovery, neglecting potential beneficial aspects of weight loss apps for college women with eating disorder behaviors.

Although there has been research on weight loss apps in HCI (Berkovsky et al., 2012; Brown et al., 2006; Choe et al., 2014; Cordeiro et al., 2015; Goudarzi & Tomic, 2006; Hsu et al., 2014; Mueller et al., 2014; Rooksby et al., 2015; Stawarz et al., 2015; Toscos et al., 2006; Vyas et al., 2015; Walsh & Golbeck, 2014), these apps are often seen as a positive influence to manage weight. No identified research has provided a detailed understanding of the use of these apps by users with eating disorder behaviors. HCI researchers have not yet looked at how this subgroup of users utilizes apps not intended for eating disorder recovery or sought to understand the potential negative influence weight loss apps may have on eating disorders.

Thus, researchers, developers, and designers are missing aspects of weight loss apps that could be helpful for eating disorder recovery and harmful for users with eating disorder behaviors. Understanding these users could be beneficial to the design of weight loss apps and our understanding of eating disorders. The goal is to shed light on this understudied area in the HCI and psychology communities.

3 METHODOLOGICAL APPROACH

In this chapter, I explain my approach to data collection. The bulk of my data is from qualitative methods; I only used quantitative methods to assess the severity of participants' eating disorder behaviors as part of their background information not to investigate my research questions. Therefore, my overall approach is qualitative. This chapter provides a brief overview of the preliminary study and main study as well as how I determined quality when employing qualitative methods.

3.1 A Qualitative Approach

I primarily used a qualitative approach for data collection and analysis, including an analysis of forum data, think-aloud exercises, and semi-structured interviews. Using more than one research method provides researchers with a well-rounded collection of data (Turner, 2010). This research program was divided into two studies, the preliminary study and the main study, which I respectively describe in more detail in Chapters 4 and 5. Each study complemented one another, and the main study built on the preliminary study.

The preliminary study consisted of an analysis of profile data and forum posts related to eating disorders from users of DropPounds[6], a popular weight loss app. The preliminary study sought to determine whether users with eating disorders utilize weight loss apps and the prevalence of users with a desire to be underweight within a weight loss app community. It also provided a first look at understanding of how these users perceived the impact of weight loss apps on eating disorder behaviors.

In order to delve deeper into users' usage and perceptions of weight loss apps and address the limitations of the preliminary study, I then conducted the main study, the crux of which

[6] Name of app changed for users' privacy.

consisted of think-aloud exercises and semi-structured interviews with weight loss app users with a history of eating disorders. The main study focused on why users choose weight loss apps, how they use them, and the unintended consequences of their use. While the preliminary study provided an initial and partial look at this phenomenon while highlighting the magnitude of users whose desire to be underweight may signal eating disorder behaviors, the main study provided an in-depth perspective, which not only confirmed many of the findings in the preliminary study, but also expanded them.

3.2 Quality Criteria

Because qualitative and quantitative research differ greatly, the quality of qualitative research should not be judged by conventional criteria, such as validity, reliability, and generalizability (Mays & Pope, 2000). These concepts are not well-aligned with qualitative research, and therefore, these terms have to be translated (Whittemore, Chase, & Mandle, 2001). For instance, internal validity translates to credibility, external validity to transferability, reliability to dependability, and objectivity to confirmability (Whittemore et al., 2001). While some debate exists over how applicable validity and reliability are for qualitative studies (Golafshani, 2003), there is consensus that qualitative researchers must demonstrate quality (Whittemore et al., 2001).

3.2.1 Credibility and transferability

For qualitative research, Maxwell (2005) defines validity as "the correctness or credibility of a description, conclusion, explanation, or interpretation" (p. 106). In qualitative research, validity criteria are credibility, authenticity, criticality, and integrity. Credibility "refers to the conscious effort to establish confidence in an accurate interpretation of the meaning of the data" (p. 530) (Whittemore et al., 2001). Authenticity is linked to credibility; it deals with portraying research

that reflects participants' feelings and experiences (Whittemore et al., 2001). Criticality involves critically appraising the researcher's search for alternative explanations, exploration of negative instances, and examination of biases (Whittemore et al., 2001). Integrity is important in the critical analysis; integrity refers to assuring "that the interpretation is valid and grounded within the data" (p. 531) (Whittemore et al., 2001). Internal validity translates to credibility, and external validity translates to transferability (Whittemore et al., 2001).

In order to strengthen the credibility of my study, I used:

a) *Rich, descriptive data*: During my data collection, participants' think-aloud exercises and interviews were transcribed, thus providing verbatim account, which helped to demonstrate validity (Lincoln & Guba, 1985; Whittemore et al., 2001). I established and articulated clear and detailed procedures for data collection and analysis. Additionally, I provided thick descriptions in order to provide support for conclusions and assumptions drawn during data analysis (J. W Creswell & Miller, 2000; Maxwell, 2005). According to Creswell and Miller (2000), the researcher demonstrates credibility "through the lens of readers who read a narrative account and are transported into a setting or situation" (p. 129).

b) C*rystallization*: By collecting data in different ways, I used crystallization to "open up a more complex, in-depth, but still thoroughly partial, understanding of the issue" (p. 844) (Tracy, 2010). Specifically, I conducted an analysis of weight loss users' profile data and forum posts for my preliminary study, and in my main study, I conducted weight loss app think-aloud exercises and semi-structured interviews with users with eating disorders.

For qualitative research, researchers cannot use the same constructs they would for quantitative research (Gasson, 2003). In qualitative research, generalizing findings may be difficult because data collection often focuses on gathering contextual and nuanced details of a specific scenario or setting (Lincoln & Guba, 1985). Instead, qualitative researchers should consider the transferability of findings and ask "how far can the findings/conclusions be transferred to other contexts and how do they help to derive useful theories?" (p. 90) (Gasson, 2003). Because I focused on a specific user subgroup whose behaviors and app use is not well understood, any insights I provided are useful to understanding the relationship between eating disorder behaviors and weight loss app use. My findings are transferable to the larger population of women with anorexia nervosa, bulimia nervosa, and other eating disorder behaviors. I used thick, rich, detailed descriptions, which helped determine if the findings are applicable to other settings (J. W Creswell & Miller, 2000). Focusing on uncovering these users' needs may shed light on the importance of and ways to understand other user subgroups' needs. For instance, how do we determine what is healthy for different groups with different needs or issues (e.g., what does it mean to be healthy when pregnant, healthy with a chronic condition, healthy with a mental health condition)? Additionally, some findings may also be applicable to the larger population of weight loss app users because this subgroup represents an extreme case, which highlight aspects of apps that may prevent a health focus.

3.2.2 Dependability

Although reliability is used for evaluating quantitative research, researchers argue that reliability is irrelevant in qualitative research because the research does not deal with measurements (Golafshani, 2003). Because validity cannot exist without reliability, demonstrating validity is sufficient (Golafshani, 2003). In qualitative research, reliability can be thought of as

dependability, as cited by (Golafshani, 2003). The idea is that "the way in which a study is conducted should be consistent across time, researchers and analysis techniques" (p. 94) (Gasson, 2003).

In order to strengthen the dependability of my data and findings, I established and articulated clear and repeatable procedures for how I performed the research, analyzed the data, and arrived at the findings based on the data analysis. By providing a detailed and transparent description of my research process, I strengthened the trustworthiness of my research. Being transparent also allows others to understand specifically how I conducted my research.

3.2.3 Confirmability

Confirmability refers to the idea that the conclusions of the research should be dependent on the participants and study conditions not the researcher (Gasson, 2003). In qualitative research, a "researcher's findings will be influenced by their own values and outlook, and instead promote the idea that the researcher should explore and acknowledge them" (p. 93), as cited in (Gasson, 2003). In order to acknowledge influences, biases, and prejudices, researchers should constantly employ reflexivity (Gasson, 2003). Specifically, researchers need to have self-awareness of the social context, which affects the phenomena under observation and "as someone who applies biases, prejudices, cognitive filtering and bounded rationality to the collection, analysis and interpretation of data" (p. 93) (Gasson, 2003).

In order to help control researcher bias, I made my procedures and assumptions explicit by employing strategies such as documenting personal reflections of assumptions and emotions, which could interfere with data collection or analysis (Lincoln & Guba, 1985). Having knowledge about eating disorders informed my analysis. For example, I was able to connect app usage with eating disorder symptoms. Additionally, conducting this study also emphasized the

seriousness of eating disorders, as some interviews were particularly difficult. Although I approached each interview with empathy, based on some sessions, I focused on being especially sensitive to participants' experiences and ensured I did not become "desensitized" to those experiences. While eating disorders are difficult to discuss for many, most participants reported being comfortable talking with me, which was apparent by their willingness to disclose their experiences. Because most participants were particularly open about their eating disorder behaviors, I became more comfortable asking about their experiences after the first few interviews.

Lastly, it is important to acknowledge the difficulty of conducting research about eating disorders and other mental health conditions. As a researcher emerged in this space, this means truly listening to participants, building trust, and focusing on understanding as well as employing strategies for self-care. I used peer debriefing, which not only acted as an external process check, but it also aided in the self-care process, providing me with "the opportunity for catharsis by [having someone] sympathetically listening to [my] feelings" (p. 208) (John W. Creswell, 2007).

3.3 Chapter Summary

In this chapter, I explained the overall approach to my studies and the quality criteria used to evaluate my methods. I conducted two studies, which complemented one another. I primarily employed qualitative methods and determined quality using the concepts of credibility, transferability, dependability, and confirmability. In the next chapter, I describe the preliminary study.

4 PRELIMINARY STUDY

The purpose of the preliminary study was to explore whether or not users with eating disorder behaviors used a weight loss app (DropPounds) and how they discussed the impact of the app on these behaviors. The preliminary study consisted of two parts: analysis of users' profile data and example quotations from users with a desire to be underweight. Because I was exploring a relatively new phenomenon (the use of weight loss apps by users with eating disorder behaviors), I chose to examine profile data and forum posts, which allowed me to see whether or not this phenomenon was occurring. Additionally, examining forum posts highlighted users' perceptions without the influence of a researcher asking specific questions. The findings informed the design of the main study.

In this chapter, I explain my data collection methods and data analysis. Then I present my findings related to the profile and forum data. Finally, I conclude with a brief discussion of the findings and the limitations of the preliminary study.

4.1 Data Collection

I had profile data and forum posts from DropPounds, a mobile and online weight loss app available on iOS, Android, and through the web. This app was chosen because it had over a million users in 2012 and has increased in popularity since (boasting over 24 million users as of January 2017) and includes many of the features and content found in the majority of weight loss apps. For example, DropPounds allows users to track their diet and activity. It also has an optional online community associated with it, which users can turn to for advice and support.

I present two pieces that move from a broader picture of the DropPounds community by looking at the breakdown of all users' profile data to a more narrow view of specific DropPounds users by investigating posts by users with underweight BMI goals. First, I analyzed users' profile

data to get a sense of the number of users within the community who set underweight goals. Second, from the forum data, I then provide examples of posts from users with underweight BMI goals to highlight their perceptions of the app's effects on eating disorder behaviors.

Because of the sensitivity around eating disorders, it was important to consider the ethics around conducting research in an online forum with users who may have a history with eating disorders (W Stommel, 2009). Both the name of the app and community were changed to protect users' privacy. Since the app company provided the data, I did not have access to users' information to contact them for their consent. Institutional Review Board (IRB) approval was obtained from three universities to conduct the research, including The Pennsylvania State University (40394). The company that owns, maintains, and operates the app gave permission to conduct research and provided app data, including forum posts and portions of users' profile data. Prior to providing the data, the company assigned a random, unique identifier to users. They did not provide fields that were individually identifying. Forum data and parts of profile data are publicly accessible through the app. Anyone can create an account for free and read posts on the forums. Users input their height, current weight, and then set a goal weight and how many pounds per week they want to lose (up to 2 pounds).

4.2 Data Analysis

4.2.1 Profile data analysis

For the preliminary study, I first analyzed users' profile data to understand the composition of the community, especially in terms of BMI. The focus was on users with a desire to be underweight. Using weight loss apps while wanting to be underweight presents a number of issues related to eating disorders and eating disorder behaviors, which is why I focused on underweight BMI goals and the use of weight loss apps to achieve those goals. While anorexia

nervosa is partially characterized by being underweight (American Psychiatric Association, 2013) and a refusal to be a healthy weight, as cited in (Le Grange et al., 2012), intentions to be underweight for one's height itself are problematic. To determine which users wanted to be underweight, I used BMI. For adults 20 years or older, an underweight BMI is less than 18.5.

Setting unhealthily low BMI goals signals a desire to be underweight and a drive for thinness, which are associated with eating disorder behaviors and eating disorders (Boero & Pascoe, 2012; Peñas-Lledó et al., 2015). Drive for thinness "is characteristic of individuals with fear of weight gain who diet to prevent it, but also of those who seek to attain an unhealthily low body weight as seen in many individuals with anorexia nervosa or bulimia nervosa" (p. 692) (Peñas-Lledó et al., 2015). Pro-eating disorder blogs and websites are often characterized by users' drive to be underweight (Borzekowski, Schenk, Wilson, & Peebles, 2010; Coker & Abraham, 2014; Gies & Martino, 2014). In terms of goal setting, Boero and Pascoe (2012) found many users of pro-ana (pro-anorexia nervosa) communities write about their maximum, current, and goal weights and are self-identified or diagnosed with eating disorders. The reported goal weights are to be underweight even if users' current weights are in the healthy or underweight range (Boero & Pascoe, 2012).

The desire to be underweight coupled with the use of weight loss apps may put users at risk for or signal eating disorder behaviors. Weight loss apps encourage dieting behaviors in an attempt to reach those who need to lose weight. Unfortunately, dieting behaviors are linked to the development of eating disorders (Ackard et al., 2002; Neumark-Sztainer et al., 2006; Shisslak et al., 1995). Studies of adolescent girls have found that high BMI is not a factor for dieting initiation; many girls of a healthy weight and even those who are underweight report wanting to lose weight and dieting (Cilliers, Senekal, & Kunneke, 2006; Huon & Lim, 2000). Simply

wanting to lose weight is associated with eating disorder behaviors and weight control behaviors. In her study of United States high school students, Forman-Hoffman (2004) found dieting and exercising to lose weight were linked to more unhealthy eating and weight control behaviors. Additionally, over 1/3rd of students who wanted to lose weight also reported one or more of those disordered behaviors (Forman-Hoffman, 2004). Therefore, this drive to be underweight acted as a marker for potential eating disorder behaviors.

The DropPounds company provided me with profile data from 19,710 users in 2012. To analyze the overall community, I removed users if they had a BMI under 5 or over 125 (*n*=14), did not have weight or height data available (*n*=271), were younger than 20 years old (due to the way BMI is calculated for those under 20) (*n*=832), or over 99 years old (*n*=1). That left me with 18,601 users. I calculated users' BMI from the weight and height data in their profile. For adults >=20 years, underweight is <18.5, healthy weight is 18.5–24.9, overweight is 25.0–29.9, and obese is 30+. Looking at profile data gave me a better understanding of the composition of the overall DropPounds community.

For the users' profile data, I used Excel to organize the data and used formulas to investigate the types and frequency of users' BMI at the time they created their weight loss plan (start BMI), BMI at time of data collection (current BMI), and goal BMI.

4.2.2 Forum posts analysis

I analyzed content from DropPounds online community. The dataset used in this study consisted of 321,999 posts over 24,183 threads that were created between October 2009 and July 2012. While the design of specific features has changed since 2012, the types of features have remained consistent.

To isolate discussions about eating disorders, I used a number of eating disorder-related keywords to identify candidate threads. Keywords included an[eo]rexi[ac], ana, bul[ie]mi[ac], mia, compulsive overeating, body d[iy]smorphi[ac] disorder, bing[e], eating disorder, ED, purg[e], and EDNOS (eating disorder not otherwise specified). The initial keyword search returned 6,190 threads representing 9,255 unique users. I examined the initial set of threads to identify and remove any irrelevant content that the keyword search returned. After removing irrelevant threads, I identified 1,036 relevant threads (2,678 posts). After removing duplicates (*n*=342), I had 2,336 posts, which represent 1,080 unique users.

I then pulled every post in the dataset written by users with underweight BMI goals. I reviewed these posts to see if and how users discussed the impact of the app on eating disorder behaviors and grouped these posts into two broad categories: reduces eating disorder behaviors and exacerbates eating disorder behaviors. I then broke these up into smaller groups to highlight specific ways users believe the app reduces or exacerbates eating disorder behaviors.

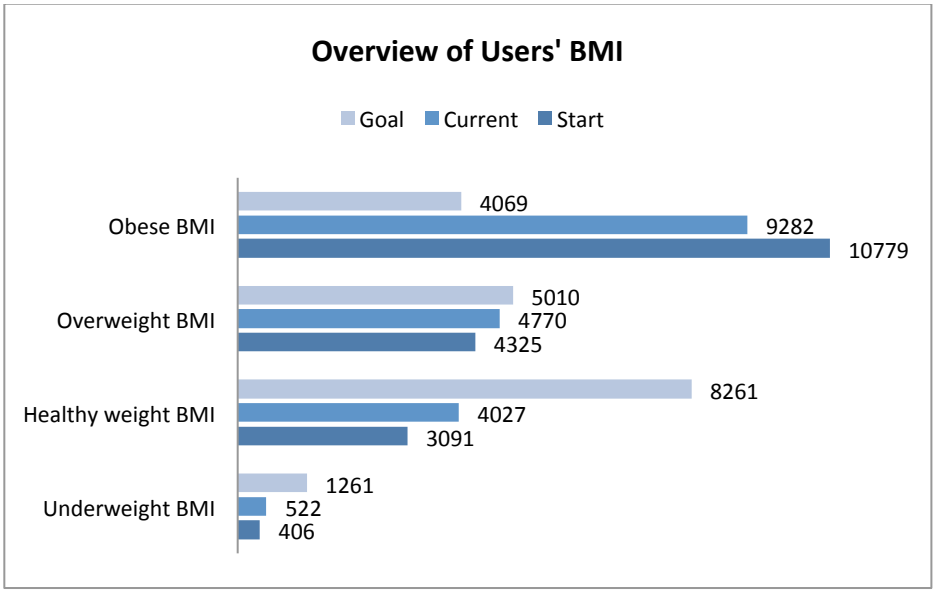
4.3 Findings

4.3.1 Profile data

Of 18,601 users, 14,031 identified as female and 4,570 as male. The age of users ranged from 20 to 99 years old (mean=38.42, *SD*=11.71, median=37, mode=28). The majority of users start with weight loss goals (*n*=18,370) followed by maintenance goals (*n*=231). No users start with weight gain goals. From current to goal, most users also have weight loss goals (*n*=17,984) followed by weight gain goals (*n*=311) and maintenance goals (*n*=306). In some instances, users lose more weight than they planned from the time between program start and current weight, so their current BMI to goal BMI reflects a weight gain goal even though their overall objective was to lose weight.

Approximately 2.18% of the community start with underweight BMIs (*n*=406), 2.81% are currently underweight (*n*=522), and 6.78% of the community have a desire to be underweight (*n*=1,261), which can be seen in Figure 4-1 along with other information about the start, current, and goal BMIs of the community. The majority of users with underweight BMI goals identify as female (*n*=1,238 compared to *n*=23 who identify as male). Most users with underweight BMI goals wish to have a weight that puts them at a BMI of 17 or above (*n*=585) followed by under 15 (*n*=289), 16 to 16.99 (*n*=220), and 15 to 15.99 (*n*=167).

Figure 4-1. Users with underweight, healthy weight, overweight, and obese BMIs



Of the users with underweight BMI goals, the majority (*n*=671) had healthy start BMIs, followed by underweight start BMIs (*n*=406), then overweight start BMIs (*n*=125), and finally obese start BMIs (*n*=59). All users with underweight start BMIs (*n*=406) had underweight goal BMIs; that is, no one who was underweight when they began the program wanted to gain weight to be in the healthy range. Additionally, no users with underweight start BMIs had healthy, overweight, or obese current BMIs.

Most users with underweight goal BMIs wanted to lose weight (*n*=1,237) and a small subset wanted to maintain their weight (*n*=24). No users with underweight BMI goals wanted to gain weight. Thus, none were interested in gaining weight even if that allowed them to remain underweight.

4.3.2 Forum posts

I found 8.98% of users who post in the forums about eating disorders had underweight BMI goals (97 of 1,080). I then looked at all users with underweight BMI goals and found 7.69% of them post in the forums about eating disorders (97 of 1,261). Users with underweight BMI goals produced a total of 246 posts (mean=2.54, *SD*=2.29, range 1-24). Thus, 10.53% posts about eating disorders are written by users with underweight BMI goals (246 of 2,336).

Seventeen posts from 13 users contained content related to how the app affects eating disorder behaviors. Details on these 13 users are provided in Table 4-1. All users with underweight BMI goals who posted in the forum about the effects of the app identified as female. The majority of these users began the program underweight (*n*=8) followed by healthy weight (*n*=5). For current BMI, most users fell into the underweight category (*n*=11) followed by healthy weight (*n*=2). Eight users discussed how the app helps reduce eating disorder behaviors, 4 users discussed how the app exacerbates eating disorder behaviors, and 1 user talked about how the app did both. I provide example posts that highlight these users' perceptions about the app in Table 4-2 and 4-3.

User ID	Age	Eating Disorder Behaviors	Start BMI	Current BMI	Goal BMI	Exacerbates	Reduces
62663	34	Restriction, low weight	12.55	13.11	12.55		✓
92214	27	Control food intake	16.09	16.49	14.51	✓	
23774	24	Bingeing	17.22	17.22	15.78		✓
144279	52	Restriction, bingeing	17.28	15.06	14.62		✓
154295	22	EDNOS, restriction, bingeing	17.80	17.47	14.98		✓
274788	40	Bingeing	18.16	16.09	15.21		✓
533842	40	Anorexia and bulimia nervosa	18.26	15.70	15.21	✓	
2042	48	Bingeing	18.46	18.46	16.98		✓
29213	20	Restriction, purging	18.75	18.46	16.24	✓	
318229	23	Anorexia and bulimia nervosa	19.57	18.47	18.23	✓	
172884	41	Former bulimia nervosa	20.90	20.01	18.07	✓	✓
215596	54	Bingeing, emotional eating	21.43	18.04	18.04		✓
397752	24	Bingeing	22.78	20.88	18.31		✓

Key:
Healthy weight
Underweight

Table 4-1. Users' BMI, eating disorder symptoms, and app perception

More often than not, users felt DropPounds was a positive influence because it created awareness and accountability that reduced bingeing, helped them eat more, improved their food choices, and provided them with a healthy plan. Many posts focus on bingeing behaviors, so many users felt the app helped them control those behaviors and choose healthier foods overall. Users with a history of extreme calorie and food restriction felt the app gave them awareness about their restrictive behaviors, which helped them see where they should add foods. Some users believed

the daily calorie budget was inherently healthy. Table 4-2 provides example posts from users who discussed these positive aspects of the app.

Positive Aspects	Example Post
Reduces bingeing	*"**The best thing for me for emotional eating or binge eating is logging! If I am faithfully logging, I have much better control** over that stuff because I don't want to enter a bunch of crap. I am really proud of myself for not succumbing to those desires to binge."* [ID 215596]
Helps eat more	*"I suffered from disordered eating my entire life. My eating issues were never extreme enough to be considered full-blown eating disorders but were enough to have a big negative effect on my life. Until I started using DropPounds, it was almost impossible for me to eat three meals a day. My usual pattern included starving myself and then bingeing, compulsive eating, and sporadic, unsustainable diets. My self-esteem has always been tied to my weight and whether I had a 'good eating day' or a 'bad eating day.' **Since I have been on DropPounds, I have finally learned how to eat three meals a day (and snacks).** Every meal and mouthful is still a battle but at least I'm finally winning the fight."* [ID 144279]
Improves food choices	*"**DropPounds for me is more about being held accountable for my food choices**, as I have a bit of a sugar issue and tendency to binge until I feel ill. **This is about making sure I get enough fruits, vegetables, fiber,** and avoid eating mindlessly."* [ID 23774]
Provides a healthy plan	"*I have EDNOS, and I'm trying to recover. This app and community really motivate me to lose weight in a healthy manner. Unfortunately, I purged last night, but today I didn't. At one point, I used to purge everything I ate no matter what it was: fruit, vegetables, diet coke, and water. I'm motivated and inspired to finish recovery by myself because I had a negative experience in a hospital. I'm very happy here, and **I love how it [DropPounds] gives you the amount of calories to eat. You can still lose weight, and it selects a goal for you, which makes it healthy.**"* [ID 154295]

Table 4-2. Positive aspects of the app and example posts

Some users also discussed how the app could exacerbate eating disorder behaviors. For example, the app encourages purging calories through excessive exercise by providing negative feedback when users exceed their budget and allowing them to "erase" calories to receive positive feedback. Not only does it promote compensatory behaviors, but it also encourages users to restrict their calories and eat less than their allotted budget. Having eating disorder behaviors in combination with using the app also could lead to or exacerbate obsessive behaviors and thoughts around logging and numbers. While some users felt the app's algorithm automatically meant that the plan was healthy, other users suggested that the app's goal-based plan was actually unhealthy. Table 4-3 provides examples posts of these negative aspects. These findings provide a look into how apps may reduce and exacerbate eating disorder behaviors.

Negative Aspects	Example Post
Encourages compensatory behaviors	*"**The times where my bar showed I was over calories, I would punish myself with an extensive amount of exercise** while talking down to myself. There was a times where I would go over an insignificant amount of calories, 50 perhaps, and punish myself with a large amount of unnecessary exercising."* [ID 29213]
Promotes restriction	*"**I have found myself doing this [trying to eat less and less like it's a game]** and have to remind myself daily (usually at every meal) that it's not about the number; it's about making healthy choices**. I have to make myself not feel like an utter failure is I don't stay under my calorie limit.**"* [ID 533842]
Leads to obsessive behaviors	*"I have struggled with bulimia/anorexia for the past 4 to 5 years, and I still struggle today in being happy with my body. I am a perfectionist and have a somewhat obsessive personality so **I can get obsessed with logging my food and thinking about how many calories I am eating and drinking at all times. I probably shouldn't be on this site sometimes!**"* [ID 318229]
Provides a dangerous plan	*"Many people who frequent these forums know about the 1200/1500 calorie minimum for women and men, but those who have not joined the forums only assume that the less they eat, the more they will lose. For example, when I began this program over a year ago, **I set my goal to 2 pounds per week in order to get things accomplished faster. My budget was around 900 calories, which I ate.** DropPounds is the one calculating the calories people consume. While we cannot solely blame DropPounds for its cold calculation, we have to consider the ignorance of many people who are using this program and who are destroying their well-being in the process."* [ID 29213]

Table 4-3. Negative aspects of the app and example posts

4.4 Discussion of Preliminary Findings

This preliminary study showed that users with eating disorder behaviors are utilizing weight loss apps. I found three main results: 1) no user (regardless of start BMI) starts with a weight gain goal, and most want to lose weight, 2) 6.78% of the community want to be underweight, and most identify as female, 3) users with underweight BMI goals tend to view the app as positive; however, some acknowledge its role in exacerbating eating disorder behaviors. Due to the nature of the preliminary study, a number of questions were left unanswered. In this section, I explain the findings and how the preliminary study informed the research questions for the main study.

I found no user set a weight gain goal. In fact, the vast majority of the community (98.76%) begins the program to lose weight (not maintain or gain). Even those who are underweight when they begin the program do not want to gain weight, and most of these users want to lose additional weight, which would put them at a more extreme low weight for their height. A small subset of users with underweight BMI goals is using the app to maintain an

already low weight. No one using the app is doing so to gain weight even if they should gain weight or report needing to gain weight as part of their eating disorder recovery. Thus, the overall focus of app use is weight loss no matter the start weight of users.

In addition to the heavy focus of weight loss by all users, I found that almost 7% of users wish to be underweight, according to BMI. The majority of users who set underweight goals (85%) begins the program at either a healthy weight (53%) or is already underweight (32%), and 98.18% of these users identify as female. These findings suggest women often want to lose weight even when weight loss is unnecessary, which is in line with prior research (Forman-Hoffman, 2004; Lynn, A.L., 2012).

Based on this study alone, I cannot ascertain why users set low weight goals. Some users explicitly stated needing to gain weight for recovery but had weight *loss* goals. For example, users with underweight start BMIs and underweight goal BMIs said the technology is helping to reduce their eating disorder behaviors, and every user with an underweight start weight had an underweight goal weight. This begs the question: do some users really want to recover? I cannot determine whether or not users truly want to use the app to reduce their eating disorder behaviors.

Additionally, I cannot determine if users are actively trying to maintain their eating disorder behaviors or if they want to recover but are not setting appropriate goals. There may be a subset of users who do not want to recover from their eating disorder or eating disorder behaviors. Weight loss apps and forums can give them a false feeling that their behaviors are healthy, which can allow them to deny they have eating disorder behaviors. Thus, in the main study, I investigated why users with eating disorder behaviors use weight loss apps and their intentions regarding eating disorder maintenance and recovery.

Similar to Tan et al. (2016), I found users discussed the weight loss app as reducing eating disorder behaviors and exacerbating them; however, more users talked about the positive aspects of the app than the negative aspects. Thus, in the main study, I further examine how weight loss apps are used and focus on the negative unintended consequences of app use.

4.5 Limitations

There are a few limitations of this research, including sample size, date of data collection, and using BMI. Although there were over 1,200 users with underweight BMI goals, not every user posted in the forums. Analyzing the profile and forum data meant I was unable to get the perspectives of users with eating disorder behaviors who did not post in the forum. Additionally, for the purposes of this study, I focused on users' discussions of the impact of the app. Thus, I could only provide example quotations from a small subset of users. Thus, this likely does not cover all perceptions of the app but is meant as a jumping point for the main study.

Another limitation is the age of the data. While certain features of the app have changed since the time of data collection, the overall focus of the app is the same. The app still contains a food, exercise, and weight loss log and shows progress visualizations based on these factors; however, the look of the app has changed. The focus of this research was not on specific design features or aesthetics, so the findings are still relevant not only to DropPounds, but also to other weight loss apps. Since data collection, the app's popularity has skyrocketed. Thus, I suspect even more users with eating disorder behaviors are utilizing the app.

Although BMI has its limitations, BMI is used in the *DSM-V* to aid in the diagnosis of eating disorders, and the Centers for Disease Control state under 18 is considered underweight ("About Adult BMI," 2015; American Psychiatric Association, 2013). I chose to focus on users with underweight BMI goals because this desire to be underweight can signal unhealthy

behaviors. Having an underweight BMI goal does not mean that all of these users have clinical eating disorders; rather the intent to be underweight and wanting to lose weight when already at a healthy weight or underweight could be indicative of eating disorder behaviors (Boero & Pascoe, 2012; Peñas-Lledó et al., 2015). Additionally, BMI under 18.5 is a potential marker of anorexia nervosa. Thus, I used goal BMI as an indicator of eating disorder behaviors. However, it is likely that I missed users with eating disorder behaviors who have goal weights that put their BMI in the healthy, overweight, or obese range, which means there are potentially many more users with eating disorder behaviors using weight loss apps. The main study aimed at addressing these limitations.

The aim of this study was to focus on weight intentions, specifically users with underweight BMI goals, and shed light on their app perceptions. Despite the limitations, this study is a good first step at looking at the composition of weight loss app communities and the impact of weight loss apps on eating disorder behaviors.

4.6 Chapter Summary

Chapter 4 presented the data collection methods, data analysis, and findings from the preliminary study. In this chapter, I also provided a brief discussion of the findings as well as the limitations, which I address in the main study. The preliminary study acted a first glance at the use of weight loss apps by those with eating disorder behaviors while the main study provides a detailed look at this phenomenon. The next two chapters focus on the main study.

5 MAIN STUDY: PART 1
Preliminary Study Connection, Methods, and & Analysis

After finishing the preliminary study and successfully completing my dissertation proposal, I began the main study, which included two surveys (demographic survey and eating and exercise behaviors and attitudes survey), think-aloud exercises, and semi-structured interviews with college women with eating disorders. In this chapter, I first explain how the main study addressed the limitations of preliminary study and then describe the recruitment, data collection, and data analysis for the main study.

5.1 How the Main Study Addressed Limitations of Preliminary Study

While the preliminary study confirmed there were users with eating disorder behaviors who used weight loss apps and discussed how they impact their eating disorder behaviors, the preliminary study had a number of limitations, which I addressed in the main study by using think-aloud exercises and semi-structured interviews with users:

a) *Answered why users use these weight loss apps:* My preliminary study began to shed light on unintended effects of weight loss apps on women with eating disorder behaviors and features that may promote eating disorder behaviors. However, because I analyzed existing content, I was not able to ask specific questions to understand why these individuals are utilizing these apps and how they utilize such technology. In the main study, I conducted interviews with users to understand why they turned to apps intended for weight loss.

b) *Got more detailed information on how these apps are used:* Through my preliminary work, I began to understand how users with eating disorder behaviors are using apps. However, my understanding of their usage was limited to the content they chose to share in the forums. Therefore, I obtained more detailed information about the ways in which

they were using weight loss apps through the think-aloud exercises and interviews with users.

c) *Expanded understanding of unintended consequences:* The preliminary study provided some insight on potential unintended positive and negative consequences of weight loss apps. Again, though, this was limited by what users discussed in the forums. The main study allowed me to initiate discussions about users' perceptions of the impact of weight loss apps and expand the understanding of unintended consequences.

d) *Further explored the impact of the design features:* By having users show me their app, how they use it, and then discussing why they use this app and how it impacts them, I was able to understand how specific features and design aspects may unintentionally exacerbate eating disorder behaviors and how some may be helpful in reducing eating disorder behaviors.

In addition to addressing the limitations of the preliminary study, these methods were appropriate for this phase for the following reasons:

a) *Probing and asking further questions:* I was able to immediately respond and adapt my data collection methods to ensure I was addressing my research objectives, which I would not be able to do with other methods, such as surveys or forum post analysis. I quickly responded to participants' comments and experiences in order to clarify assumptions or questions that arose and explored atypical findings (Lincoln & Guba, 1985).

b) *Story behind experience from participants' point of view:* Because I was unable to identify any published studies that explored the effects of weight loss apps in relation to eating disorder behaviors, it is useful to get as much rich data as possible about the users'

experiences with weight loss apps. Interviews enabled me to get the story behind their experiences from their own point of view (Kvale, 2006).

c) *Detailed and thorough information:* Conducting think-aloud exercises and semi-structured interviews allowed me to obtain detailed and thorough information (A. Adams & Cox, 2008) and get large amounts of rich and grounded data (Kjeldskov & Graham, 2003). Interviews specifically permitted me to get a deeper understanding of my participants' experiences.

d) *Personal approach:* Eating disorder behaviors and eating disorders can be stigmatizing. Using interviews helped create a more personal experience. This enabled me to create a relationship with them that made them comfortable enough to share their perspectives, which may not have been achieved through other less personal approaches, such as surveys. Through this study, I heard their stories, talked with them, and ultimately created a rapport with participants so they felt that this was a safe place to discuss their eating disorder behaviors. Participants expressed feeling comfortable talking with me, and many discussed how this study gave them an outlet to discuss these issues.

5.2 Institutional Review Board (IRB) Approval and Study Participants

IRB approval was obtained from The Pennsylvania State University to conduct the research (STUDY00004634). Because anorexia nervosa, bulimia nervosa, and related eating disorder behaviors tend to affect college women (D. Eisenberg et al., 2011) and weight loss apps users tend to be younger (Fox & Duggan, 2012; Smith, 2015), I focused on young women between the ages of 18 and 25 with self-reported eating disorders (symptoms related to anorexia and bulimia nervosa) who use or have used weight loss apps. Because some people do not meet the full

criteria for a specific diagnosis and because many people never seek treatment for their eating disorder, I recruited both participants who were formally diagnosed and those who were not.

In order to recruit users with a history of eating disorders, I contacted on-campus groups (University Health Services and The Center for Counseling and Psychological Services) to post flyers for my research (see Appendix B for flyer) and one professor to post to a campus listserv. I also posted flyers on bulletin boards across campus and in women's restrooms, which I felt would allow users to take a pull tab with my contact information or take a photo of the details in private, and off campus, such as at local gas stations. This method was effective; four days after flyers were posted, eight women contacted me. I also posted a digital copy of the flyer on Facebook. Finally, I asked two professors to share an alternative flyer during class time (see Appendix C). User participants were compensated $25 each.

5.3 Data Collection

I used three data collections methods: 1) surveys (demographic survey and Eating and Exercise Behaviors and Attitudes Survey), 2) think-aloud exercises, and 3) formal semi-structured interviews. The surveys helped to obtain demographic information as well as eating disorder status. The think-aloud exercises and interviews complemented one another but sought to address different things. For instance, the think-aloud exercise focused on how the app is used and specific app features. The interview, on the other hand, focused more on the users' perceptions of the app and sought to answer why they use weight loss apps. Although these were distinct methods of data collection, they occurred during the same data collection session.

I began each data collection session with a brief overview of the study. At this time, I went over the Informed Consent form (see Appendix D, E, and F) and asked the participant to sign if she had not done so already. Participants then filled out the demographic survey and the

Eating and Exercise Behaviors and Attitudes Survey (EEBAS)[7]. Then I asked permission to video record the think-aloud exercise and audio record the interview. All participants agreed to video and audio recording. Twenty-three data collection sessions took place in-person in the Information Sciences and Technology Building at The Pennsylvania State University in a private room. One interview was conducted over the phone because the participant currently lived in another city.

As shown in Table 5-1, all participants (*n*=24) completed the demographic survey and interview. Nineteen participants completed the EEBAS. Seventeen of 24 participated in the think-aloud exercise. Seven did not because they no longer used a weight loss app, and I did not want to make them use an app that may trigger eating disorder behaviors. In those cases, we discussed the app and how they used it, but I did not video record their using an app.

Data Collection Method	Number of Participants Completed
Demographic Survey	24
Eating and Exercise Behaviors and Attitudes Survey	19
Think-Aloud Exercise	17
Semi-Structured Interview	24

Table 5-1. Number of participants that completed each portion of the study

5.3.1 Surveys

5.3.1.1 Demographic survey

I created the demographic survey using Qualtrics (see Appendix G). It contained typical demographic questions, such as age and race/ethnicity. However, it also asked questions related to participants' eating disorders (diagnostic status, history, recovery status) and weight loss and health apps (names of apps used, whether or not participants believed their eating disorder began before or after using the app).

[7] Because the eating and exercise behaviors and attitudes survey was added after the first 15 interviews, 10 participants took the survey after the data collection session. The remaining 9 participants took the eating and exercise behaviors and attitudes survey at the beginning of the data collection session. The updated consent document can be viewed in Appendix E, and the consent addendum is provided in Appendix F.

5.3.1.2 Eating and Exercise Behaviors and Attitudes Survey (EEBAS)

The EEBAS was also created using Qualtrics (see Appendix H). It is a combination of three well-known measures for assessing the severity of disordered eating and exercise behaviors and attitudes, similar to (Tan et al., 2016): the Eating Attitudes Test (EAT-26) (Garner, Olmsted, Bohr, & Garfinkel, 1982), the Eating Disorder Examination Questionnaire (EDE-Q 6.0) (Fairburn & Beglin, 2008), and the Clinical Impairment Assessment questionnaire (CIA 3.0) (Bohn et al., 2008; Bohn & Fairburn, 2008).

The EAT-26 is a self-report questionnaire that assesses symptoms and concerns characteristic of eating disorders on a six-point scale and using behavioral questions (Garner et al., 1982). It is comprised of three subscales: diet, bulimia and food preoccupation, and oral control that make up an overall score. For those who score over nineteen and/or qualify for one or more of the behavioral questions, the recommendation is to see a qualified professional because they are exhibiting symptoms characteristic of eating disorders. Even without the cut-off score, this measurement can be used as a continuous measure of eating disorder behaviors.

Similar to the EAT-26, the EDE-Q 6.0 is a self-report questionnaire that measures frequency of eating disorder behaviors in the last twenty-eight days that reflect severity of aspects of the psychopathology of eating disorders (Fairburn & Beglin, 2008). A highly reliable and validated tool, EDE-Q is the most commonly used assessment for eating disorders (Berg, Peterson, Frazier, & Crow, 2012; Tan et al., 2016). It is comprised of four subscales: restraint, eating concern, shape concern, and weight concern, which make up the global score. Higher scores indicate greater levels of symptomatology.

The CIA 3.0, on the other hand, measures the severity of psychosocial impairment due to eating disorder features in the last twenty-eight days on a four-point scale (Bohn et al., 2008;

Bohn & Fairburn, 2008). It is a sixteen-item measure that focuses on mood, self-perception, cognitive functioning, and work performance, which is intended to be taken after a measurement of current eating disorder behaviors (such as the EDE-Q). It then provides values to assess the severity of psychosocial impairment secondary to eating disorders. Higher scores indicate greater psychosocial impairment. Studies have found that a score of sixteen is best cut-point for predicting eating disorder case status.

5.3.2 Think-aloud exercises

After the surveys, we moved to the think-aloud-inspired exercise. I video recorded the think-aloud exercises using a GoPro camera mounted to a table, as show in Figure 5-1. In order to build rapport, I asked participants a general, open-ended question prior to starting the exercise (DiCicco-Bloom & Crabtree, 2006). Then I explained the think-aloud-inspired exercise, and we began. The think-aloud is a method in which participants speak out loud thoughts that come to mind as they go through a task (Charters, 2003). In its current form, the method comes from cognitive psychology, and its aim is "to give the researcher insight into the processes of working memory" (p. 70) (Charters, 2003).

Figure 5-1. Data collection setup

Research has shown that think-aloud techniques are effective and reliable ways to get information about thought processes (Charters, 2003; Ericsson & Simon, 1980). In HCI, the think-aloud methods is one of the most popular methods for usability testing (Nielsen, Clemmensen, & Yssing, 2002) and is typically used to identify issues of usability and even to provide explanations for these issues (Lewis & Wharton, 1997). Similarly, the cognitive walkthrough method is a task-specific approach that often seeks to identify problem spots and reasons for the problems when users attempt to complete certain tasks using the interface and is used in HCI usability research for "evaluating user interfaces by analyzing the mental processes required of users" (p. 717) (Lewis & Wharton, 1997).

Although my work does not aim to evaluate the usability of an interface or identify problems with that interface, aspects of these methods can be useful to examine what users think about the apps they use as they use them, especially when using specific features or trying to complete different tasks (e.g., goal setting). Think-alouds have also been used for more than interface design considerations; they have been used to have users describe their experiences while they are using technologies.

My objective was to not only to explore their perceptions, but also to see the types of weight loss apps they used and how they used them. Interacting with their app gave users a concrete way to demonstrate their use and connect their thoughts to actual actions. As a researcher, this allowed me to examine aspects of the app that the user may not even feel are worth discussing if just asked a general question during the interview. For instance, when I saw that a participant set a low daily calorie budget, I was able to ask them about it.

I used the video to capture what the participant did on her weight loss app while she described it. Audio recording alone did not allow me to see specifically what the user was

looking at as she talks, and note taking did not allow me to capture all the nuances of participants' actions. Video recording allowed a more complete way to capture data and a broader scope of human behaviors (T.-L. Wang & Lien, 2013). By using video and stills from the video, I tied participants' thoughts to specific app features, and I was able to be more engaged and focused on the participant and our conversation.

The objective with the think-aloud exercises was to address how the apps are used. More specifically, I investigated how they set goals and types of goals, how they viewed and used information from progress visualizations, how they participated (or did not participate) in the community or social aspects of weight loss apps, and their use and perceptions of other app features. Consequently, I asked users to walkthrough three tasks: 1) setting goals, 2) viewing progress visualizations, and 3) using social and community features of the app. As users went through these tasks, I asked them to speak what they were thinking. I asked additional questions based on what users said and did.

5.3.3 Semi-structured interviews

After the think-aloud exercise, I began the interview portion of the study. Interviews are a commonly-used, powerful qualitative research method to investigate people's experiences (Kvale, 2006). In HCI, qualitative methods such as interviews focus "on understanding the qualities of a particular technology and how people use it in their lives, how they think about it and how they feel about it" (p. 138) (Anne Adams, Lunt, & Cairns, 2008). While semi-structured interviews may be more difficult to analyze than structured ones (A. Adams & Cox, 2008), I chose the semi-structured format so that certain questions are asked consistently, yet there is flexibility to allow participants to discuss what is important to them and allow me to respond. Additionally, the more structured the interview, the less conversational the interview tends to be,

which often makes the participants feel less at ease and less likely to reveal relevant information (A. Adams & Cox, 2008).

At approximately 14 interviews, I saw repetitive themes in the participant responses, and they converged into the same points (i.e., data saturation) (Marshall, 1996). Some studies have suggested that researchers conduct 5 to 25 interviews (John W. Creswell, 2007). Other research has suggested 12 to 60 interviews for graduate students (Baker & Edwards, 2012). Prior studies have shown that data saturation can be reached at around 12 interviews given a good sample (Guest, 2006). I conducted 24 interviews total.

The interview protocol for users aimed to understand their experience with weight loss apps and get a deeper understanding of their background and how it related to their app use. More specifically, the goals of the interviews with users were to examine their eating disorder history, why they used weight loss apps, the role the app played in exacerbating or reducing their eating disorder behaviors, reflect on their use over time, and their perceptions about it (e.g., if the app exacerbated or enabled eating disorder behaviors, do they view this as problematic?). During the interview, I asked questions regarding why they used weight loss apps, in what ways they used them, if and how the apps had affected her eating behaviors, and if and how their usage changed over time. The think-aloud exercise and semi-structured interview protocol is provided in Appendix I.

5.4 Data Analysis

In this section, I describe how I analyzed the data from the surveys, think-aloud exercises, and semi-structured interviews. All user participants received a unique participant identifier (U01, U02…) in order to maintain their privacy and confidentiality.

5.4.1 Surveys

I used Excel to analyze the demographic survey. Specifically, I used functions to compute means, standard deviations, ranges, and counts. Overall, the EEBAS was analyzed using Excel and SPSS. The EAT-26 and the CIA 3.0 only required mean computations, and therefore, Excel was used. For the EDE-Q, I used Excel to generate the means and standard deviations, but I also compared the means to norms. Therefore, using SPSS, I conducted an independent samples t-test comparing means from the present study (n=19) to Quick and Byrd-Bredbenner (2013) (n=1533). BMI for those 20 years old and older was computed using the United State National Institute of Health calculator[8], and for those under 20 years old, BMI was calculated using the Centers for Disease Control and Prevention calculator[9].

5.4.2 Think-aloud exercises and semi-structured interviews

In total, the think-aloud exercises and semi-structured interviews consisted of 21 hours and 36 minutes, as shown in Table 5-2. The think-aloud exercises and interviews were transcribed and analyzed together. I transcribed 8 of the 24 think-alouds and interviews and used Scribie's transcription services for the remaining 16. I received IRB approval to use this transcription service and had the transcriptionists sign a non-disclosure agreement (see Appendix J). Transcription was appropriate because the goal was "to analyze the content of communication" to understand the participant's experience (p. 2937) (T.-L. Wang & Lien, 2013). I also used the videos and still images from the videos to better understand specifically what the participants were discussing. All participants gave permission to use their videos and still images from videos in presentations and publications.

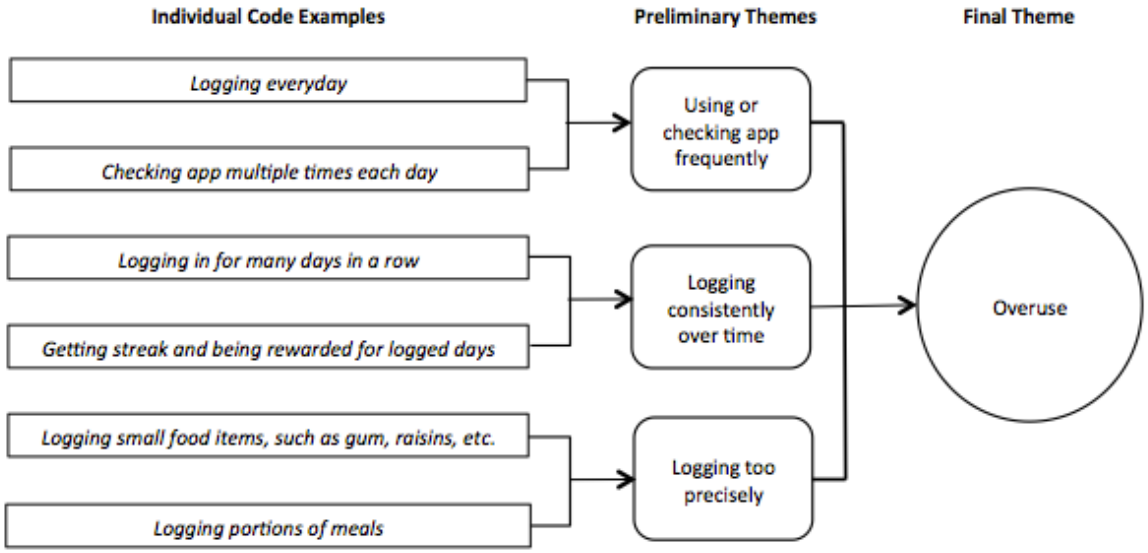
[8] https://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmicalc.htm
[9] https://nccd.cdc.gov/dnpabmi/calculator.aspx

Data Collection Method	Audio Length	Transcription Length
Think-Aloud Exercises and Semi-Structured Interviews	21 hours, 36 minutes, 3 seconds	436 pages

Table 5-2. Data collection method, audio length, and transcription length

Then using Braun and Clark's six-phase thematic analysis approach (Braun & Clarke, 2006), I analyzed the data by becoming familiar with the data, systematically identifying codes and themes, and defining and naming the common themes found across the entire data set. I first became familiar with the data and took notes about things I noticed across the data. Then I grouped similar discussions and answers together and developed initial codes related to three areas: why apps are used, how they are used, and unintended consequences. For instance, in terms of how apps are used, one of the major themes is *overuse* (see section 6.2.2.1). This emerged from initial codes about logging and use frequency, duration, and preciseness. An example of this process is provided in Figure 5-2. During data collection, I iteratively performed the analysis in order to refine the themes as more data was collected.

Figure 5-2. Example of thematic analysis process



6 MAIN STUDY: PART 2
Findings

In this chapter, I explain the findings from the main study. I first provide findings related to the participants' demographic information, eating disorder, and app use, which were gathered from the surveys. Then I answer my research questions by presenting the results from the think-aloud exercises and semi-structured interviews.

6.1 Surveys: Participants' Information

In this section, I present findings from the demographic survey and EEBAS.

6.1.1 Demographic survey

Participants were ages 18 to 23 with the mean being 20.63 years. The majority of participants identified as White (non-Hispanic) (*n*=18) with one from Israel. Three identified as Asian, Asian American, or Pacific Islander, 2 identified as multi-racial, and 1 identified as Native American or American Indian. All participants were current university students. As shown in Table 6-1, most participants had not been professionally diagnosed with an eating disorder (*n*=17), and most reported being in recovery or recovered (*n*=20). Participants estimated they had an eating disorder anywhere from 2 months to 7 years (mean=34.93 months; *SD*=26.78 months). They commonly reported anorexia nervosa, bulimia nervosa, and eating disorder not otherwise specified/other specified feeding or eating disorder (EDNOS/OSFED), and their eating disorder behaviors included extreme restriction, obsession with "healthy" foods (orthorexia), bingeing, excessive and compensatory exercise, purging, and extreme anxiety and concern related to food and weight.

ID	Professionally Diagnosed	ED[1] / ED Behaviors	Do you think you currently have an ED?	Reported Recovery Status	ED Length
U01	Yes	Anorexic behaviors, binge eating	No	In recovery/recovered	2 months
U02	Yes	Anorexic behaviors, orthorexia	Yes	Not in recovery/recovered	1 year
U03	No	Anorexia nervosa, exercise anorexia	No	In recovery/recovered	6 years
U04	No	Anorexic behaviors, EDNOS/OSFED, excessive exercise, strict diet	No	In recovery/recovered	1 year
U05	No	Anorexic behaviors, back and forth between eating and not eating	No	Not in recovery/recovered	2 years
U06	No	Anorexia nervosa, orthorexia, binge eating disorder	No	In recovery/recovered	3 years
U07	No	Anorexic behaviors, restriction, purging	No	In recovery/recovered	1 year
U08	No	Anorexic behaviors, barely ate, some bingeing, EDNOS/OSFED	No	In recovery/recovered	1 year
U09	No	Anorexia nervosa	No	In recovery/recovered (body image issues; diet)	2 years
U10	No	Bulimia nervosa	No	In recovery/recovered	6-7 years
U11	No	EDNOS/OSFED, binge eating-exercise/diet-binge eating, had great anxiety related to eating/dieting	No	In recovery/recovered	>4 years
U12	Yes	Bulimia nervosa	No	In recovery/recovered	6 months
U13	Yes	Anorexia nervosa	Yes	In recovery/recovered	3 years
U14	No	EDNOS/OSFED, always thinking about food, need to track everything eaten, concern when not hitting macronutrients, restriction, bingeing	Yes	In recovery/recovered	7 years
U15	No	Anorexia nervosa	No	In recovery/recovered	1 year
U16	No	EDNOS/OSFED, anxiety about food, afraid to eat "unhealthy" in pubic, bingeing in private, compensatory exercise, diet-bingeing cycles	No	In recovery/recovered	4 years
U17	Yes	Anorexia nervosa, bulimia nervosa	No	In recovery/recovered	6 years
U18	No	Anorexia nervosa	No	In recovery/recovered	1.5 years
U19	No	Anorexia nervosa, orthorexia, excessive exercise	No	In recovery/recovered	1 year
U20	Yes	Anorexia nervosa	No	In recovery/recovered	1.5 years
U21	No	EDNOS/OSFED, restriction, bingeing, purging, excessive exercise	Yes	Not in recovery/recovered	>4 years
U22	No	Anorexia nervosa	No	In recovery/recovered	1 year
U23	No	Bulimia nervosa, bingeing, purging	No (relapses)	In recovery/recovered (relapses)	5 years
U24	Yes	Bulimia nervosa	No	Not in recovery/recovered	6 years

Table 6-1. Participant eating disorder status

Table 6-2 shows participants' information regarding app use. Most (*n*=20) felt their eating disorder began before using weight loss apps, and the most commonly used app was MyFitnessPal (*n*=21). Founded in 2005, MyFitnessPal[10] has become one of the most popular weight loss apps ("Hacking Health: How Consumers Use Smartphones and Wearable Tech To Track Their Health," 2014). It allows users to create a diet plan by entering their height, starting weight, goal weight, weekly weight loss/gain goal, and activity level. Users can enter their foods by searching the database of foods, manually entering calories, or scanning barcodes, and they can input exercise manually or by synchronizing other apps or wearables, such as Fitbit. The app also allows users to track nutrients, such as carbohydrates, and set nutrient goals. MyFitnessPal provides visualizations of calories consumed/burned, weight loss, and nutrients. Users can also choose to connect with other users through adding friends, messaging friends, participating in challenges, and posting on the MyFitnessPal forums. Many of the other apps used had similar features as MyFitnessPal. Participants reported using apps anywhere from 2 months to 8 years (mean=30.21 months; *SD*=30.05).

[10] https://www.myfitnesspal.com/

ID	Apps Used	App Use Length	ED Before/After App
U01	MyFitnessPal	2 months	After
U02	MyFitnessPal, Nike+Running	1 year	Before
U03	MyFitnessPal	8 years	Before
U04	MyFitnessPal, MapMyRun	4 years	Before
U05	MyFitnessPal, Fitbit app, Moodnotes	4 months	Before
U06	MyFitnessPal, Fitbit app	4 years	After
U07	MyFitnessPal	5 months	Before
U08	MyFitnessPal, WeightWatchers app, 21 Day Fix app	7 years	Before
U09	MyFitnessPal (then Diet Tracker), Calorie Counter	7 years	Before
U10	MyFitnessPal	4 years	Before
U11	MyFitnessPal	8 months	Before
U12	Cronometer	1.5 years	Before
U13	MyFitnessPal	5 months	After
U14	MyFitnessPal	2 years	Before
U15	Lose It, Steps, MyFitnessPal	2 years	Before
U16	Fitbit, MyFitnessPal, Nike Running App, Nike Training, Charity Miles, Healthy Out, Eating Well, Spartan Race	5 years	Before
U17	MyFitnessPal	7 months	Before
U18	MyFitnessPal, Pact	5-6 years	Before
U19	MyFitnessPal, Fitbit, MapMyRun	5 months	Not sure
U20	Weight Loss Coach, Fitness Reminder	6 months	Before
U21	MyFitnessPal	4 years	Before
U22	MyFitnessPal, CalorieCounter	1 year	Before
U23	Lose It	5 months	Before
U24	MyFitnessPal	4 years	Before

Table 6-2. Participant app information

6.1.2 Eating and Exercises Behaviors and Attitudes Survey (EBBAS)

The EEBAS results are presented for each participant in Table 6-3. Participants reported current (mean=22.90; *SD*=3.58), high (mean=24.71; *SD*=3.84), low (mean=19.54; *SD*=3.40), and ideal BMI (mean=21.13; *SD*=2.26). At the time of data collection, most participants were in the healthy range (*n*=16), followed by overweight (*n*=2), and obese (*n*=1). Highest reported BMI for participants was most often in the healthy range (*n*=14), followed by overweight (*n*=3), and obese (*n*=1). Lowest reported BMI most often fell in the underweight (*n*=8) or healthy range (*n*=8) followed by overweight (*n*=2). The majority of participants reported an ideal weight in the

healthy range (*n*=17) followed by underweight (*n*=1) and overweight (*n*=1). These results suggest most of the participants did not need to lose weight before, during, or after using weight loss apps.

Table 6-3 also shows each individual's scores on the EAT-26, EDE-Q 6.0, and the CIA 3.0. Sixteen participants (of 19) answered two or more of the EEBAS questionnaires in a way that suggest they are exhibiting eating disorder behaviors. Seventeen of 19 participants reported their ideal weight as less than their current weight, and only 2 reported their ideal weight as higher or the same as their current weight.

ID	Current BMI	High BMI	Low BMI	Ideal BMI	EAT-26 Score	*EAT-26 Behavioral Questions*[11]	EDE-Q 6.0 Global Score	CIA Score
U01	18.70 (13th percentile) (healthy)	21.60 (50th percentile) (healthy)	18.00 (6th percentile) (healthy)	16.20 (< 1st percentile) (under)	**30.00**	**Yes: C,E**	**2.96**	**24.00**
U02	NA	NA	NA	NA	NA	NA	NA	NA
U03	NA	NA	NA	NA	NA	NA	NA	NA
U04	NA	NA	NA	NA	NA	NA	NA	NA
U05	NA	NA	NA	NA	NA	NA	NA	NA
U06	21.10	23.20	16.40	20.40	2.00	No	0.51	3.00
U07	NA	NA	NA	NA	NA	NA	NA	NA
U08	22.00	23.40	20.90	21.10	**24.00**	**Yes: B C**	**2.78**	**16.00**
U09	22.50	23.30	18.50	20.90	**31.00**	**Yes: A**	**2.71**	10.00
U10	27.90	30.10	25.80	24.40	**21.00**	**Yes: A B C**	**3.01**	7.00
U11	19.50	23.50	18.90	18.90	**25.00**	**Yes: A**	**2.35**	**22.00**
U12	21.60	22.60	20.80	20.70	**29.00**	**Yes: A B**	**3.38**	**20.00**
U13	23.50	23.50	15.70	20.40	8.00	**Yes: B**	**2.37**	5.00
U14	20.40	21.80	17.80	20.10	14.00	No	1.44	4.00
U15	23.80	26.60	18.30	21.60	12.00	No	**3.44**	**16.00**
U16	29.10 (93rd percentile) (over)	31.10 (95th percentile) (obese)	27.30 (90th percentile) (over)	23.30 (71st percentile) (healthy)	**47.00**	**Yes: A C**	**3.93**	**36.00**
U17	20.10	22.30	16.70	19.70	**25.00**	**Yes: C D E**	**3.06**	11.00
U18	22.10	23.20	20.30	21.10	**23.00**	**Yes: A C**	**3.27**	**17.00**
U19	20.00 (29th percentile) (healthy)	23.40 (69th percentile) (healthy)	17.60 (4th percentile) (under)	20.20 (31st percentile) (healthy)	**24.00**	**Yes: A**	**1.93**	13.00
U20	24.80	26.60	15.80	23.90	5.00	No	0.38	1.00
U21	22.30 (62nd percentile) (healthy)	23.00 (68th percentile) (healthy)	19.20 (22nd percentile) (healthy)	21.50 (52nd percentile) (healthy)	**25.00**	**Yes: B**	**3.71**	**25.00**
U22	19.20	19.50	17.10	19.20	**29.00**	No	**2.99**	4.00
U23	24.20 (77th percentile) (healthy)	25.20 (82nd percentile) (healthy)	20.30 (37th percentile) (healthy)	21.30 (50th percentile) (healthy)	17.00	**Yes: A B**	**2.69**	12.00
U24	32.30	35.50	25.80	26.60	14.00	**Yes: B C**	**4.35**	**36.00**

Key:

Underweight	Healthy weight	Overweight	Obese

Bold indicates hitting the cut-off point (EAT-26 and CIA) or exceeding the norm (Virginia M. Quick & Byrd-Bredbenner, 2013) (EDE-Q)

Table 6-3. Individual participant BMI and EEBAS scores

[11] See Appendix H for behavioral questions.

The overall EEBAS results are broken down by each measurement that it is comprised of as shown in Table 6-4. For the EAT-26, the overall mean score was 21.32. Fifteen of 19 participants exceeded the cut-off point, meaning they should see a qualified professional because they are exhibiting eating disorder symptoms. The CIA 3.0 results can also be viewed in Table 6-4. The overall mean of all participants did not reach the cut-off point of 16 (mean=14.84). However, 9 of 19 participants exceed the cut-off point.

Measurement	Range	Mean (SD)
EAT-26 Score	2-47	21.32 (10.63)
EAT-26 Diet Subscale	2-32	14.37 (7.96)
EAT-26 Bulimia and Food Preoccupation Subscale	0-9	4.53 (2.74)
EAT-26 Oral Control Subscale	0-6	2.42 (2.06)
EDE-Q Global Score	0.38-4.35	2.70 (1.04)
EDE-Q Restraint Subscale	0.40-3.80	2.27 (1.13)
EDE-Q Eating Concern Subscale	0.20-5.00	2.05 (1.22)
EDE-Q Shape Concern Subscale	0.50-6.00	3.39 (1.37)
EDE-Q Weight Concern Subscale	0.40-5.80	3.06 (1.50)
CIA Score	3-36	14.84 (10.39)

Table 6-4. EEBAS ranges, means, and standard deviations

The EDE-Q 6.0 results are also shown in Table 6-4. However, to make these results meaningful, I compared them to the norms of undergraduate women in the United States, which can be seen in Table 6-5. The global score for the present study is extremely significantly higher than the norms reported in Quick and Byrd-Bredbenner (2013), $t(1550) = 3.5064$ $p = 0.0005$. The restraint, eating concern, shape concern, and weight concern subscales were all either very significantly higher or extremely significantly higher than the norms, $t(1550) = 2.7932$ $p = 0.0053$, $t(1550) = 4.6036$ $p = 0.0001$, $t(1550) = 2.6623$ $p = 0.0078$, and $t(1550) = 2.9262$ $p = 0.0035$, respectively. These findings show that despite most participants not having been professionally diagnosed with a clinical eating disorder, they exhibit eating disorder behaviors.

	Norm Mean *(SD)*	Participant Mean *(SD)*	*p* Value*
EDE-Q Global Score	1.65 *(1.30)*	2.70 *(1.04)*	0.0005
EDE-Q Restraint Subscale	1.35 *(1.43)*	2.27 *(1.13)*	0.0053
EDE-Q Eating Concern Subscale	0.89 *(1.09)*	2.05 *(1.22)*	0.0001
EDE-Q Shape Concern Subscale	2.39 *(1.63)*	3.39 *(1.37)*	0.0078
EDE-Q Weight Concern Subscale	1.98 *(1.60)*	3.06 *(1.50)*	0.0035

*Independent samples t-test comparing means (*n*=19) to (Virginia M. Quick & Byrd-Bredbenner, 2013) (*n*=1,533)

Table 6-5. EDE-Q participants' scores compared to norms

6.2 Think-Alouds and Semi-Structured Interviews: Answering RQs

In this section, I answer the three research questions by presenting findings from the think-aloud exercises and semi-structured interviews. First, I address why college women with eating disorders use weight loss apps. Then, I focus on how they use these apps. Finally, I end with the unintended consequences of using weight loss apps.

6.2.1 Why college women with eating disorders use weight loss apps (RQ1)

College women with eating disorder behaviors do not report seeking a weight loss app with eating disorder recovery or maintenance in mind. Rather, they choose a weight loss app with two objectives: losing weight and being more aware of food. First and foremost, most want to lose weight regardless of their current weight or their eating disorder history. When asked the objective or driver behind using a weight loss app, most participants mentioned losing weight (*n*=22). For instance, when asked about the reason for using weight loss apps, participants responded: *"I used to be just like naturally thin, and then I decided to lose 10 pounds 'cause I thought I should lose 10 pounds." [U06]* and *"It was three years ago, and I wanted to lose weight. So I got the app, and then I went too overboard with it." [U13]*.

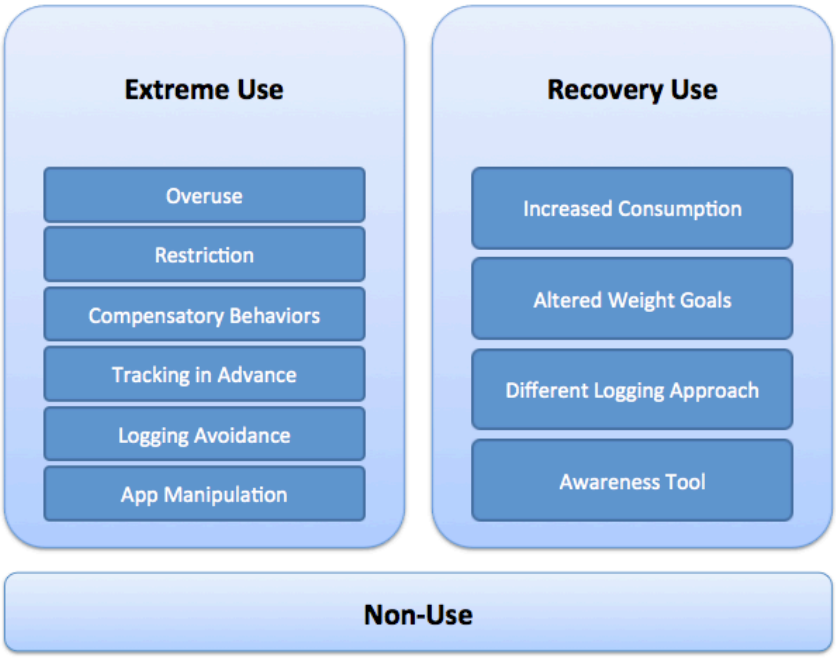
While the majority of participants talked about weight loss, some also mentioned becoming more aware of what they were eating through tracking everything as a motivation for

using a weight loss app. For example, one participant stated, *"It [the reason I chose a weight loss app] was awareness. It was just to see what was going on." [U24],* and another simply said her objective was to *"Track everything." [U14]*. Another participant explained her motivation was both weight loss and awareness: *"I think a combination. So one of them [reasons] was to lose weight a little bit and also to be more aware of the nutrients." [U12]* While some participants wanted more understanding of what they were consuming, the majority's primary driver was weight loss.

6.2.2 How college women with eating disorders use weight loss apps (RQ2)

College women with eating disorders use weight loss in a number of ways, including unknowingly and knowingly supporting extreme behaviors and supporting recovery. Thus, three usages[12] emerged: extreme use, recovery use, and non-use, which can be seen in Figure 6-1.

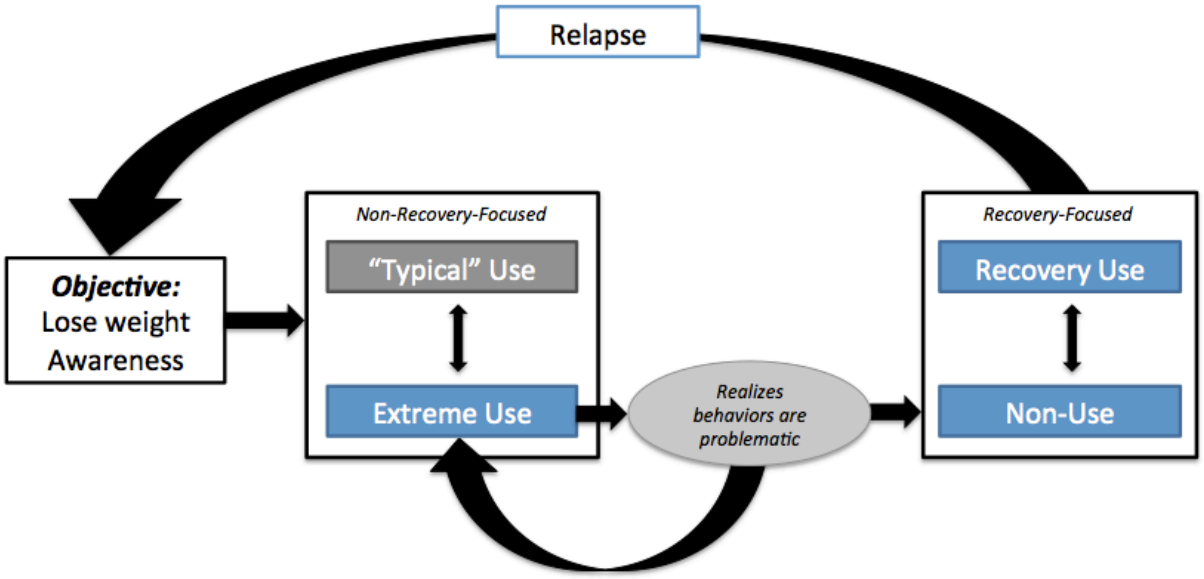
Figure 6-1. Types of weight loss app usage



[12] See Appendix K for summary and definitions of usage types.

From participants' reflections, a pattern of usage emerged, as shown in Figure 6-2. Beginning with their objectives to lose weight and be more aware of their food intake, participants sometimes use the app as intended (what would be considered typical use; this is greyed out because it is not something I covered in depth). However, more often than not, these behaviors become extreme. At some point, many participants realize their behaviors are problematic, in which case they either knowingly continue their extreme use of the app or focus on recovery by using the app with recovery goals in mind or ceasing use of the app altogether (either temporarily or permanently). Despite recovery intentions, participants often relapse by beginning to use the app again in extreme ways or reverting from recovery use to eating disorder behaviors. In the next section, I go into more detail about the types of usage (extreme use, recovery use, and non-use) as well as relapse.

Figure 6-2. Pattern that emerged from participants' reflections



6.2.2.1 Extreme Use

In terms of extreme use, six subthemes emerged. Participants 1) overuse the app, 2) restrict calories and food groups, 3) engage in compensatory behaviors, 4) track in advance, 5) selectively log to avoid negative emotions, and 6) manipulate the app to lose weight and net fewer calories.

1. Overuse

Overuse was related to using or checking the app too frequently, logging consistently, and tracking food too precisely. Many participants talked about how they would use the app everyday and often check the app multiple times each day. One participant talked about how she used the app everyday and even started logging foods a day in advance:

> *"When I was in the middle of my eating disorder, I would definitely use it [the app] everyday. And it was one of those things where I would pretty much try and track everything the day before." [U06]*

Not only did participants use the app everyday, but they also often checked the app many times a day and not just to log food and exercise. One participant explained how she checked the app throughout the day:

> *"Definitely before [recovery], it was really bad. Like I would get on there [the app] a few times a day, like more than the 3." [U02]*

Similarly, another participant talked about how she would check the app all the time and base her behaviors on the app's feedback. She used it as a tool to figure out what she should do:

> *"I checked the app all the time to see 'Okay I put in this snack. What does the app say I have to do now?' It was like I was relying on the app to tell me things." [U09]*

Another participant described how she would check her Fitbit multiple times a day while in high school:

> *"I'd go to school, and I'd often check throughout the day or tap it [Fitbit] 'cause it'll show you the lights." [U16]*

A number of participants echoed this constant checking of weight loss apps. One participant described a time when her friends were interested in the Fitbit and asked if she wanted to purchase one. Having self-awareness, she explained that if she were to have a Fitbit, she would use it too often and be unable to escape from it, which is why she chose not to get one:

> *"My friend was like, 'You going to get a Fitbit or did you have a Fitbit?' I was like, 'Are you kidding me, do I have a Fitbit? If I had a Fitbit and I had to look at everyday at how many steps I was taking, I would be on that thing the entire time looking at it.' Trying to see how many calories I burned, how many steps I took. If I didn't hit that many steps, I'd be pissed 'cause I didn't... That would be terrible… And the problem is, like for example for a Fitbit for your app, you can't get away from that because you're so inclined to always be on our phone and that I think it's attached to your wrist. You can't get away. So you're just going to look at it all the time. It's like when you check your phone, you look at the time, you turn it off, but you look at it again 'cause you forget the time, so you're going to just keep looking at it again and again and again." [U17]*

Not only did many participants use the app everyday, but they also used the app consistently over long periods of time. The app highlighted this use by showing users' logging streak. For example, one participant reported logging for over 200 days, which made her feel accomplished:

> *"[I was proud of how] I logged in for 200-something days in a row." [U03]*

Similarly, another participant talked about how she was proud when she logged for long periods of time:

> *"I really used to use this after my freshman year when I was like really trying to lose weight, and probably one of the proudest things I would see was that I was logging for so long 'cause it just kind of meant to me that I was stuck with my plan to lose weight… But I liked seeing I had logged for so many days because it just made me feel like I was accomplishing something." [U04]*

In addition to using the app often and logging over long periods of time, some participants described how they used the app to precisely log even the smallest amount of food. One participant discussed logging one communion wafer and raisin:

> *"So literally, it [the app] just knew everything… It had the one tiny little morsel of food logged in there… I remember I went to church one day and I got a communion [wafer], and I even found the calories of it, which it's a half of calorie, that doesn't matter. But I think it was still in there, so I logged it… Why would you even have that in there? So that just didn't help… It had every single food in it. So literally, it just knew everything, and I just would put in one raisin, eventually." [U13]*

Another participant reported measuring and logging only fractions of servings, even if it meant not finishing her meal. She would only eat a small portion of her food and then figure out the calorie content of that food:

> *"I would log in, like if the serving was say one burrito. I would calculate the percentage, how much I ate… so 5/8th of the burrito… And if I made something at home, you could also log that in, so like a flour tortilla or salad dressing 'cause I was making my whole wrap and you can put in how much you had. So usually a serving is one tablespoon, I would have a little, little amount of it, so like 1/3rd." [U22]*

Overusing apps was commonly reported among participants. Many used apps everyday and even checked them multiple times each day. Not only did participants log everyday, but they also logged consistently over time. When they logged food, they would be extremely precise, logging even the smallest amount or portion of food.

2. Restriction

Restriction, or limiting one's calories and/or food groups, was a common theme among participants. Because many participants used MyFitnessPal as their primary app, they discussed their calorie budget as 1,200 calories, which is the lowest MyFitnessPal will allow users to set. Despite this threshold, participants reported setting their own calorie budget goals in their mind and eating less than the allotted 1,200 calories. For instance, one participant's objective was to

always eat below her calorie budget. She described how the app gave her a 1,200 daily calorie budget, but she aimed to consume below 1,000 calories:

> *"I kind of set it [my goal], and then it [the app] gave me a calorie count of maybe 1,200 calories. But I never wanted to go above 1,000 calories. I remember coming home from the gym, and if I was around like 500 calories, like I was happy with that… so I definitely didn't want to be anywhere near the maximum. I wanted to be underneath… I feel like that kind of does start an eating behavior where you don't want to eat anything… I liked it [the app] just because like at the time, I wanted to limit my calories, wanted to limit what I ate. So it was like a positive reinforcement for me, like when I met my goal of like not really eating… So in a way it was kind of bad because I was like restricting my diet so much." [U07]*

Many participants' descriptions paralleled trying to eat less than the calorie allotment provided by the app. Another participant discussed not wanting to eat enough to even reach the app's calorie budget let alone exceed it:

> *"Then it [the app] gave me the recommended calorie thing, and I would just try to do way less and less and less of that. Like I didn't try to meet it, I guess… It [the app] had you put in your weight and stuff. I think that the calories they gave you was the lowest that it would give you… Now I feel like they [my goals] were unhealthy for me, but at the time I didn't. It [the app] would set [calorie] goals, but I would try to just not meet them 'cause that was better than meeting it or going above [the calorie budget]." [U13]*

In addition to restricting calories and eating underneath the app's provided budget, participants also talked about restricting food groups, such as carbohydrates and fats. For example, one participant not only discussed trying to stay under 1,000 calories each day, but also strictly limiting carbohydrates:

> *"I didn't know so much about dieting back then, like that's the whole reason it [the eating disorder] started. I was just like avoiding things that had carbs in them… I was using it [the app] everyday just trying to stay below 1,000 calories and mostly like just not eat carbs so… No, [in the middle of my eating disorder, I didn't exceed my budget]. I like was very strict about being under it… And like I definitely knew that eating 800 calories was like not a good idea, but I did it anyways." [U06]*

Similarly, another participant would restrict her food intake to have as many calories remaining as possible while also avoiding all fat. Although restricting her diet so much caused her pain and dizziness, it became a natural part of her life:

> *"Pretty much setting the goal was just to look at the calories remaining and have it [the calories remaining] be like the highest it possibly could… I actually did like looking at this too, the pie chart… A lot of times, especially when I was really limiting my diet, there'd be like no fat… Eventually, like it was hard in the beginning, and I knew, I knew like that wasn't how it was supposed to feel, like losing weight, like it wasn't supposed to hurt, like be hungry all the time or like feel dizzy, like I'd wake up and feel dizzy. And knew that that was bad, but I was like, 'Well, it's ok, I just need to lose the weight, and then it's fine'. So we [my sister and I] never really thought that it was like bad; it just became normal." [U04]*

Participants reported restricting their calories and restricting food groups through the app. While MyFitnessPal would not allow them to set a calorie goal less than 1200, most participants reported trying to consume fewer calories than 1,200 calories even when they recognized that these behaviors were unhealthy.

3. Compensatory behaviors

Participants would compensate for their food intake or their weight gain. Compensatory behaviors included purging most often exercise but sometimes vomiting or further calorie and food restriction. They talked about how the app would show the amount of food they ate and their weight through progress visualizations. For instance, MyFitnessPal shows a red visualization when users exceed their calorie budget and a green visualization when users were under their budget. These visualizations acted as a driver for compensatory behaviors. One participant described a time when she worked at a doughnut shop and exceeded her calorie budget. The app represented her going over her calorie limit through the red visualization, so she exercised until she burned enough calories to be "in the green" or under her budget. She even

talked about how exceeding her limit would result in her restricting her calories the following week:

> *"I used to work at [doughnut shop], so I would snack on things there, so you can log having a [doughnut hole]… and I actually had eaten a lot of calories, and I felt like crap… And I logged it, and I think it went into the red. When I went to gym, I worked out for so long that day, and I was able to see it go back to green and still say it had remaining calories… Like to see it go back to green made me feel like, 'Ok, like I'm fine' even though in retrospect, even if I'm eating a bunch of crap and exercising, that's really not that much healthier… But I liked seeing it go from like red to green… If I see the red, it's pretty much a bad day, and I feel like I have to start all over again. So then you'll probably see the next week [I'll] be super low in like everything." [U04]*

Similarly, some participants discussed how they would go out of their way to ensure they burned off excess calories consumed. One participant explained how regardless of the amount of calories over her budget, she would exercise to purge calories. When she exceeded her allotment by a significant amount of calories, she became overly concerned to the point of prioritizing exercising over attending class:

> *"If it [calorie intake] was [over] 100 or 200 calories, I'm like, 'Ok, it's fine, it's 200 calories, I can just burn it at the gym tomorrow.' But if it was like 500 or 600, I would just be like... There would be, at points, like if I had Chipotle or something normal that day and I didn't go to the gym, it would bother me at night [that] I didn't go to the gym. Then I would wake up... There were points I would skip my class to go to the gym to burn this off. Yeah, it was crazy." [U22]*

Other participants often reported exercising to "erase" calories from the app regardless if they had exceeded their budget or not. For instance, one participant talked about how she purged calories to reach 500 to 600 calories through working out. Sometimes when she felt as though she consumed too many calories, she would purge through self-induced vomiting:

> *"I kind of used this app to document like every single thing I did. So if I went for like an hour walk, I would put it in here and like every little exercise I did to get calories out of the app, I would do that… the exercise part was kind of how I was able to get to my 500 calorie limit. Normally, I would only want to eat around 800 or 900 calories, and then after exercise, it would drop down to, I would normally burn like 300 calories, so it would get pretty low. I remember one day… after exercising, I was at 0 calories. And I*

was like, 'Look! Look at this! That's kind of cool.' Like thinking about it, it's like so bad, but the app's kind of designed that way, to kind of want you to cancel out your calories… I guess my weight loss journey was not eating, and then it became more struggle to have cheat days but not over-cheat the days. And that's when I kind of, like if I felt if I was eating too much, I would like make myself throw up sometimes." [U07]

Some participants used the app to purge all consumed calories. One participant explained how she wanted her calories for the day to be zero. If she exceeded her budget, then she would exercise to remove the calories from the app:

"I used it to... I would input my exercising to see if I could... The goal was to kind of make it zero-zero, so enough exercising and little calories to kind of... cancel it out… Yes, [sometimes I would exceed my calorie budget]. So then I just kind of made sure that I exercised a lot more to balance it out… Yes, [I would change my behaviors the next day]. And for some reason if I didn't hit my exercise mark that I wanted to, the next day was going to be like, 'Hell's going to break loose', or I'm just like, 'Go at it, and exercise even harder to make up for the calories I didn't lose the day before and then on top of what I'm going to do for today.'" [U17]

In addition to compensating for food intake, other participants talked about ways they would try to offset weight gain through reducing food intake and increasing exercise. For instance, after seeing that she had gained weight, the same participant who exercised to compensate for exceeding her budget described how she would skip future meals:

"I went from 109 to 107 [pounds]. And then, if I gained weight, I would just stop eating more, I guess, and just exercise more… I will log in if I'm over because if I logged in like that, if it was 98.6 pounds, then it will be like, 'Okay, you're going to be 102 pounds.' It would increase the weight if I went over the 1,200 calorie limit. And then to make up for that next day, I would just skip breakfast and lunch, just eat dinner… I would just be like 'Yeah, I have to limit myself tomorrow.'" [U22]

Many participants described compensatory behaviors for consuming calories and gaining weight. This was especially true if participants exceeded their calorie budget; however, a number of participants also reported purging to "erase" calories from the app regardless of how many calories they consumed. Additionally, some discussed not only exercising to compensate but also further restriction.

4. Tracking in advance

Many participants discussed logging in advance. Rather than acting and then tracking, participants would log foods first and then eat them. For example, one participant explained how she would plan what she would eat the night before:

> *"If I want to, the night before, I'll tell myself what I will eat, like I get very big on planning the meal for the next day when it's still the day before. So it's a big control thing." [U02]*

Similarly, another participant explained how she used the app to schedule when she was allowed to eat. She even logged her meals at least a day prior to eating:

> *"And then I would have to use that [my log] as a schedule. 'Ok, at this time you eat this, this time you eat this.' But in the beginning, I was never like that… In the beginning… I wasn't much obsessed with checking it [the app]. More towards the end, I would start to log in my day before my day even happened to then kind of play with it to see, 'Ok, if I ate this instead, I can have this. That many calories could replace that, or that food can replace this.' And I'd start to log in days before they even happened." [U17]*

Some participants would log an entire day's food in the morning before consuming anything:

> *"I [would log] mostly in the morning 'cause I'd log for the rest of the day. But it'd be every meal." [U16]*

One participant explained how she would lie in bed and log in all of her meals for the day to see what the calorie totals would be by the end of that day. This made her feel safe knowing that she would be under the limit before consuming anything:

> *"Before I would use it [the app] before I ate, like within my bed, waking up in the morning. I wouldn't get out of bed until I had everything in for breakfast, lunch, and dinner. So I would enter all of it, and then by the "end of the day" supposedly, still I haven't gotten out of my bed. I would see, 'Oh, so by the end of this day, I'll have this amount of calories, this amount*

of protein. I will be fine, everything is ok.'… And then I would feel like a safe person because I already know that nothing happened." [U12]

Tracking in advance was common among participants. When participants logged foods before consuming them, they were able to see how eating would impact their calorie limits. They would then use the log as a rigid plan to control when and how much they were allowed to eat.

5. Logging avoidance

When exceeding their calorie or nutrient budget, participants often reported feeling negative emotions. In order to manage these negative feelings, some would avoid logging if they knew they would exceed their allotted calories or nutrients. For example, one participant described not wanting to log dessert she had eaten after seeing how much fat it contained:

> *"Normally on my cheat days, I try not to even enter it in the app because I didn't want to see it on the app [laughs]. But I think we went to the [restaurant] with my dad, and I remember me and my sister, we split a cheesecake, and she went to enter it in the app and saw that it had 40 saturated fats! And she literally started to almost cry after seeing that 'cause like, it's weird to say, but it's kind of devastating just because like visually, once you start losing weight, I started to picture the food I ate on parts of my body. So I was like, 'That cheesecake's going to go right to my thighs, like right to my stomach.' I didn't even enter it in the app 'cause I was like, 'I don't want to see it,' like I didn't want to know." [U07]*

Similarly, one participant talked about how she did not log if she felt she exceeded her budget as a way to avoid negative feelings:

> *"What actually happens is if it's way over, I just don't log it [because] I don't want to see the damage. So I literally won't log it… I avoid that negative emotion by just simply not logging it… So I literally won't log it. If I've had X amount of shots of vodka - it [the app] counts alcohol in there if you want it to - I'm not going to put that in. I know, I'm well aware that's 1,000 calories. If I'm going to have, [wing restaurant] after drinking, not going to put that in there." [U10]*

For some, the act of logging made their food consumption "real". Avoiding entering food allowed participants to act as though they did not actually eat, which minimized negative

feelings associated with exceeding their calorie budget. One participant explained how she would not log when she felt she exceeded her calorie limit in an attempt to deny the fact that she did and protect herself from the negative emotions of doing so:

> *"I feel like when I went over, I knew I went over, so I wouldn't add it to the app... 'Cause I would feel bad about myself. I didn't want to see it, like that made it real that I went over. So I just never added it, but I knew. Obviously, I knew, so." [U13]*

Along those same lines, another participant described only logging until dinner. If she consumed anything after dinner, then she felt guilty. Therefore, she would avoid logging it to pretend as though she had not eaten anything else:

> *"I was on a every three, four-hour eating schedule, so just whatever it was partitioned for those hours would always be put in. And I did find that at night, well, especially two weeks on that, I definitely wasn't eating enough for my body. So at night, after dinner, I would eat a lot more just because I was so hungry. And obviously, at that point, I was like, 'I shouldn't be eating this.' And I tended to log up, probably up until dinner, and then anything after that, I would just not log and just forget about in my mind… I think [I didn't log after dinner] just because I felt like it would be a guilt thing. I was physically really, really hungry, but I wasn't allowed to go over... I didn't want to be in the red, so I pretended if I didn't log it, then it didn't exist." [U19]*

Some participants even personified the app and felt as though it judged them for exceeding their budget. For example, one participant discussed how she did not track her weight if it increased:

> *"Well, I'll weigh myself, but then if it's higher than I want, I won't log it because I know that, not that the app is mad at me, but then it shows the bar going up, and I don't want to see it." [U15]*

In order to avoid feeling guilty or judged by the app, participants avoided logging when they felt they were over their calories or nutrients. Despite knowing they exceeded their daily budget, logging made their consumption or weight gain seem more real. They used logging avoidance as a defense mechanism against negative feelings.

6. App manipulation

The last extreme usage is app manipulation, which often was finding ways to trick the app to provide a lower calorie goal or net fewer calories. This was often achieved by not honestly reporting information about exercise and activity level. For instance, one participant talked about how she reported her activity level as sedentary even though she was very active so the app would show her a lower calorie budget than she should have had otherwise:

> *"I put in 'not active' even though I was active, so like that made it [calorie budget] even lower for my maintenance [calories]. So like I feel like that, it helped me because it was lower than I already should be… I put in I wasn't active even though I was really active, so my maintenance calories were already lower than they should have been. And then if I put in like 'lose 2 pounds per week', it would be even lower. So I feel like that can be manipulative… I think it can easily spiral into like disordered eating." [U03]*

One participant explained that those with eating disorders already underestimate their amount of physical activity, so they choose the lower calorie budget. Then they try to consume less than the allotted calories even though this budget is already too low based on their actual activity level:

> *"I think at the beginning, they have three different levels of activity: moderate, intense or... It was very basic. There was no way of knowing what you consider a job that's active. So I remember thinking one, 'How do I even know these are tailored to me?' But then two, especially for someone that has an eating disorder, when you're having to choose between moderate or vigorous exercise, you're always like, 'Well, I'm probably not vigorous enough,' even though you're probably doing more than 90% of the people that use it. So I feel like for those types of people, we always pick the lower limits, and then we see that we're getting near the limits, and we try to get even more under that." [U19]*

Another way to manipulate the app was to avoid logging physical activity, which would make the app "think" they did not burn any calories. For example, one participant explained how she would do a lot of calorie-burning activities and then go to the gym but never log calories burned

from exercise. She would be under her calorie budget even without inputting the calories burned from exercising:

> *"I was dancing 4 days a week for like 2-ish hours and then I was swimming 4 to 5 days a week for 1 to 2 hours as well as thinking I needed to start lifting. So I would in between all that, go to the gym 4 times a week and lift up the 10 pound dumbbells, so my calorie expenditure was probably 3,000 to 4,000 calories a day, and I was eating 1,000… I didn't [record my exercise]. I don't think I ever recorded it simply because I knew I was doing so much." [U06]*

Participants manipulated their calorie budgets and expenditures by not accurately inputting their activity level and exercises. In spite of not tracking physical activity, the app told them that they would lose weight, so being more active than reported acted as buffer or a means to more quickly achieve weight loss.

6.2.2.2 Recovery Use

Although extreme use was prominent, many participants reported using the app for recovery at some point. Four recovery subthemes emerged: Participants changed their app usage and oriented it towards recovery by 1) increasing their consumption, 2) changing weight goals, 3) altering their approach to and perspective of logging, and 4) using the app as an awareness tool to ensure they balanced food consumption and exercise.

1. Increased consumption

One way weight loss apps were used for recovery was by increasing consumption. Through the app, participants logged additional calories and foods and focused more on macronutrients. This essentially taught them that they could eat more, which reduced their fears around extreme weight gain. One participant talked about how adding calories and tracking macronutrients helped her recover. By adding calories and focusing on tracking macronutrients, she was able to

slowly gain weight. Then over time, she realized she could eat three meals a day and not gain too much weight:

> *"I slowly added calories, and then that's when I started tracking my macros, like my protein, carbs, and fat, to reach a certain amount to slowly gain weight, and then I guess you could say the way I use the app in recovery, like it kind of taught me how to eat again because when I would eat, it was just so disordered. I would have like 5 crackers. It was just all over the place. So I would say tracking my macros on here [the app] helped me recover because it taught me how to eat again, like a breakfast, lunch, dinner, and then snacks… I would say, I would say I just saw my weight so low, and like I was like unable to function, so I'm like, 'Well, like I could add 100 more calories'. Then I was like, 'Well, maybe I can add like a hundred more' because I didn't really gain anything. So I realized then like, oh, I can eat, and it will make my performance better, and I'm not really going to gain weight." [U03]*

Similarly, another participant discussed increasing her calorie intake to be healthier. On her app, she demonstrated how her calorie budget went from the minimum 1,200 to 1,750, which was a step towards recovery:

> *"Yeah, [my goals are set towards recovery], so even my goal number... Whereas I showed you in, I think it's... in 2013, my goal was 1,200, very low; 2014, a little bit higher, 1,500; 2015, 1,750. That's kind of where I'm at now, back down a little bit. I guess I started to get more conscientious again… So yeah, my goal of calorie intake has definitely gone up, which shows progress because it shows that I'm trying to achieve more of a healthy diet and not go under my calorie intake for how active I am as a person." [U21]*

One participant explained how WeightWatchers (the app), which focuses on daily points instead of calories, helped her recover because it taught her to eat more and took the focus away from calories, which alleviated some fears about weight gain:

> *"Well, like I never had like a diagnosed eating disorder, but I would say probably like freshman, sophomore year, kind of like before I started using them [apps], I would just like barely eat kind of thing, and then like the apps kind of helped me see like, or the WeightWatchers, you can still be fit and skinny if you eat more, so I think it kind of helped me personally knowing I'm not going to be gaining weight by eating more necessarily, so it helped me track it, so that's kind of when I started using it and got more into it… I think the biggest thing with eating disorders is showing like that you can still eat more and not gain weight because people never know where the fine line is of this is what you should be eating, but if you eat this much, you're going to gain weight. So I*

think it's that fear of gaining weight, and you constantly like don't want to do any change. And I think that's even where I even struggle with. It's like, like if I eat more for breakfast, am I going to start gaining weight?... 'cause then I'm not going to eat more. And I think it's just the unknown, but I think with WeightWatchers, what helps is seeing that you know what you need to eat to still like lose weight or to like still stay your own weight, and I think that's what helps." [U08]

A number of participants used the apps to increase their food and calorie intake. When they saw they could consume more and still not gain too much weight, participants became more comfortable eating. Adding more calories, eating more, and focusing less on calories helped participants through the recovery process.

2. Altered weight goals

In order to focus more on recovery, participants changed their weight goals. Sometimes this meant altering the goal from weight loss to weight gain. Other times, participants changed their weight loss goal to be more realistic and less extreme. One participant described how she set the app to gain weight. Based on her weight gain goal, the app provided a new, higher calorie budget, which comforted her because she could see she could safely eat a lot of calories:

"My [most recent] goal was to gain some weight back because I'm at 110 right now, so I wanted to gain at least 5 pounds because I feel more comfortable with that, so it has me at a weekly goal at .5 [pounds] per week, and from that, I'm supposed to be matching my calories and everything, so that's really all I've done through that, just to like keep on a track, but it hasn't really affected anything… I haven't reset it since like 3 weeks ago. It's just, I know I have to gain weight, so that's my goal that's been on there, and before I saw the doctor, I wasn't changing it either. It was a weight loss goal at that point… I think sometimes it's [logging] comforting, I mean towards recovery sometimes, like just to realize I have so many calories left, and I really should be filling it. Like I should be working towards a weight gain, so I think it's comforting in that, like that's why I went back on it, to see maybe if it could turn things around." [U02]

Similarly, another participant changed her goal to gain weight, which is something MyFitnessPal supports:

"It [the app] did let me select weight gain. It says, 'What's your goal? To lose, gain, or maintain?' And MyFitnessPal also still does that. And this time I put 'gain'." [U09]

Others did not alter their objective of weight loss but instead, focused on less extreme goals. One participant did not set a weight gain goal but felt that adjusting her weight loss goal to a more realistic one was important for her recovery process:

> *"When I saw the goal of 120, I'm like, 'I should probably change that' because if I say I'm so far from that, it's only going to discourage and probably prompt unhealthy behaviors… Changing the goal from what it might have been a year ago to how it is now, that's important for staying in recovery, I'd say." [U10]*

In order to focus on recovery, participants changed their weight goals within the app. Some switched from weight loss to weight gain while others kept weight loss goals but adjusted them to lose less weight overall.

3. Different logging approach

Another way participants used the app for recovery was by changing their approach to and perceptions of logging. While previously many had focused on precise tracking and often logged food in advance, participants tried to be more lenient in recovery. One participant described how she continued logging but stopped being so exact and letting it control her as much. She refrained from logging before she ate and would only log after consuming food. This changed her mindset so that she could now respond to her body's needs instead of having to adhere to what the app said. The app was no longer a strict list of foods and calories she was allowed to eat in the future but rather a tool to track and reflect on what she had already consumed:

> *"When I came back to it [the app], I just said, 'I'm just going to monitor it but not obsess about it'. So I was still measuring things. So let's just say I cooked a bunch of rice, and then I put a cup of cooked rice in my bowl of dinner or something. Then I'll be, 'Ok, this is a cup. I don't need to make sure it's exactly a cup. I'll be fine if it's a cup of food. Everything is ok.' So it was just more of a mindset. I would still use it, but usually not before I ate but after I ate, or maybe I would have breakfast, log it in after I had it. So if I felt like eating an extra banana in the morning, then I would do that and then just log another one. It was just less dictating what I do, but more me informing the app what I did." [U12]*

In addition to changing when and how to log foods, participants also changed their perception of what logging could do for them. For instance, one participant said she kept tracking but focused more on her health instead of how logging could change her appearance:

> *"[I used it with recovery in mind] a little bit, maybe. Towards the end of using them [apps] I was like, 'I want to be more healthy than I want to be concerned with what I look like,' and that was a pretty good point of using them. I was more happy with that time, I think, than any others because I was more worried about my actual being instead of what I looked like." [U16]*

Changing one's approach to logging was helpful for recovery. Specifically, participants made an effort to be less precise and track their food after they ate as opposed to before (act and then track vs. track and then act), which reduced their obsessive behaviors. Others tried to focus on how logging could improve their health during recovery instead of fixating on how the app could be used to change their appearance.

4. Awareness tool

Finally, the app was also used as a tool to create awareness about how little or how much participants were eating and exercising. For instance, one participant explained that at the beginning, the app exacerbated her eating disorder, but she was able to alter her usage for recovery. She used the app as a tool to ensure she was not burning more calories than she consumed. Also, the awareness of food content reduced her fear around food:

> *"I just recently stopped wearing it [Fitbit], but when I went home for break, it almost became more imperative for me to wear it in the spring semester because I wanted to make sure that I was eating over what I was burning… I think, at first, it was really controlling, the fact that I could see it made it worse. But then on the counter side, when I realized it was a problem, the fact that I could see it gave me the tool to really get out of it… I feel like you almost need to be aware of it in the recovery stage because there's definitely... Just like there was a fear of not knowing what's in food because you want to lose weight, there's a fear of not knowing what's in food because you want to gain weight." [U19]*

Similarly, another participant explained how the app helped her make sure she was eating enough and not exercising too much. While she used to exercise to burn off all calories consumed, during recovery, she increased her calorie intake and decreased her exercise, which she was successfully able to do by seeing calories consumed and burned:

> *"Then after that, she [my doctor] said, 'You're going to permanently damage your body if you don't start eating normally and getting your period again and stuff.' So then I started using the app to see how much I was... This time it was almost checking me to make sure I was eating enough, and that I wasn't zeroing out every day on calories. And so that was my relationship with the app. At first it was helping me lose, and then it was helping me get better… I consider myself, that I was anorexic... I would eat 600 calories during the day, and I would go to the gym, and I would not leave until I burned 600. So, I thought, 'Ok, that's normal. That's zero calories. That's how it should be.' And I didn't realize that my body was also burning 900 calories regardless of working out… Yeah, so the app would help me because I'd realize, 'Wait, I don't... I should...' Really, I was burning negative 900 calories because my body was still doing work too, and I didn't realize that. So, it was helping me when I was trying to get back to a healthy weight because it showed me you shouldn't work out that much if you're eating that little because your body is also burning it. It let me eat more because if I was still going to go for a four-mile run that day, I was able to eat more because I knew that my body was also burning this amount… I changed it [the app] to a higher calorie intake and less working out." [U09]*

Another participant talked about using the app to track basic exercise in order to know how many calories she should eat to replace the calories she expended:

> *"I think the step count is kind of cool, just seeing how much I walk around campus, just without having to exercise, like how many calories that estimates to burn, so because then like, just to elaborate on it: the doctor told me to not be exercising so much to take stress off my heart, so she told me to limit it to walking around campus, so I feel like on days that I don't, which is very rare, don't exercise, I can see that I am still burning calories that I need to be replacing." [U02]*

Weight loss apps acted as an awareness tool. For some participants, they used the app to understand how to more safely balance calories consumed and calories burned. With a better mindset, the app was helpful during the recovery process.

6.2.2.3 Non-Use

The third type of usage is non-use. Sometimes participants felt the best course of action for their recovery was to stop using the app either temporarily or permanently. One participant simply said that not using the app was the most helpful thing she did for recovery:

> *"I would say that, not really, [there are not aspects that help with recovery] just because I recovered from my eating disorder by not using it [the app]… So I don't think it [the app] really helps people to really recover from it [eating disorder]." [U07]*

Some participants recognized the potential for their app usage to contribute to and aggravate eating disorder behaviors, so they opted to delete the app. For instance, one participant talked about how she felt like she could not use the app safely and did not want to return to the worst of her eating disorder:

> *"I feel like I'm just going to go back to that point [eating disorder] if I keep on using it [the app]. I don't want to go back to that point. That was a very, very bad time. And I just can't do that to myself anymore, so I just stopped using it." [U22]*

Similarly, another participant explained how the app triggered eating disorder behaviors. Even when advised by a nutritionist to use an app to track her eating, she refused. Additionally, she explained that the app is set up for eating less and losing weight even with recovery goals in mind, which is problematic:

> *"I started getting better. Then I wasn't using it [the app] because I found that tracking, it was really a trigger for me… And then I think I didn't really use the apps too much when I was recovering because I was really worried if I started tracking things, I would fall back into that trigger thing and wanting to be less and less and less… The nutritionists have asked if I wanted to set up a rigid plan and then track it, and I said no because I knew that was what had put me in the bad place. So I was afraid to go back to it, but they did recommend it. And I think even at that, I think it would be really risky to put someone in MyFitnessPal the way it is designed now because even if you go with the mindset of I'm going to try to eat over, it's not set up for trying to eat more, it's set up to eat less. And I think that would just be really trigger-some." [U19]*

One participant talked about taking a break from using the app. She dropped to 105 pounds at 5 feet 7 inches (which put her at an underweight BMI of 16.4) and began having stomach problems, so she temporarily stopped tracking her food using the app. Eventually she began using the app again to prepare for a fitness competition; however, she realized she was not ready to compete and decided to take a break from the app again, which she felt helped her recover:

> *"I don't know if I think anything about this app would be good for anyone with an eating disorder to use. I generally don't advocate tracking food if you have an eating disorder or had one or think that you are predisposed to have one… I took a really long break from tracking, like the past year, I stopped using the app and just kind of started eating like a normal person again, and that was really nice so. I think everyone should do that, and I think that's really what has helped me so… [I stopped using the app again because] I realized maybe it wasn't the best time for me to do it [a body building show], so I didn't do a show, and that was when I decided to take a break off of tracking, like completely for like the past 8 months, and that was what really helped me like fully recover." [U06]*

One participant described how she stopped using the app when it consumed too much of her time and she was having anxiety attacks about food. She explained how tracking using the app made her obsessive about food to the point of looking up calorie information not only in the app, but also on the internet in two different languages, so she stopped using the app temporarily:

> *"[I decided I needed to stop using the app for a while because of] literary anxiety attacks. And I wouldn't have been using this term if I didn't experience myself and I wasn't a psychology major, taking up classes. Explaining what it is, anxiety attacks. It was really like that. It was especially when I was really abusing the internet with looking up things and certainly to the point. I speak two languages, so I grew up speaking Hebrew. I would look in Hebrew websites about calories and stuff, and then I would look in English websites about how many calories are in stuff. I just completely lost my mind. So once it occupied me way too much of my day just time-wise and energy-wise, I went to a psychologist on campus… because I was so anxious. And if I would binge-eat, then it would have been binge eating of vegetables because I was so anxious about gaining weight. Just something at some point after a long miserable, I think semester at least, I just said, 'No more' and 'This is crazy. Nothing should drive me nuts, like food'. So that's when I said, 'I'm going to erase it [the app]. I'll be fine.'… That's when I erased it [the app], when it was just occupying me and energy-wise and time-wise just to insanity really… I have no doubt in my mind that once I graduate and I'll do sports just for fun not for competition, I will erase it [the app], I will never, ever use it. And if I ever have kids, I'm not sure I will, I won't reinforce it in any way." [U12]*

Other participants did not choose to stop using the app on their own but were either asked to or forced to delete it. For instance, one participant discussed how she was forced to delete the app when she went into an eating disorder treatment program. When she recognized the effects of the app, she realized that deleting it was the best course of action:

> *"I didn't really choose to stop [using the app]. I was forced to stop. But then once I was forced to stop and went to treatment and everything, it made me realize how dangerous those things [apps] can be… But I just think, I don't know... I could never go back to it [the app] or see myself safely dealing with it… When I went into treatment, I just had to tell them [my parents]. I think I deleted it [the app] myself, if I can remember, 'cause I knew that I wouldn't be able to sneak around my house snapping pictures of labels and tracking everything. I tried it in the beginning, the first couple of days I was home, and it was just not going to work. And I deleted it. I told my doctor that I was using it, and that kind of motivated me to cancel [delete] it 'cause she told me basically I had to… But if they [my parents] knew [I used the app] before they would have been pissed… It took a couple weeks in therapy, I think, for me to really kind of hit the nail on the head. When I first came home, I thought I was fine. I didn't think I was that bad. I knew I was thin, but I didn't think I was that bad. The moment that you start to see your family cry because they think you're going to die 'cause you're so skinny, and you see your grandparents cry 'cause they think they're going to lose their grandchild, and they're older than you, and they should die before you die, that really kind of... You're like, 'Shit. I fucked up.' And then you kind of hit a moment where you're like, 'Well, I need to kind of, wipe clear of everything.'... And I think that's why I got rid of the app with the help of my doctor. And I was just like, 'We got to start somewhere.' And I didn't want to see any more people cry 'cause it was so devastating. It was so devastating, and I was just like... I came home, and I was like, well, they threatened to take me out of [college]. They threatened to take me out of basically everything that I was ever involved with here [college], which scared the shit out of me 'cause I don't want to leave this place. So seeing people cry, being threatened to leave here, I was like, 'I got to get my shit together.' And something snapped in my head because... I don't know. It was hard. It was very, very hard. It was difficult, the summer. But I kind of got myself together, which was obviously good." [U17]*

Similarly, another participant described how her parents and eating disorder treatment led to her removing the app after using it in college:

> *"That's [the app's] kind of what started everything. It was three years ago, and I wanted to lose weight. So I got the app, and then I went too overboard with it. And so, I just, when I entered treatment, I obviously deleted it 'cause I was like, 'I can't use this anymore.'... And also, I bet you my parents probably made me delete it because they knew I was getting sick 'cause I came home for the summer and they... I obviously lost*

weight, and they probably made me delete it, so… Yeah, because my house is small at home, and we're always... We're a close family, so I feel like... Yeah, they would totally see me adding random... I would eat a grape and add it, and they would be... They go like, 'See?' kind of. Also they were so hyper-aware 'cause everything I did they were paying so close attention 'cause they knew I was not ok, so… I always felt inadequate and less attractive than everyone else at [college]. And so I think when I used it [the app] at school it just, like that all in the background, just fueled it way more… Constant comparison. It's just the whole college environment, anywhere in college, it's just bad… So I deleted it. Now, I try not to track anything with that." [U13]

At some point, many of the participants stopped using weight loss apps at least for some period of time because they thought it would help with recovery. A number of participants recognized the potential for apps to trigger and exacerbate eating disorder behaviors even if they did not realize the adverse effects when using it.

6.2.2.4 Relapse

Even though relapse is not a separate type of usage, it is related to app usage. Relapse refers to reverting to prior unhealthy habits. This could be retuning to the app after trying to cease use for recovery or falling back into using the app in extreme ways after trying to use it in a healthier way. Although a number of participants stopped using weight loss apps at some point, many of them relapsed in terms of using the app again despite its adverse effects and reverting back to extreme or unhealthy behaviors. Many participants began using weight loss apps again after taking a break from them. For instance, after deleting the app for recovery, one participant talked about re-downloading it:

"I think I downloaded it [the app] again. I deleted it when I started recovery, which was three years ago. But I keep wanting to re-download it." [U13]

Even when participants had recovery in mind, many wanted to use weight loss apps to keep track of their foods or lose weight. For example, one participant discussed how she fell back into an

eating disorder mentality despite trying to use the app for recovery. Although she set a weight gain goal and has a high calorie budget, she still wants to have a calorie deficit:

> *"Then after seeing the nutritionist, I gave it like a week, and I started to pick it [the app] up again… But I feel like I've tapered back into it [eating disorder behaviors]… I have a set goal to gain weight on here, but it's kind of hard to tame, just kind of like the mentality I have now. I still fall back into the same patterns… It's [my current calorie budget's] healthy because I'm supposed to be eating like 2,250, so that number is healthy. The way I'm going about it is not healthy… Just like I have that goal, but knowing that I can still be in deficit everyday, like that's very unhealthy that I'm not actually meeting the goals." [U02]*

Similarly, another participant downloaded an app to track her macronutrients. In spite of wanting to use the app in a healthy way, she described being triggered by the app. Even seeing app reminders concerned her, so she deleted the app again:

> *"Now that I'm trying to gain weight, I've been working on kind of tracking my macros, and I'm using that almost more in a positive sense, like getting the right amount of fats, protein and whatnot. And then, I got an app… And I'm like, I said, 'Let me try... Maybe I'm ready to dabble in it again.' I got an app that tracks my macros and that just became... It just brought up bad memories, and I deleted it. And I was like, 'This is... I don't want to... I'm not ready for this right now. I can't deal with it.' So I just deleted it. But I tried to get back into it in a positive way, but I just don't think I can… I think it [the app] fueled me so much that it totally clouded my vision… and my sense of thinking. It's almost a little bit like a monster. It takes over you without you even knowing. So then what you think you're doing is good, and you don't even realize it's actually killing you. So I've almost looked at it... Whenever I see it pop-up on things, it almost kind of scares me 'cause I know that if I touched it, it might take me down that path again that I don't need to go down." [U17]*

Some participants felt as though they needed the app and reverted to eating disorder patterns. For instance, one participant explained how she does not think the app is healthy for her, yet she still uses it because she is discontent with her body. Although she recognizes her eating disorder thoughts and behaviors, she reverts back to them and uses the app to restrict. She dislikes feeling like she has to use the app:

> *"I don't think apps are seen as a problem, which is very problematic in the culture of eating disorders because it's on my phone, I take it everywhere I go. And similar to other*

girls that if they have the app, it's just at their use at any moment. And I don't think dietitians or therapists even think of that as a big deal. In the world of eating disorders, they try to pick out mental issues surrounding your disorder, which is helpful sometimes, but they have to give you techniques in order to get out of that. One technique would be to just erase all of these fitness apps… If they're still recovering, they still, like me, I should not even have this app because I still have days where I'm like, 'Oh, I have to go out. Tonight's Friday. I have to make sure this number is low.' Even tonight, I'm going out tonight with my friends, and my calorie intake already is pretty low for the day. I didn't log it, but I know in my head just because I'm weird. But I know it's low, so I'm like, 'Ok, I'll look thin tonight. When I go out, I won't be bloated.' Those kind of thoughts are just every day thoughts that people recovering still get because they're obviously not fully content with their body yet. These apps are just a very big obstacle to their recovery because it increases their chance to falling back into bringing their calorie intake down or bringing down how much they eat in a day… I think I still use the app [even though I think it's not healthy for me] because I'm not completely content with my body right now. I see other girls around me in such a large school, and I see so many different shapes and sizes, and I get self-conscious sometimes. I feel like I can control that by still sticking to a set of calories that I think is normal. And this makes me jealous sometimes because my friends don't have the app. They don't even think about how many calories they intake, and these are girls that are even lower weight than I am, and they don't even care about it. That's one thing that upsets me, is that I still have to worry about this damn app and the numbers at the end of the day." [U21]

Some participants described pressures to lose weight and be fit as a result of being athletes or fitness competitors, and they felt the app in some ways was the only way to achieve their athletic goals:

"[I started to use the app again because of] just the desire to lose the weight because I know that I can't do it on my own. I really enjoyed competing in the body building show despite what it did to me after, and I think that's a result of how I went about it, like the methods my coach used. And I really enjoyed that experience of being on stage, and like, it's like this very glamorous day; you've never felt like prettier and whatever. You like get your hair done, your makeup done. It's crazy. It's like a great day. But it was like the after effects that I struggled with, and so I want to do that again, but I know I'm not ready to do it if I can't lose the weight on my own and like get to a better starting point. Like I think if I started prepping right now, I would need to lose probably like 25, 30 pounds. That just tells you how unhealthy the sport is right there [laughs]. But so I want to get to like a healthier weight for my body. I think that I am at a healthy weight just not like where I want to be. So I figure if I ever want to compete again, I should lose the weight first and try and find a way to maintain a lower weight, which is possible… I don't think it [the app] was [healthy]. I think it is better now but still not necessarily healthy. And if I could go back and never touch it [the app], I would… [I use the app] because I do want to lose a couple pounds, and I feel like I'm in a better mindset now to do it. That's kind of like the only way I know how to do it." [U06]

Similarly, another participant described how she wanted to use the app to make sure she can perform as a student athlete:

> *"Some days I'm just like curious, so at the end of the day, I'll just plug in everything like, 'What did I eat?' because it's really easy to get sucked into it. And then, 'Was it half a cup? Was it 3/4 of a cup?'... I think [I incorporated the app back into my life] because it was a long time that I didn't use it. I thought maybe I'm now being too lenient with what I'm eating, and I'm an athlete; I'm here on a team, and I need to make sure to be fit. I need to make sure that... I know I'm eating healthy because I only eat healthy food, but I just wanted to make sure that I'm not gaining back weight because we're in season; we're competing, so I'm still and even now this coming weekend, it's our biggest competition. I'm still in my head trying to figure out whether I'm balancing being obsessed and still being aware because I'm not indulging or anything, but because I felt so much in control when I was with this app and now I don't have it, some days I feel, 'Oh I should probably get back to that because I'm probably being too lenient at each meal, and I might gain weight.'...I think that [I still use the app even though I think it's unhealthy] because I'm still at a time that it's very crucial what I weigh and how much I eat because of my profession of being a student athlete." [U12]*

Other participants talked about using the app again and trying to be healthier with it but still having negative thoughts. For instance, one participant talked about re-downloading the app numerous times and changing her weight gain goal to a weight loss goal. Although she said she wants to be healthy, she is concerned about being fat and wants to lose weight:

> *"I put gain, and then, of course, within a few months I got like, 'Oh, I've gained too much,' and I switched... This is, I think, the third time I downloaded an app. I switched it to 'I want to lose weight,' and then I used that for a while on and off, and then I just kind of stopped, and I would journal. And then every once in a while, I would go back, and for a week, I would use MyFitnessPal again and have to do some calculations on my own sometimes, but after that, it was just not as frequent anymore… I still was conscious because obviously, like I said, I wanted to be healthy, but I still wanted to look a certain way. So, I probably could have even afforded to do 3,000 calories or something. But it also depended too, for me, I like to exercise on my own sometimes, but I exercise a lot more when I'm in-season for a sport… But then of course, the app is showing me that I wasn't burning enough now because I wasn't working out as much, and then again that made me upset. I'm like, 'Ok, so now am I getting fat because I'm eating a lot more, but I'm still not working out enough?' I don't know… I'm already starting to use it [the app] a little bit. I put in what I ate. I'm planning when I'm going to work out. So I think I get into these... I think I'll probably use this a little bit now… I would say right now, after getting back from college and definitely gaining weight this year, that I would like to lose weight again. But I would never pick anything as drastic as what I did last time. And I*

> *only workout probably three or four days a week, and it's moderate activity. So I think I would just be more realistic too. Like I said, when I was out of season for a sport and that was in the winter, I would say, 'Ok, I'm going to go work out a lot more.' So I made my goal I want to lose this much weight per week or whatever. But now I wouldn't do that. I would be much more content with a gradual weight loss… I'm just, I don't need to lose weight. I'm just, would like to get a little bit more healthy with it." [U09]*

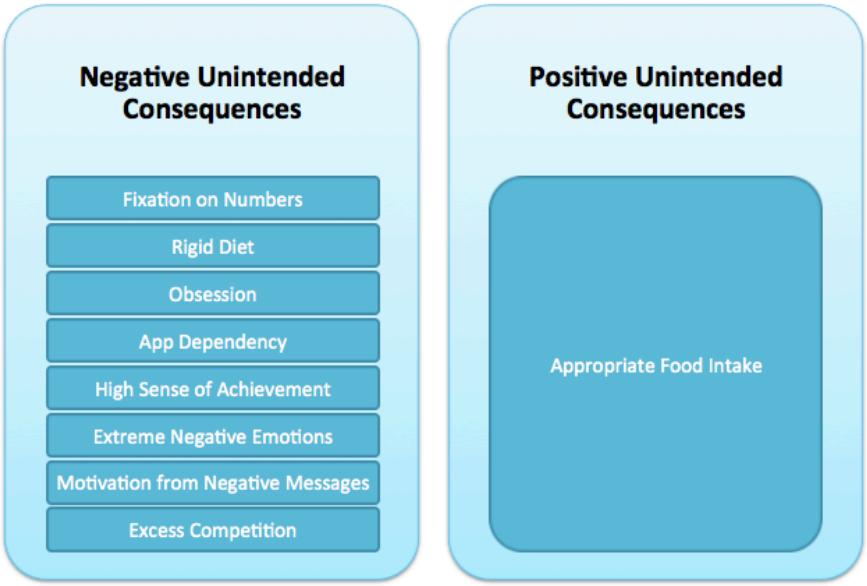
While many participants felt weight loss apps contributed to and exacerbated their eating disorder behaviors, many felt the need to use apps. Many recognized the apps were not necessarily healthy for them and resulted in their falling back into eating disorder patterns. However, because of their discontent with their bodies or athletic pressures, a number of participants began using weight loss apps again.

6.2.3 Unintended consequences of weight loss app use (RQ3)

In addition to varying usage, participants also reported unintended consequences[13] of using weight loss apps, which can be seen in Figure 6-3. Overall, the majority of participants reported unintended negative consequences from using weight loss apps, but a few felt the app had some unintended positive effects.

[13] See Appendix L for summary and definitions of unintended consequences.

Figure 6-3. Types of unintended consequences



6.2.3.1 Negative Consequences

However, the unintended negative consequences of apps were most often mentioned. Eight major themes emerged: 1) fixation on numbers, 2) rigid diet, 3) obsession with the app and food, 4) app dependency, 5) high sense of achievement from being under budget or losing weight, 6) extreme negative emotions from exceeding the budget, 7) motivation from negative messages, and 8) excess competition.

1. Fixation on numbers

Weight loss apps tend to put an emphasis on numbers associated with foods, exercise, and weight. Participants discussed developing a fixation on numbers, which worsened their eating disorder behaviors. One participant talked about how the app made her more aware of calories:

> *"I guess it [the app] has made me more aware of numbers and just trying to meet some you know, calories burned for exercise and stuff like that because it will log it in there. So getting really hung up on numbers has worsened things." [U02]*

Participants also talked about how weight loss apps can change users' relationship with food so that the food essentially boils down to its numbers. At the worst of her eating disorder, one

participant talked about how every food was viewed as its calorie amount and how she still sees food differently after using the app:

> *"I think it's [logging food and exercise everyday] definitely very triggering because you look at food differently. Like now when I look at food, I see like that's protein, that's fat, that's carbs instead of like that's a chicken breast, that's peanut butter, that's a piece of bread, and so it's always thinking, how can I eat these things when I only have so many carbs or I have to eat this much protein? And so it's definitely very, very triggering to be tracking it all the time. And especially back then [during my eating disorder], it was like, 'Well, that's 100 calories right there, like I need to eat broccoli instead, that's like 35 calories'… It's a number game basically… In high school, whenever I was naturally skinny, I didn't think about like what I was eating or how it made me look until I started using the app." [U06]*

Having used the apps so much, many participants already knew the calorie content of every food they ate before logging it. For instance, one participant explained how she became an expert in the numbers associated with foods she consumed:

> *"The problem with the app is that the app makes you so aware of how many calories are in food without you even looking at it because then you start to memorize what's in different foods, and you become an expert on calories. And I noticed that after using the app, I didn't realize how much of an expert I was in calories, knowing what's in everything." [U17]*

Another participant also explained how the app made her so acutely aware of numbers that she did not even need the app to track any longer:

> *"I don't think [I had an eating disorder before the app]. I think it helped start it… And then I feel like eventually, I stopped using the app because I didn't even need it 'cause I was constantly thinking about it so much that I knew every little thing of what I ate. I didn't even need the app to keep track of me, so I just deleted it because I was like, 'It's stupid.' And it kind of taught me all the calories of everything anyway 'cause you look at it so many times." [U13]*

Similarly, another participant explained how she began to think about numbers associated with anything she consumed, even a shot of alcohol:

> *"It [the app] made me more aware of the calories in something 'cause even if I wasn't recording it consistently throughout the day, I can tell you right now a shot of Captain*

has 86 calories in it. Without MyFitnessPal I couldn't tell you that… But I was also thinking, 'I'm drinking a lot of calories right now.' And without MyFitnessPal, I don't think I would be thinking that." [U18]

Participants also discussed how the app dictated what they would do because they were so focused on trying to ensure food fit their strict numbers:

"It's numbers. Every time you have a specific number, someone with an eating disorder, their mind just instantly goes to, 'Does this number fit what I want?' or 'Does this number fit what I need?' So if you have a number of calories on a meal and you have an eating disorder and you see that, and you say, 'This is the only thing I can have today because this is all the calories I can have.' It's awful. It just sucks." [U24]

Another participant described her anxiety around needing to hit her number goals exactly and fit foods into her calorie and macronutrients goals and how that affected her ability to spend time with her family:

"I try to get exactly on [the number]… I like having it exactly on… It [the app] made me more OCD [obsessive compulsive disorder] 'cause I'm like, 'I have to hit this number,' basically… It's made me more, very stringent on what I'm eating and making sure I hit those numbers… There was one time my parents wanted to go out to dinner… So, I called the [restaurant] so I could already track it and have it as close as possible. And then my parents get here, and they're like, 'Oh, we're going go to [this other restaurant] instead.' And I was literally having anxiety about going. I didn't want to go to dinner. I was like, 'No. I already had everything perfectly planned for my day,' and that was probably a bad moment… I feel like eating disorders stem from people trying to be perfect, and with this, you're hitting numbers trying to be perfect, so I think that could be kind of bad." [U14]

The heavy focus on the numbers in weight loss apps was problematic for a number of participants. They developed a fixation on numbers, which changed their relationship with food, made them acutely aware of calorie content, and resulted in their trying to fit foods into their strict budgets. By providing a way to monitor their diet so closely, the app fueled their eating disorder behaviors.

2. Rigid diet

In addition to focusing heavily on numbers, the app led many participants to develop a strict and rigid diet. Many participants talked about how they ate the same foods everyday. One participant explained that she eats the same food everyday so she does not have to strictly track. She knows that it will fit into her goals:

> *"I pretty much eat similar things everyday just because I am like used to, like I don't know, I buy the same foods and stuff like that so, so I don't really have to like track it really strictly and like wonder what it is… And like sometimes I'll track it early, and sometimes I'll wait to eat something, but like I said, I eat similar things, so I know what they are and how they fall in line with my goals." [U06]*

Similarly, another participant discussed how she tends to eat the same things everyday because it is easier to track:

> *"I think another kind of bad thing about it [WeightWatechers] is I eat the same thing almost every single day except for dinner, but I think like just because in my head, I can kind of keep track of the points, and I think that's probably part of it. I'm not going to eat like a lot of new stuff if I have to like kind of go and do the work for it and see how much it is, so I think that kind of makes me eat the same thing everyday." [U08]*

The app also fed into the concept of safe foods, where users would only buy and track foods if they were already aware of their calorie content. One participant explained how she was afraid to eat anything new and eventually found logging to be pointless because there was no variety to her diet:

> *"I was literally eating the same thing everyday 'cause I was scared to eat anything else… I found the app to be kind of pointless, I guess, just because I was doing the same thing everyday, so it's not like I really have to keep entering it." [U07]*

Similarly, another participant discussed how she does not log her food as much because she eats salads everyday now, and if she is uncertain about a particular food, she will not eat it:

> *"[I haven't logged in a little while] because I go to only salad everyday, like my diet is always the same. So I don't think there's a need to track my food… Like if I reach my goal weight… I will still use this app to keep track my weight because I will still step on scale every week, I think. I will use the app to search the foods for the calories, but I*

don't think I will log every food I eat because that's kind of unnecessary… I will search the food calories because if I'm uncertain about this food, I don't think I will eat them because I am afraid it's high in calories." [U01]

In addition to being fearful of new foods, participants were reluctant to try new things because it was easier to track foods in their personal app database or foods that had a barcode. For instance, one participant said she avoided trying new items because they would not be in her app already:

"I've obviously gotten the rigid eating of the same things. So then that even influenced me to almost not try new things because I already had everything in your standard database. So it was easy just to go and get that." [U19]

Another participant explained that she would not eat anything unless it had a scanable food label so that she could ensure it was accurate, which resulted in her eating a lot of the same foods:

"I love how it could scan a label… That was my favorite thing in the world 'cause I would buy things that will only have... It got to the point where I would never buy something that didn't have a label on it 'cause I couldn't track it… And I would be very secretive about just having a picture and being able to successfully find it on the app. If I couldn't find it on the app, I wasn't going to eat it 'cause it didn't... It wouldn't have been correct. I kind of secretly loved that detective work of logging in the information… You start to eat the same things, and you start to memorize what's in different foods." [U17]

For many participants, eating the same types of foods was common. It was easier for participants to log foods eaten previously or foods with barcodes, which led to participants consuming the same types of foods and developing safe foods. Additionally, participants also felt comfortable with foods for which they already knew the calorie content, which resulted in a rigid diet.

3. Obsession

A number of participants explained that they became obsessed with logging and developed obsessive thoughts around food. One participant simply said:

"I think it's [logging my food and exercise everyday is] definitely very triggering because you become obsessed with food." [U06]

Similarly, one participant expressed how she became addicted to the app by logging her weight so often, which made her think a lot about food:

> *"I think sometimes it [the app] makes you think about food too much versus like when you're really hungry… I think it [logging my weight so much] made me a little bit more like addicted to the app and everything 'cause you feel like, 'Oh, like tomorrow I have to weigh myself, so I'm going to eat a lot less,' and then you would kind of see it go up or down on the, like the graph." [U08]*

Other participants talked about how dangerous the apps were for them. One participant, who had begun to use her app to log in advance, described how the numbers associated with food and exercise made her more obsessive:

> *"I just think the entire app in general is harmful… For someone like me, it's extremely dangerous. Just everything. Being able to log your calories, 'cause you become obsessive over taking pictures of labels, you're measuring things, and getting the correct amounts becomes impulsive and just like obsessive. Exercise then, plays a same role in that. I think, just every aspect of the app can be dangerous… I think if I didn't have - I got to be honest. Before I started using the app, I felt like my logging wasn't that dangerous. It wasn't that compulsive or that obsessive, I should say. The app just fueled the fire because I was able to just really look at numbers, and the numbers are so concrete, which comforted me 'cause then I really knew what I was doing to myself. I just think because they label the numbers so clearly between exercise and calories, that just really glued me in. That's kind of what hooked me, which then once I was hooked, I use it everyday and then try to hit my marks lower and lower, which then just kind of fueled it." [U17]*

Another participant, who also tracked ahead of time, explained how tracking allowed her to control every aspect of her life:

> *"I got more hung up on tracking everything. Before I could just eat something. I didn't have to worry about logging it into something. I didn't really keep track of it throughout the day…. Then the ability to track it only made it [eating disorder behaviors] worse… [I would] just be very obsessive about it… Like you get so fixed on controlling everything because you know it's at your hands, literally. You can control everything and then act on it." [U02]*

Some participants also described how using the app led to obsessive thoughts about food and working out. One participant explained how her thoughts about food superseded her schoolwork:

> *"I'm definitely way too... I think about how much I eat way too much and how much I'm working out, and it brings it forefront to schoolwork or something… Well, I mean it sounds great. You get paid for working out and everything, but at the same time you're getting paid to stick to a calorie goal, to make sure you work out enough, and if you're paying attention to that, then you might not be paying attention to schoolwork as much. It definitely makes me think a lot more about how much I'm working out per week, when I'm going to get a workout in, what I'm going to do to work around other things to do that… I mean, like I said, it's great and everything, but at the same time, sometimes I wish I weren't thinking about it so much." [U18]*

Logging every meal in the morning before eating anything, another participant described how she became very obsessive with the app and the numbers in the app. She measured everything precisely and checked the numbers the app gave her by searching for those same foods on the Internet, which led to multiple anxiety attacks.

> *"I used to [log consistently]. Last year, I did consistently do it, and I think I even noted it on the computer that I became so obsessed about it that I lost my mind because I got really crazy about, 'Oh, maybe this is not accurate.' So I started looking stuff up and how many calories it has and how many proteins it has, and I lost my mind 'cause you find so many things on Internet. And I remember, I had that year at least five, six anxiety attacks because I was so anxious about what I'm eating, and I was so nervous about it. And the app said one thing and then the computer said something else, and I just lost my mind… So for me, it emotionally was a bad thing, the app… That's when I was really obsessing, and I would make sure everything is measured to the centimeter, to the ounce... I think it [the app] makes us overthink food, which can lead to obsessing about it… So I think the focus should be way more on health and way less of numbers 'cause the person is obsessed about numbers anyway. No matter what eating disorder they have, they're obsessed on numbers. So I think this [the app] just reinforces the wrong thing." [U12]*

Many participants described becoming obsessed with logging their food, exercise, and weight. They also discussed how using the app was addictive, which led to further obsessions about eating.

4. App dependency

Developing a dependency on apps was common. Many participants discussed how they needed the app and how they became very anxious when they stopped using the app. Participants frequently expressed feeling as though they had to use the app to stay in control. For example,

one participant explained how even though she knew the app was unhealthy for her, she still needed to use it:

> *"In the moment, I didn't care. I knew it [the app] was harming my brain because I knew it was messing with my head mentally, but I just wanted to keep it because I felt like that was the one thing I could control. Because when you have an eating disorder, that's the one thing you want, is control. And I knew this app gave me control over what my parents wanted me to eat, just in that sense. I never really told them 'cause I didn't want to lose that control I had. Because being forced to eat a sandwich or being forced to eat, to go see a therapist, I had no control over those, but with the app, I felt like I had control over one part of my life that I really wanted to change." [U21]*

Another participant described a time when she went to a clinician, and the clinician wanted her to explore the idea of not using her Fitbit. Even just talking about it with the clinician was uncomfortable:

> *"I had seen the physician, and when I went, I had my Fitbit on, and she was like, 'So how does that make you feel?' And I said, 'Well, what do you mean?' She was like, 'How often do you wear it?' I was like, 'Oh, all the time other than the shower.' And she's like, 'Ok. Well, what if I told you to take it off? Would that make you uncomfortable?' And I remember being like, 'Oh, no. I can't. What would it be like if I went a day without knowing my calories? That would be terrible.' So and then, I think she was like, 'Well, why don't we try it?' And I was just like, 'No.' And then that was the last time I saw her." [U19]*

Some participants described feeling a great deal of anxiety when not using the app. In fact, one participant explained how she deleted the app and then re-downloaded it to relieve the anxiety she felt:

> *"Last summer, I had to delete it [the app]. I deleted it and had to get it back 'cause I was like, 'Oh, my gosh, I need to know what I'm eating.'... I literally got anxiety, so I had to get it back… It was last summer. So, what was actually happening was I was in a caloric deficit 'cause I had my show in May. So, after that I gradually worked my calories up. But I was still... I did it very slowly, so I was really restricted during the week. So, on the weekends, every Saturday, I wouldn't track, but I would binge like crazy. So, one of my things, I was like, 'Maybe I should just stop tracking and just eat intuitively.' So, that's why I tried deleting it. And then like a few days later, I had to get it back… I just want to hit everything correctly." [U14]*

Similarly, participants talked about how the app relieved their anxiety around food, fueling their dependency on it. One participant said she had less anxiety by using the app to plan her day. Even when she entered treatment for her eating disorder, she wanted to keep using the app:

> *"I just used it [the app] to plan my days, so then I... In a sense, that planned my meals. Then I didn't have to 'cause if I had to plan my meals, I'm going to worry about that. I'm going to worry about the calories, and if I can have the app tell me, 'Ok, [her name], you know... Your eating disorder wants you to eat this for breakfast. You're going to eat this, and then lunch, and then dinner.'... I had a lot less anxiety... [After entering treatment] I was like, 'Ok. You think I can cut it [the app] out? I'm going to just keep it on for a little bit.'" [U17]*

Another participant explained how logging everything before she ate relieved anxiety because she no longer had to be concerned with logging or hitting her goal:

> *"Because I remember telling him [clinician] that I feel safer when I log everything... And he didn't say, 'That's insane,' he just said, 'Ok, so you do that and then you have a plan and then you go about your day you're not anxious about it.' Because at some point it was really like a safety net. I don't have to think about it if everything is already in there, and I already know... When I felt like I'm in control of everything, especially those days... The days with the most happiness related to the app were those that I logged in everything in the beginning of the day, and then I'd prepare my food and took it with me, and then I didn't have to enter the app at all because I knew I've already logged it all, I've already seen that I'm good calorie-wise and protein-wise, that I don't need to enter the app because I'm only eating what I already put in. Those were the happiest days... because I had so much energy for other things in my life. Because usually I would go in the app, probably between every class, just making sure I didn't forget anything. And then while eating and then after eating and I just noticed all this time I could read my book, or I could Skype my family, or I could just stare at trees and the sun because I'm not doing this... I had more time and more energy, and I was less anxious 'cause I think every time I went in the app [my] heart beat a little bit faster 'cause I just wanted to make sure that I put in what I thought." [U12]*

Participants often developed a dependency on the app because it gave them control and alleviated anxiety. Even the idea of deleting the app made many participants uncomfortable.

5. High sense of achievement

When eating under their calorie and nutrient budget, compensating for food intake, and losing weight, participants often felt a great sense of achievement. A number of participants focused on

the green progress visualation, which users can see when they have remaining calories. Some simply stated things like:

> *"I don't want to see red, so just trying to keep it green makes you feel good, like you're doing something good. [I felt accomplished when] keeping it green." [U23]*

Similarly, another participant explained the connotations with the color green, which made her feel accomplished:

> *"I definitely would say that if I got to the end of the day, and there was, like if on Tuesday, I was a little bit more in the green [on] Wednesday, I'd feel better about it. So it was almost like an accomplishment per se… Sustaining it [my eating disorder] would absolutely be seeing that when you're low or you're in the green, those kind of... You don't even think about green being a good thing but just the color cues that you associate with rewards… when you're starting to reinforce eating less, eating less, eating less… So I think it's [the app's] very much targeted towards the weight loss rather than fitness, per se." [U19]*

Another participant expressed feeling successful for being in the green and consuming less than her allotted calories both daily and weekly:

> *"I like, obviously like to be in the green for the calories remaining… This thing, progress bar, I mean, I kind of like, I mean, I used to like to see it really close to that like goal line or even like below, which sounds bad. But like because that looked better to me if the bar's lower. So I mean, I guess, maybe that's kind of a problem, but I mean, it kind of made me feel that I was kind of like successful for the week if it was like mostly under the bar, obviously [laughs] even though that's under your calorie thing, which is probably not good… I just kind of wanted to see where I was in my calories for the day, and if I was like under what they allotted me, then I was happy… If I went to this bar and I saw everything was like below the goal, then that would kind of make feel like all right, that was good." [U04]*

Many expressed feeling rewarded for consuming less than their allotted calories. For instance, one participant said she always felt accomplished and happy when using the app because she almost always ate less than her budget:

> *"[I felt happy and accomplished when using the app] all the time. I don't know. Just one time, I feel like I just... Whenever I log stuff that was less than the 1,200, I was happy… [I felt] amazing [when I ate under my calorie allotment]… I just felt like I achieved my goal*

for the day. I just felt a sense of achievement. And then each day I would get lower and lower and lower… Because it [the app] taught you that if you went over, you didn't succeed that day. But if you went under, then congrats, you're going to lose weight! You did what you were supposed to do that day. And then, that made my mind set that exact weight of the app so I didn't even need it anymore because it was already in me. It was so weird, but yeah… If it [my calorie total] was less than what I ate the day before, then I was proud. At the end of the night I would look through what I ate, and if it was mostly vegetables or something, I'd be proud, and then if it was strayed from that a little, I would probably freak out." [U13]

Similarly, another participant talked about being proud of having remaining calories:

"I guess my most proud thing is just when I see this number that has still so many left over… That number, it's just my satisfaction of the day. If it's on track, or if it's even under a little, that's when I know I did good that day." [U21]

Another participant went into more detail about how she is proud of having a calorie deficit:

"I just like everyday you look back on every diary entry, and I burn a lot of calories on there, so I guess like, in a sick way, I'm like proud of what's [calories] remaining at the end of the day… Like this one was a full day, and like based on my weight goal, I had a lot remaining at the end of the day, and it's like, that was something I enjoy seeing, yeah… [I'm] just embarrassed that I have to say that's something I'm proud of. Like that I'm happy to see that there's a deficit by the end of the day… Because like mentally you hate to see that you've exhausted all of your calories for the day. Like it's a good thing that you should be getting that calorie goal but…yeah." [U02]

In addition to the calorie deficits, some participants expressed feeling rewarded for seeing the graph that showed weight loss over time. One participant said she was extremely proud not only when she was under her calorie limit, but also when she saw her weight decrease:

"I can see like my weight drop from like, every time I see a drop, I will feel so happy… I like that graph because I can see my progress. I can see the weight changing, and it's kind of keeping me like feel I'm always on the track… I feel very good [when I eat under my budget]… Because I feel like I'm losing weight if I'm like under the limit… When I track my weight or when I'm under my limit, I feel so proud of myself." [U01]

Participants felt achievement when they would see visual cues for calories remaining and weight loss. Particularly with MyFitnessPal, the caloric progress shows a green number when users eat

less than their calorie budget or exercise enough to have remaining calories. When users track weight loss, they see a drop on a line graph. Participants found these to be extremely rewarding.

6. Extreme negative emotions

While participants felt positively when they were under their calorie and nutrient budget and lost weight, they felt negative emotions when they exceeded their budget. Again, participants often focused on the color visualizations used for calorie intake and expenditure. When users exceed their budget on MyFitnessPal, their calorie number changes to red. One participant simply said:

> *"Yeah, [I felt negative emotions with] the red marks; you don't want to see that." [U23]*

Other participants talked about feeling guilt, embarrassment, and shame over exceeding their calorie budget. For instance, one participant explained how she was "freaked out" by the red number to the point of not wanting to go to school and discussed how it contributed to the development of fear foods:

> *"At the end of the day, if I was still very hungry and I didn't have any calories left, that whole red number... That red number would use to scare me a lot because I'd be like, 'Well, now I can't eat anything, and I'm really hungry, and I can't sleep with an empty stomach.' Then if I ended up eating, I would wake up feeling guilt for going over my intake because I felt like it would get in the way of my goal of losing weight… Once it hit 200 or more, I would get really stressed out, even panic because… I would be ashamed because I felt like I wasted my whole day of when I was fasting 'cause when I was fasting, it would be a really low goal of calories… So it was just very stressful to deal with the red numbers… The red number would come, and I'd be over my calories, and it just freaks me out all the time. I wouldn't even want to go to school if I knew I ate too much that night or that day before… I feel guilt for what I ate that day 'cause it's usually something that was high in calories, like a cookie or something. And then that caused that to become a fear food, like dietitians like to call it, a fear food that I try to exclude from my diet because that leads to a red number that embarrasses me." [U21]*

One participant talked about how she felt badly after seeing the red number regardless of how much she exceeded her calorie allottment:

> *"No, [it doesn't matter if it's over by 5 or 500 calories]. If I see the red [from exceeding my calorie budget], it's pretty much a bad day, and I feel like I have to start all over again. So then you'll probably see the next week [I'll] be super low in like everything… It [exceeding my budget and seeing the red] just made me feel bad [laughs] and just like gross about myself." [U04]*

Other participants explained how they would feel terribly no matter how much they would exceed their budget; however, they felt even worse the higher the number would be. For instance, one participant expressed how the visualizaton was the same regardless of how many calories she went over and how that made her feel negatively:

> *"I think it was a number, and it would probably turn red if you were above, which didn't help. [Going] above [my calorie budget], it was terrible… I'm pretty sure that it [the visualization] was the same no matter how much, which was stupid. But then I felt like you went over 500, and it looks like this horrible... I feel like it would just make you feel bad about yourself, but I know if I went over 5, I was so upset. If I went over 500, then I would... It was a whole different level." [U13]*

Similarly, another participant expressed her frustration over the limited visualization and how it made her feel badly about herself:

> *"I don't like the color red. I feel like it's bad, and it would always be like a frowny face, like bad, like you didn't do what you're supposed to today, and I was like, 'I know, I know I didn't.'… I think they definitely need to be not as like strongly represented. Like if you're one calorie over, it's like, 'Ok, like no big deal.' It should be like a range, you know what I'm saying? One calorie over is different than being like 400 calories over, and I think it definitely gave me the wrong perception and made me kind of go like the other way especially like when all my things were red in [my] app, I was like, 'Ok, well, then this makes me definitely not want to eat for like 3 days after seeing that.'" [U05]*

Another participant discussed trying to use the app for recovery and feeling guilty for exceeding her calorie budget even though that was the goal:

> *"I was like, 'Shit, if I need to gain... If I need to increase my calorie count, and after I put that into this app, it's showing me more calories than I've ever eaten before, it's going to just be more anxiety 'cause now I can see it's not... It's never been that… I don't want to see.' So it would just freak me out." [U17]*

Participants described a range of negative emotions, including guilt, shame, embarrassment, and fear, for exceeding their calorie budget. This was partly due to the red visualizations provided by the app.

7. Motivation from "negative" messages

Although there are some features in weight loss apps that attempt to curb eating disorder behaviors, their actual impact is opposite to their intended impact. For example, MyFitnessPal has a feature called "Complete Diary". It is a button that allows users to tell the app they are finished logging food, exercise, and weight for the day. Once clicked, either a message pops up stating, "If everyday were like today, you would weigh X pounds in X weeks" or a message appears stating the user is not consuming enough calories. Many participants found both of these types of messages motivating regardless of the content or context of the message. One participant explained that seeing how many pounds she would weigh based on today's calorie intake fueled her to continue her eating disorder behaviors:

> *"It was, 'If you ate like this and exercised like this for a week, in one month you would be this weight'. They [the app] would calculate it. So I used to do all this, and I was under-eating, so they would show me, you would be 90 pounds in a month or something if you kept on eating like this... I would just under-eat more to make that happen faster… So, I used to exercise 400 calories, then I would just skip lunch, I would eat dinner… Over here it would be 500 remaining or something. And at that point it would be, 'Ok, so you're going to be 95 pounds if you kept on eating like this in two weeks'. So that was more of a motivation, I think… Because you're trying to lose so much weight, and you're like, 'If you keep on under-eating, you're going to be 98 pounds,' which is exactly what you want to be at that point… It's not a warning... For anorexics, at that point, like, 'Ok, so I'm just going to keep on doing this.'" [U22]*

One participant reflected on how she used to feel about those messages and how that perception has changed. She talked about how seeing how much she could weigh was motivating:

> *"If you click this 'Complete Diary', like I'll do it for yesterday, yesterday when I ate 2,000 calories according to this. So it tells you, 'If everyday were like today, you would weigh this amount,' which [laughs] it's like I have such mixed feelings about it because*

like it can be motivating, but also it can be really triggering, and like some days it'll tell you you'll weigh more than you weigh, and sometimes it'll tell you like if there's one day when I'm not feeling so great, and I only eat 1,300 calories, it'll say I'd weigh 129 pounds in 5 weeks. That's really unhealthy thinking my starting point in this app is 141 and to lose over 10 pounds in 5 weeks, that's really unhealthy, but like someone with an eating disorder is like, 'Yeah, yeah, you're right; oh my god, I can weigh less than that in 5 weeks if I eat less'... I would always complete my diary, and that was kind of like, I'm done eating for the day so… When you're in the middle of your eating disorder, you think this is motivational, but when you look back on it, it's like, that's horrible [laughs], like that's really horrible." [U06]

Some participants described receiving the warning message that they were not consuming enough. One participant said she found the warning to be motivational to continue her current behaviors:

"At times, as I input in my weight day-by-day, and then it would be less calories, more exercise, there'd be a notification that would come up that would say, 'You're doing something wrong. This is not ok.' And I kind of took that as like a, 'I'm doing something right.' I took the negative messages kind of like a positive message… The first time that saw the message pop up that I was eating too little and exercising too much, it shocked me at first. But I was just like, 'Oh my god, this is so cool.' They were like, 'If you keep eating this amount and exercising this much, in a week, you will be this weight.' And I was like, 'Well, that's a pretty cool weight.' And I was like, 'Well, that's awesome!' And I was like, 'Well, let's keep doing this.' That was kind of time where they were like, 'Warning' but I'm like, 'No, this is a great warning. Let's keep going.'" [U17]

Another participant talked about her mixed feelings with the warning message. Although she thought that the minimum of 1,200 calories was a positive aspect of the app, when she received the warning message, she felt torn. Therefore, she would add random foods to avoid getting the warning message:

"I like the fact that it's minimum of 1,200. If you go to complete the log for the day, and it's under 1,200, it'll say like, 'You're not eating enough.'... [It makes me feel like] I should eat more. I don't know. And it feels a little judgmental. But at the same time 1,200 isn't that much, you should probably reach that… That's when I go in and just add random foods to my diary." [U18]

When participants received messages that should be seen in a negative light, they felt more motivated to continue their current eating disorder behaviors. This most commonly occurred when they were using MyFitnessPal and would "complete their diary" for the day.

8. Excess competition

Many participants described being in competition with themselves and with the app. However, this sense of competition was unhealthy because it fueled eaitng disorder behaviors. For instance, one participant explained how using the app made it a game to eat less and less:

> *"It was kind of like a game to beat the calories, kind of. So one day I had a 0, maybe it was like a negative calorie. I was like, 'Oh, wow, like look at me, like that's cool!'...Just because like you can visualize what you're eating, so the more you don't eat, it's like, 'Oh, I beat the app!'... I definitely wanted to beat the calories they gave me. I feel like that kind of does start an eating behavior where you don't want to eat anything... Like especially 'cause they give you a calorie limit. I know when I was under the calorie limit, I was like, 'Ok, I won today'... I was like, wait a second, the app kind of like made it a game for me to like not eat much." [U07]*

Another participant described how she felt she needed to consume less than the previous day to beat the app and herself:

> *"I think that the calories they gave you was the lowest that it would give you [laughs]. But I just was like, 'Ok, I'll do that one.' And then, it just became this weird competition thing with it [the app]... I would just be like, 'I need to be lower than what it was before.' [laughs] I don't know... It just always had to be less than the day before in the food and the weight and everything... Because then, if I wasn't, then I was like a failure 'cause that was what the eating disorder thoughts were telling me." [U13]*

Similarly, one participant discussed how she had to have more calories remaining each day in order to beat the previous day's calorie intake:

> *"It [my goal] was pretty much everyday just have the most calories remaining as possible... If anything, if I had more calories remaining the first day, then I felt like the second day was like less like good or whatever even though I still ate healthy and whatever, worked out. It would be like then tomorrow I have to like go back to what that one was or whatever... Kind of beat myself or whatever, I guess." [U04]*

Another participant stated the app became a game to consume less, which worsened her eating disorder behaviors:

> *"I think it [the app] worsened it [eating disorder behaviors] because it became more of a game for me… I could visually understand what was going on with my body. I could see, 'I'm in negative 400 calories today; let's see if I can get negative 500 tomorrow,' or 'I'm at...' Maybe this is because I'm a competitive person, so I was coming up with games for myself with this, but I think it more worsened it than helped it." [U09]*

One participant said that she felt like at times her behaviors were unhealthy but that the sense of competition drove her:

> *"As the eating disorder began to develop, it went from tracking what I eat to almost... It sounds so stupid, but I know some days I'd look back and be like, 'Wow, I didn't eat at 2 o'clock. Wow, that's cool. I guess I can do that tomorrow too.' So it [the app] definitely sustained negative habits, transitioning from just wanting to know what I eat and then becoming a competition of continuously doing less and less... At the beginning, I can definitely see how it would be healthy, and I think it is a great thing for the people who use it. But when I started to get into competition with myself, there was definitely times where I was like, 'This can't be good.'" [U19]*

Participants talked a great deal about feeling as though they were in competition with themselves and the app. They wanted to beat the app and "win" by having more calories remaining each day.

6.2.3.2 Positive Consequences

In terms of unintended positive consequences, only one major theme emerged: appropriate food intake.

Appropriate food intake

Some participants felt the app allowed them to get an appropriate food intake because it helped them eat more, balance food and exercise, and reduce bingeing. One participant explained how seeing that she could eat more without gaining too much weight helped her:

> *"It's [the app] helped… I can fit certain things into my macros and not feel bad about it. I was fitting an Oreo everyday kind of thing and realized that there's no bad foods… It*

helped me eat a lot more. This past off-season I was eating so much. Honestly, I don't want get back up to that point, but it really helped my metabolism get up and so I could track it and realize, 'Oh, I can eat this much food and still stay pretty lean.'" [U14]

Similarly, another participant described how MyFitnessPal acted as a reminder to eat more:

"I did think, when I initially started using them [apps], they were really helpful in, like MyFitnessPal, when I knew I needed to hit 2,000 calories a day, it was helpful in determining if I had hit that and as a reminder system." [U19]

One participant talked about how before she used an app, she had no idea how much she should be exercising, so the app helped her balance her exercise and food consumption:

"I'm kind of... I tend to do things in extreme ways. So in the past once I decided to that I'm going to lose weight, what I would do is that... I will not only cut back tremendously on my food intake, but also add a lot of exercise. So I would do these things at the same time. So in order to achieve a very dramatic change in weight loss, which was really bad for my health because my body really couldn't adjust to all of those big changes… So, cut out the food and then work a lot... That was way before I started using the app… I had no idea how much I should exercise. But now, with the calculation everyday, I kind of know how to maintain an overall energy balance." [U11]

Others explained how the app reduced bingeing. For instance, one participant explained how keeping track of her food helped with her bingeing:

"It [the app] reduced my binge eating because if I keep track… sometimes I go to [local restaurant]… I like milkshake there! It's like so good!... But like I keep, I track this because like I can search the restaurant [local restaurant], and then they will tell me how much calories and I feel like, and after logging the food I ate, oh that's so crazy, I will not have my dinner after that. I think that's kind of helped me, reduced my binge eating." [U01]

Similarly, another participant talked about how the app gave her control to reduce over-eating:

"Maybe it [the app] helped with binge eating disorder because I could see that like, like there's such a fine line, like either you're not eating enough and then you're like eating too much [laughs]. And so like the app has kind of helped me meet in the middle with like hey you already ate what your body needs to survive, you don't need to eat a bunch of food now, you know?" [U06]

While mostly negative consequences were reported, some participants described positive aspects of the app that helped reduce eating disorder behaviors.

6.3 Chapter Summary

This chapter summarizes the findings from the main study. This includes background information about the participants, the reason college women with eating disorders use weight loss apps, a description of the three types of app usage and relapse, and an overview of the unintended positive and negative consequences of use. It also provides a description of the five types of extreme use, the four types of recovery use, the eight types of unintended negative consequences, and one unintended positive consequence.

To summarize, participants' motivation for using weight loss apps is primarily to lose weight and to also be more aware of their food consumption. Their usage and perception of these apps change over time from extreme use to recovery-focused use and non-use. In addition to varying uses, unintended consequences exist. While some participants reported unintended positive consequences, unintended negative consequences were more prevalent.

The next chapter will explain the relationship between the findings of the preliminary study and the main study. Then Chapter 8 will focus on the main study results.

7 DISCUSSION: PART 1
Comparing and Contrasting the Preliminary Study and Main Study Findings

In this short chapter, I compare and contrast the findings from the preliminary and main study.

7.1 Refining and Expanding Unintended Consequences

The main study extended and expanded the results of the preliminary study. In the preliminary study, I found users had both positive and negative perceptions of the weight loss app. In the main study, similar themes emerged, but these perceptions were broken down into two different groups: usage and unintended consequences. This differentiation between use and consequences was not flushed out in the preliminary study, as the goal was just to provide a starting point to understand the effects of weight loss apps. After analyzing data from the main study and distinguishing use from consequences, it became apparent that the preliminary study's findings focused more on unintended consequences than usage. Therefore, I compare and contrast the preliminary study results with the unintended consequence findings of the main study, which can be seen in Table 7-1.

Preliminary Study	Main Study
Positive	
Reduces bingeing	Appropriate food intake (reduces bingeing)
Helps eat more	Appropriate food intake (eat more)
Improves food choices	*Opposite discussed*
Provides a healthy plan	*Not discussed*
Not discussed	Appropriate food intake (balance food and exercise)
Negative	
Encourages compensatory behaviors	High sense of achievement, extreme negative emotions
Promotes restriction	High sense of achievement, extreme negative emotions, motivation from negative emotions, excess competition
Leads to obsessive behaviors	Obsession, app dependency
Provides a dangerous plan	*Not discussed*
Not discussed	Fixation on numbers
Opposite discussed	Rigid diet

Table 7-1. Comparing and contrasting preliminary and main studies' findings

Overall, the main study helped refine the unintended positive consequences and expand the unintended negative consequences. While four categories of positive and four categories of negative consequences emerged in the preliminary study, the user sample reported more positive effects than negative. In the main study, there were data on the unintended positive consequences; however, many more users reported negative effects than positive. Thus, I was able to condense and refine the unintended positive consequences. The main study resulted in a great deal of data on the unintended negative consequences, allowing me to extend some categories and expand on the types.

In the preliminary study, four positive perceptions emerged: the app *reduced bingeing, helped users eat more, improved their food choices,* and *provided a health plan*. In the main study, I saw two of these themes, *reduced bingeing* and *helped eat more*, which I then grouped into one theme, *appropriate food intake*. While users in the preliminary study discussed the app *improving food choices*, the opposite was discussed in the main study. Users reported the app leading to a *rigid diet* where they were afraid to alter their meals. While the app's ability to *provide a health plan* was seen in the preliminary study, this was not mentioned in the think-aloud exercises and semi-structured interviews. In the main study, users talked about balancing exercise and calorie intake, which was not a primary focus in the preliminary study. Therefore, as part of the *appropriate food intake* theme, balancing food consumption with calories burned was included. Because of the detailed and in-depth data in the main study, the newly refined theme of *appropriate food intake* more accurately reflects the unintended positive consequences of weight loss apps by this user group.

In terms of unintended negative consequences, the main study extended and expanded the results of the preliminary study. Although many users in the preliminary study did not report the

negative effects of the weight loss app, four categories emerged: the app *encouraged compensatory behaviors, promoted restriction, led to obsessive behaviors,* and *provided a dangerous plan*. The first three themes emerged in the main study in some way. However, *encourages compensatory behaviors* and *promoting restriction* was separated into multiple themes, including *high sense of achievement, extreme negative emotions, motivation from negative emotions, excess competition.* In the main study, *leads to obsessive behaviors* was also broken down into two themes: *obsession* and *app dependency*. Although users in the preliminary study discussed the app *providing a dangerous plan*, this was not present in the main study likely because MyFitnessPal was the most commonly used app, and it does not allow users to set a daily calorie budget below 1,200 calories.

The preliminary study demonstrated that users with eating disorder behaviors use weight loss apps and provided a basis for understanding the effects of weight loss apps. However, it was only able to provide example posts, and data saturation was not reached. The main study addressed the limitations of the preliminary study, and the think-aloud exercises and semi-structured interviews resulted in a great deal of detailed information, which allowed me to refine and expand the categories found in preliminary study.

7.2 Addressing Why Users Report More Negative Effects in the Main Study

While there were many similarities in terms of unintended consequences across both studies, one primary discrepancy exists. In the preliminary study, users mainly expressed positive feelings, uses, and effects of DropPounds in the forum; however, in the main study, users overwhelming discussed the negative impacts of using weight loss apps and extreme use. While my research did not specifically address this discrepancy, I can postulate why it may exist.

The preliminary study results indicated that women's discussions of eating behaviors in the DropPounds' forum often focused on being healthy, and no user in the sample openly said they were trying to maintain eating disorder behaviors. However, their private weight goals would put them at an underweight BMI. The tension between users' private goals and forum posts may be related to self-presentation. According to Counts and Stecher (2009), "self-presentation can be thought of as the image or idea of the self, or the process of creating this image for a variety of social purposes" (p. 191). Research has shown that people present themselves in desirable ways when they are in the public (Goffman, 1959). Self-presentation motives include achieving your goals, presenting positive view of self to the world, and conforming to social norms. According to Goffman (1959), life is comparative to the theater: people do "front stage" work when they are interacting with others in public settings, and they do "back stage" work, which consists of the private things people do when no one is looking. These two presentations can be misaligned.

Although research has shown eating lightly to achieve thinness is desirable for women (Vartanian, Herman, & Polivy, 2007), having an eating disorder or eating disorder behaviors in a community whose focus is health may be undesirable. This is in line with prior work on self-presentation in online community. Schwammlein and Wodzicki (2012) found that "members of the common-identity community focused on characteristics shared among members of the community" (p. 387) versus those who were part of the common-bond community. The DropPounds community shares a common identity: its users emphasize *healthy* weight loss. Many of its users are serious about maintaining a healthy lifestyle and are against unhealthy or extreme tactics to lose weight. Because of this, users who may have eating disorder behaviors and want to post in the forums may attempt to conform to the community's norms and its

members' opinions and characteristics. Many more may choose not to post in the forums about their eating disorder behaviors due to fear of backlash from the rest of the community or privacy concerns.

This may explain why users in the main study were more open to discussing the negative influence of weight loss apps; they had no community norms to which to adhere and were not expressing their concerns and sharing their experiences in a public forum where health was the focus. Instead, they were in a one-on-one setting where it was appropriate to talk about eating disorders and unhealthy behaviors, which likely contributed to their openness in discussing the negative consequences and extreme uses.

7.3 Chapter Summary

Chapter 7 showed how the preliminary study and main study compare. Although I conducted two separate studies, the bulk of my contributions come from the main study as the preliminary study was only a partial perspective with a number of limitations, which the main study addressed. Therefore, the next chapter focuses on insights from the main study.

8 DISCUSSION: PART 2
Insights from the Main Study

In this chapter, I focus on the main study results and discuss how they address my research objectives of developing a better understanding of the use and unintended consequences of weight loss apps. The structure of Chapter 8 is as follows: I first present the idea of a *health journey* to capture the changing usage and impact of apps on users with eating disorder behaviors. Next, I explain how the unintended negative consequences highlight *problematic aspects of design* of weight loss apps. Then, I offer *design suggestions* for future technology. Finally, I conclude with general insights from this study, which should be considered by other researchers when studying or designing technology, particularly in the context of eating disorders.

8.1 The Health Journey

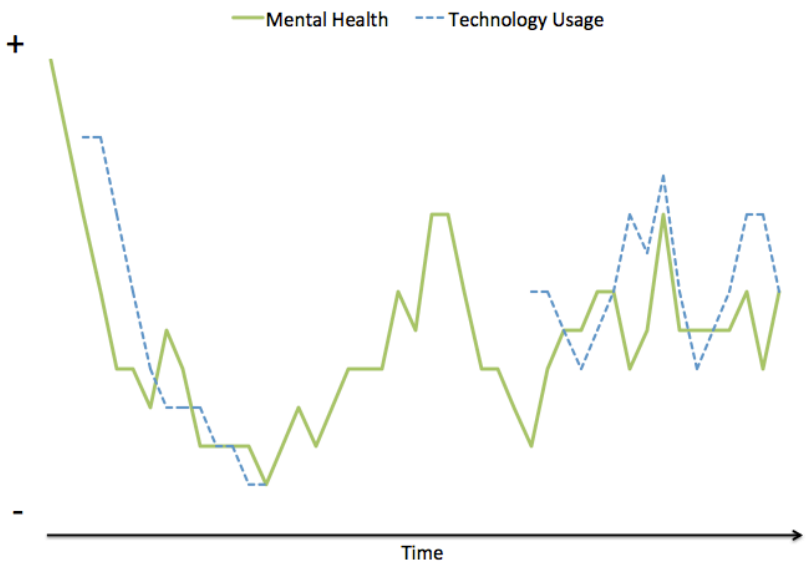
8.1.1 A new conceptualization of individuals' experiences around health

In order to better conceptualize people's experiences with technology and their overall mental health, I introduce the concept of a *health journey*. By definition, a journey is "an act of traveling from one place to another" and "a long and often difficult process of personal change and development" ("English Oxford Dictionary: Journey," 2017). This concept emerged from users' reflections of the mutual influence between their eating disorders and weight loss apps. This non-clinically-focused perspective of individuals' mental health helps to capture users' lived experiences, which includes the various roles technology plays and its impact at different times along the path towards recovery. A number of participants used the term "journey" to describe their experiences with eating disorders and weight loss apps.

The *health journey* represents a person's winding, indirect path with numerous ups and downs. There are often periods of progress and periods of regression, characterized by peaks and

valleys, respectively. The *health journey* is complex and can include different factors, such as perceptions of mental health and technology usage and impact. Figure 8-1 shows what an individual's health journey might look like. Based on my data, I have drawn out two aspects that users discussed as part of their journey towards recovery: mental health (in this case, specific to eating disorders) and technology usage. The solid line is continuous and represents a person's mental health; whereas the dotted line represents technology usage, which can begin and cease at any point along an individual's journey. These two lines show how mental health and technology use may influence one another. When a line is closer to the top of the graph, it means what is represented by that line (mental health or technology usage) is more positive, and when it is closer to the bottom, it is more negative.

Figure 8-1. Envisioning the *health journey*



A person's mental health exists both in relation to technology use and outside of it. That is, the *health journey* has the ability to represent a person's experiences as they adopt various roles (e.g., user, patient, etc.). Thus, an individual's *health journey* can be mapped before, during, and after using technology. We can begin mapping an individual's *health journey* at any point but

must recognize that health is pervasive across that individual's life. Thus, this map may represent only a fragment or snapshot of a person's health.

The term "journey" has been used to describe health in HCI before (M. Jacobs, Clawson, & Mynatt, 2014; Maia Jacobs, Clawson, & Mynatt, 2014). Much of this work has likened the experiences of breast cancer patients to a journey (M. Jacobs et al., 2014; Maia Jacobs et al., 2014; Maia Jacobs, Clawson, & Mynatt, 2016). Their idea of a journey tends to view an individual as a patient and focuses on clinical care and those involved in care, which makes sense given the nature of diseases like cancer. However, mental health conditions, such as eating disorders, are different in that there is a great deal of stigma around mental health conditions (Gaebel, Rossler, & Sartorius, 2016), and many people with eating disorders or eating disorder behaviors never seek treatment (D. Eisenberg et al., 2011; Hudson et al., 2007). Therefore, it is important to explore the everyday experiences of those with eating disorders outside of a clinical context.

8.1.2 Characteristics of the health journey

While the health journey can be used for other types of health conditions, it is particularly well suited for mental health conditions, where clinical care and diagnosis is not inevitable. Table 8-1 highlights characteristics of the *health journey* and contrasts them with characteristics of the CITM.

Health Journey	**CITM**
First person view	Third person view
Individual as individual	Individual as patient
Multi-directional but objective is upward trend	Uni-directional: downward trend
May begin before symptom onset	Begins at symptom onset or diagnosis
No true endpoint	Endpoint often death
Goals are to understand process	Goals are care-driven
Focus is individual's experiences	Focus is disease
Descriptive (but has power to be analytical)	Descriptive and analytical
Not necessarily temporally-dependent	Process often temporally-dependent

Table 8-1. Contrasting characteristics of the health journey with CITM

Specifically, the *health journey* provides a first-person perspective where the focus is the individual's experiences instead of their disease, meaning the viewpoint is from and driven by the individual, who is seen as an individual rather than a patient. This is in contrast to the CITM, which is a third-person view driven by healthcare providers. While the objective is an upward trend (for instance, recovery in the case of eating disorders), the *health journey* is not multi-directional. This means that unlike the CITM where the overall trend is downward, the *health journey* could move up or down at any point depending on a number of individual, social, and environmental factors.

Although the CITM's start point usually begins at symptom onset or diagnosis and ends in death, the start point of a *health journey* can be before symptoms begin. "Journey" does not necessarily imply endpoint, which is appropriate in the context of eating disorders and other mental health conditions where individuals may be "in recovery" their whole life. Thus, a mapped *health journey* usually only represents a portion of an individual's life, and different *journeys* may exist. While an individual's *health journey* is mapped over time, the temporal aspect does not necessarily dictate an individual's path, which is different from the CITM where time is large driver to the various stages.

Ultimately, the goal of the *health journey* is to understand individuals' experiences not on how and what care to deliver. Due to its early stages of conceptualization, the *health journey* is largely descriptive; however, it may have power in the future to be analytical. For instance, if enough journeys are mapped than we may be able to predict the journey path, especially if we can understand this path's relationship to other factors. Additionally, we can also provide "typical" things individuals experience along this journey.

For this study, participants described their journey by reflecting on their experiences of their eating disorder and the interplay between their eating disorder, their use of weight loss apps, and their environment (friends, significant others, parents, sports coaches, school, work, etc.). For many participants, the start point of their journey was before their eating disorder began. For example, participants drew connections between body image issues or specific stressors and the development of their eating disorder. The end point was the time of data collection, where the majority of participants expressed feeling as though they were in a better place than they had been previously, with most aiming towards recovery or actively trying to be healthier. Thus, most journey descriptions are specific to the process of eating disorder recovery.

8.1.3 Mapping the health journey

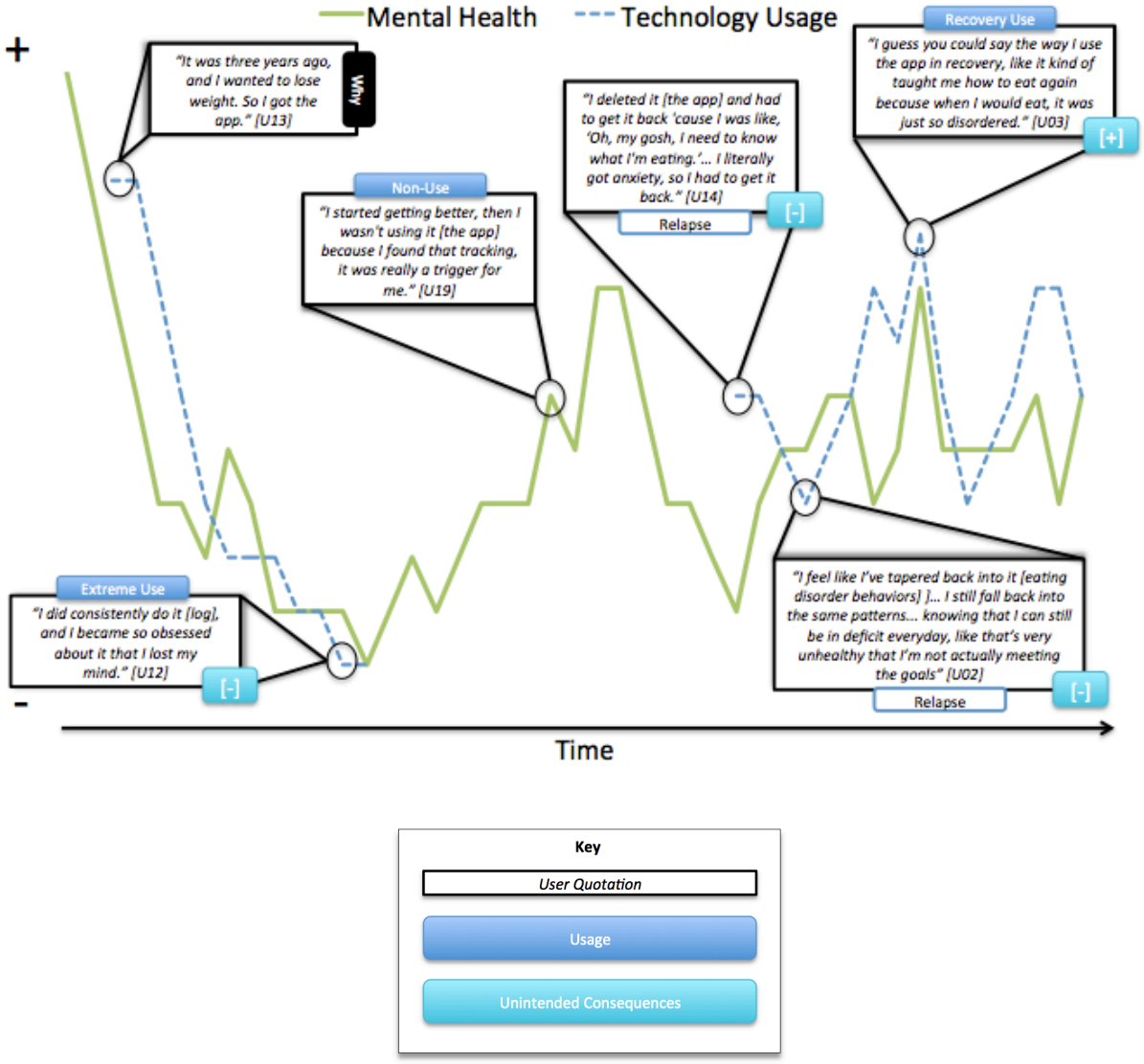
An example of experiences one might have at various points along the *health journey* is shown in Figure 8-2. For the purposes of this research, the *health journey* encompasses the use of weight loss apps and its relationship to a user's eating disorder. Usage ranges from extreme use to recovery use or non-use. Mental health[14] ranges from poor, such as in the midst of their eating disorder, to good, such as recovered or in recovery. A user's *health journey* includes weight loss app usage, the mental health effects related to app usage (positive and negative unintended consequences), and relapse.

The concept of journey highlights multiple uses and consequences of weight loss app use for individuals with eating disorders. As shown in Figure 8-2, women with eating disorders do not just use weight loss apps in one way, and the impact of these apps changes. As users reflected on their experiences, they talked about the changing nature of their use and perceptions of weight loss apps over time. Sometimes they unknowingly supported eating disorder behaviors,

[14] For this study, mental health is focused on eating disorders.

and other times they knowingly maintained eating disorder behaviors using weight loss apps. Users also appropriated weight loss apps for eating disorder recovery and reported some positive aspects. However, users often expressed falling back into eating disorder behaviors. Some users stopped using apps and then began using the apps again both in positive and negative ways.

Figure 8-2. Example quotations at various points across the *health journey*



The *health journey* cannot be fully graphed ahead of time; however, the *health journey* is flexible enough to allow real-time mapping. Currently in the *health journey*, the focus is on the

relationship between an individual's mental health and their technology usage. However, in the future additional lines could be added to include other factors, such as an individual's social relationships and physical health. While this research is specific to eating disorders, the concept of the *health journey* may be applied to other types of mental health conditions, especially when the focus is the individuals' point of view, their self-management of their health, and its relationship to technology.

8.1.4 Why the health journey matters

While this is only a preliminary conceptualization of the *health journey*, it has utility for understanding and visualizing the relationship between technology use and mental health from the individual's perspective. Although it is currently descriptive in nature, it has the potential to be predictive. Mapping qualitative and quantitative data to the *health journey* could help identify patterns between technology usage and mental health. The *health journey* could be useful for numerous stakeholders, including individuals with eating disorders, healthcare providers, educators, and researchers.

Because the *health journey* takes a first-person viewpoint of eating disorders, it is particularly powerful in its ability to provide women with eating disorders a voice to share their experiences, which is crucial in reducing stigma and giving individuals hope. In fact, having a platform to express their experiences emerged as one reason participants chose to take part in my study. Others with eating disorders can use the mapped *health journeys* of others to better understand their own eating disorder, which may provide them comfort in knowing others have had similar experiences along their path to recovery.

With mental health conditions, where treatment rates are low, dropout rates are high, and stigma is prevalent, it becomes increasingly important for healthcare providers to understand

individuals' own experiences with eating disorders, especially because so much of their experience exists outside the clinical setting. One aspect is understanding the role technology plays in the lives of those with eating disorders. While some researchers have urged clinicians, caregivers, researchers, and institutions to be aware of the existence, possibilities, dysfunctions, and impact of technology in relation to eating disorders (Castro & Osório, 2013; Teufel et al., 2013), to what extent healthcare providers understand and assess technology use is not well known. Thus, the *health journey* provides them with a preliminary look at how technology is used and may affect the onset and occurrence of eating disorder symptoms, which can be useful in the process of diagnosing and treating individuals with eating disorders. For instance, in the future, using the *health journey* to identify patterns could be valuable in knowing when a particular treatment approach may be most effective.

This understanding of individuals' experiences is not only important for eating disorder specialists, but also for general healthcare providers because they are often the first to see the patient. Unfortunately, many general practitioners overlook eating disorder symptoms (Becker et al., 2005; Mond et al., 2007; Thompson & Park, 2016), and many general healthcare nurses find it difficult to communicate with people with eating disorders (Gaebel et al., 2016). The *health journey* may improve general healthcare providers' understanding of eating disorders, which can help them ask important questions, allowing them to identify otherwise overlooked symptoms. The first person perspective of the *health journey* may also improve empathy, which is important because research has shown that in the healthcare system, eating disorder treatment is often "perceived as traumatic, punitive, blaming, lacking in understanding, and misguided by an overemphasis on the physical dimensions of the illness" (p. 12) (Bannatyne & Stapleton, 2016).

In addition to healthcare providers, the *health journey* may be beneficial for educators who want to develop eating disorder intervention programs. The *health journey* can increase educators' understanding of individuals' experiences with eating disorders. Through the mapping of *health journeys*, educators can better understand different factors that may contribute to eating disorder behaviors to determine what their interventions should focus on, and by identifying patterns, they may be able to determine the best times for these interventions.

Finally, for researchers, the *health journey* emphasizes the need to understand context. Thus, it can be used as a framework for studying the changing nature of technology in the context of health. Researchers can conduct longitudinal studies on the use and impact of technology for various conditions and map individuals' experiences based on these studies. Additionally, for those studying eating disorders specifically, the *health journey* provides a basis for understanding the role of weight loss app in the process of eating disorder recovery, which can be used as a catalyst for future research.

8.1.5 Why the CITM is a poor fit

The need for the *health journey* comes from the shortcomings of the CITM (Corbin, 1998; Pierre Woog, 1992). This is not to say that the *health journey* is a replacement to the CITM, but rather it is a complementary perspective. While all phases of the CITM could be seen in individuals with severe eating disorders where healthcare providers are involved, these phases may not be true for all mental health conditions. While portions of my study's users' experiences fit certain aspects of the CITM (for example, stable, unstable, acute, and crisis phases), other aspects and phases of the model are not well suited for some individuals' eating disorders. The biggest issue with the model is its clinical focus; it incorporates clinical healthcare in a patient's health management, which makes sense given that it was developed for nursing (Pierre Woog, 1992).

Although it encompasses other aspects of a person's health, the model views the person as a patient by default. For instance, in the CITM, the trajectory onset phase is denoted by an individual's diagnosis. However, as seen in my study, many people with eating disorder behaviors never receive a formal diagnosis, which makes the CITM a poor fit. Additionally, people are not always patients and often do not view themselves as patients even if they have a chronic health condition.

This clinical focus is also apparent in the acute and crisis stages, which are characterized by hospitalization (Corbin, 1998). Even the vignettes provided as examples in *The Chronic Illness Trajectory Framework: The Corbin and Strauss Nursing Model* have a strong clinical focus, highlighting the ongoing relationship with healthcare providers and centers (Pierre Woog, 1992). While this is true of some eating disorders, not all individuals with eating disorders are hospitalized, enter treatment centers, or even receive clinical treatment (Hudson et al., 2007). While the CITM is helpful in understanding the goal of care management in relation to a person's health, it neglects those who do not receive or rarely receive clinical healthcare, which is quite common for those with eating disorders (Hudson et al., 2007).

Even though it is argued that the course of illness is not inevitably downward in the model (Pierre Woog, 1992), a trajectory by definition is "the path followed by a projectile flying or an object moving under the action of given forces" ("English Oxford Dictionary: Trajectory," 2017). Therefore, when picturing a person's trajectory, it is easy to envision the downward path, especially because downward is major phase of the CITM (Pierre Woog, 1992). This image does not reflect the experiences of those with eating disorders, at least as described by participants in my research.

Similarly, *The Chronic Illness Trajectory Framework: The Corbin and Strauss Nursing Model* argues that the CITM does not mean death occurs in every instance, dying is a major phase of the model. This is relevant in some cases of eating disorders. For example, some researchers have found the mortality rates (deaths per 1,000 person years) to be 5.1 for anorexia nervosa, 1.7 for bulimia nervosa, and 3.3 for eating disorder not otherwise specified (Arcelus, Mitchell, Wales, & Nielsen, 2011). However, dying is not an inevitable phase for many with eating disorders.

Although the CITM intends to include the actions around the care of the person with the condition, it lacks an understanding of the role today's technology plays in the management of healthcare and reduction and/or exacerbation of symptoms. When the concept of the trajectory was first conceptualized and even by the time the model was developed, smartphones and consumer technologies for personal health management were not common like they are today ("Mobile Fact Sheet," 2017). Additionally, health apps have become more prevalent (Krebs & Duncan, 2015). Thus, it is not surprising that a model developed almost 30 years ago has a limited focus on technology. However, at a time when more and more people are turning to the internet and apps for support, understanding the role technology plays in everyday health management is important. Given the prevalence rates of eating disorder behaviors (D. Eisenberg et al., 2011; Hoerr et al., 2002; Neumark-Sztainer, 2005; Reinking et al., 2005) and low rates of clinical treatment (Daniel Eisenberg, Nicklett, Roeder, & Kirz, 2011; Hudson et al., 2007), it is crucial to consider when and how to deliver appropriate content through alternative mediums, such as apps. The *health journey* addresses some of the limitations of the CITM, mainly its clinical nature as well as its lack of "consumer" or personal technology focus.

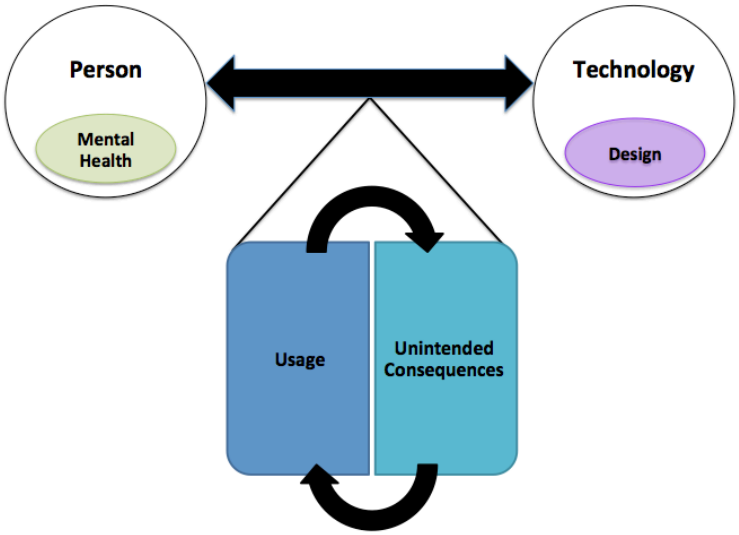
8.1.6 Mutual shaping, context, and the sociocultural perspective

One of the most important aspects of the *health journey* is that it does not assume technology exists in a vacuum; rather, it emphasizes the mutual influence between the individual and technology and context. The *health journey* does not aim separate the individual from technology, highlighting that they both play a role in shaping one another, which is in line with the mutual shaping approach (Hofkirchner, 2010). From this integrativist perspective, "the relationship of ICTs [information communication technologies[15]] and society [is] neither… strictly determined by one or the other nor… completely independent from each other" (p. 173) (Hofkirchner, 2010). This is in contrast to the sociocultural perspective, which tends to focus on the how media and new media affects individuals and their eating disorder behaviors. Thus, this research challenges this perspective by not focusing on just technology's impact on an individual but rather on how these two actually influence one another.

Users' experiences with weight loss apps reflect mutual shaping because the person cannot be fully removed from the technology (and its design). In this study, usage and unintended consequences are related to both the individual and the technology and cannot be fully separated, as shown in Figure 8-3. Although I cannot determine the causal relationship between the usage types and unintended consequences from this study alone, it seems as though it is bidirectional. In terms of usage and consequences, for example, *overuse* of apps may result in *obsession* and *app dependency*, and *obsession* and *app dependency* may result in *overuse*.

[15] For the purposes of this, ICT refers to any technology.

Figure 8-3. Mutual influence between person and technology



On one hand, the user influences how weight loss apps are used and the unintended consequences experienced. For instance, if a user is in a severe stage of her eating disorder and reluctant to change, then her usage may be more extreme, and she may experience more unintended negative consequences than someone who is in recovery. On the other hand, weight loss apps also affect the user and how the user interacts with the app. For example, receiving negative feedback from visualization within the app may negatively impact a user's mental health and trigger more severe eating disorder symptoms. It is important to note that these influences happen simultaneously and thus cannot be separated from one another. Thus, mapping mental health along with technology usage may provide powerful insights about their relationship. While many users believe weight loss apps are dangerous for those with eating disorders or eating disorder behaviors, many stated the effects of the app depend at least somewhat on how they are used and users' mentalities, attitudes, and motivations during use, which further supports the idea of mutual shaping.

In addition to mutual shaping, the *health journey* highlights the importance of context by showing that technology is used in different ways at various times and thus, may have different

effects on users over time. Typically, studies talk about technology as either a negative influence or a positive one. For example, from the sociocultural perspective, technology negatively impacts body image and eating disorder behaviors while much HCI research views weight loss apps as beneficial to users. However, viewing technology as either positive or negative tends to neglect the broader context with which the technology exists. My research emphasizes that technology is neither inherently good nor bad. Weight loss apps can be used in extreme ways (both unknowingly and knowingly) and for recovery and have both negative and positive consequences.

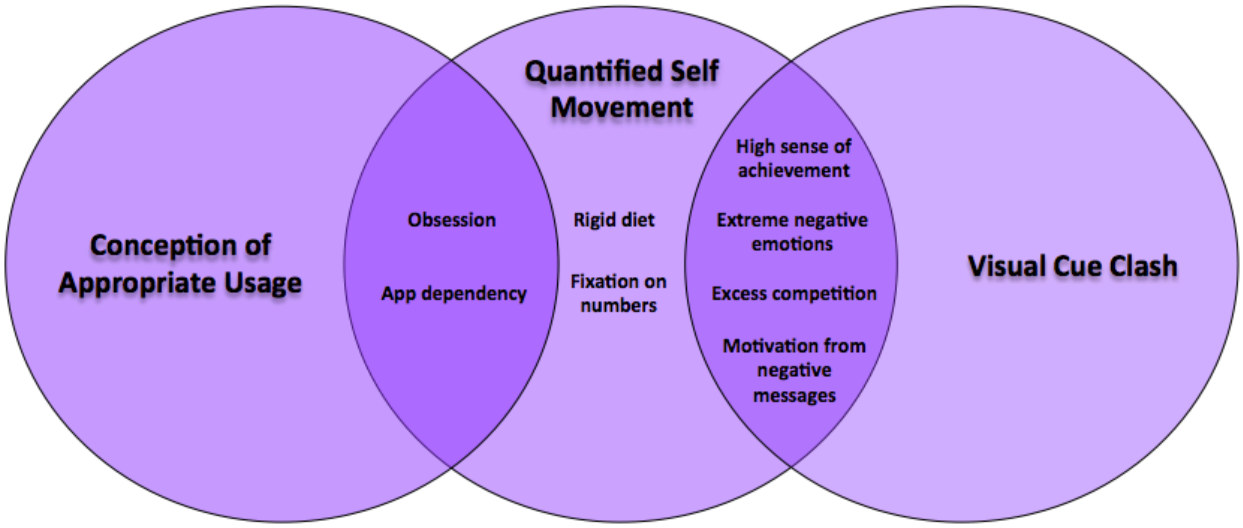
In line with the sociocultural perspective, there are aspects of weight loss apps that contribute to and exacerbate eating disorder behaviors, such as developing a *fixation on numbers*, *rigid diet*, *obsession* with the app and food, an *app dependency*, having a *high sense of achievement* from being under budget, feeling *extreme negative emotions* from exceeding the budget, getting *motivation from negative messages*, and being in *excess competition* with themselves and the app. Therefore, some users, especially those who are still struggling with eating disorder behaviors, can easily be triggered by using weight loss apps. Thus, weight loss apps may be viewed as a sociocultural influence on eating disorders. This research adds to existing literature on the negative influence of new media in the context of eating disorders. However, my findings also challenge the sociocultural perspective because the same technology can be used and impact a single user differently. For example, with a recovery- and health-focused mindset, some users who are trying to add more calories into their diet, focus on nutrition, or determine the appropriate food intake may find it helpful to track their foods and alleviate anxiety around weight gain using these types of apps. However, more research is needed to weigh these benefits from the numerous negative effects.

8.2 Problematic Aspects of Design

Despite recovery goals and unintended positive effects, unintended negative consequences are prevalent. Why are these unintended negative consequences prominent regardless of where users are in their health journey? This is both due to the individual and the design of weight loss apps. Because technology has some impact on users, there may be aspects of design that can be changed to positively affect them. It is important to note, however, that just making design changes will not remove all unintended negative consequences and extreme use because of the mutual shaping that occurs and some usage and unintended consequences may be more related to the user and her eating disorder than weight loss apps. For instance, using the app to *track in advance* seems more the result of eating disorder symptoms than of the actual app's design.

Although the user is a complex human being influenced by biological, environmental, and social factors, my research does not seek to evaluate the individual or propose changes the individual should make. Therefore, I focus instead on examining the design side and offering suggestions for weight loss apps. Many of the popular apps tend to be designed primarily for weight loss and often neglect a true health-focus despite often marketing themselves as a means to improve health. Users mentioned various aspects of design and app features when describing unintended negative consequences. I explain how the design of weight loss apps may partially contribute to these unintended negative consequences, which are related to three major areas: 1) the quantified self movement, 2) our conception of appropriate usage, and 3) the visual cue clash, as shown in Figure 8-4.

Figure 8-4. Three areas of design and their relationship to unintended negative consequences



In terms of weight loss apps, the quantified self is reflected in the app's heavy focus on numbers (weight loss in number of pounds, goal weight in number of pounds, food journaling in number of calories and macronutrients, exercise in number of calories burned, number of days logged, etc.). While self-tracking numeric data has benefits (Choe et al., 2014; de Vries et al., 2016; Li et al., 2011; Lupton, 2014), my findings cast light on issues with the quantification and tracking of behaviors related to diet and exercise, especially for those with a history of eating disorders. This falls in line with Purpura et al. (2011) who cautioned that weight loss technology focuses too heavily on quantitative measures and "promotes behaviors based on limited understanding of users' actual personal situations" (p. 429). Users with eating disorder behaviors develop a *fixation on numbers* and a *rigid diet* partly due to weight loss apps' heavy focus on numbers, which is largely driven by the quantified self movement. Because food, exercise, and weight are quantified and goals are numerically driven, users become overly preoccupied with numbers.

Although awareness is often cited as a positive outcome of self-tracking (Choe et al., 2014), awareness can be negative. While the ability for apps to create awareness was mentioned in other studies (Cordeiro et al., 2015), it was not as extreme. Especially for users with a history

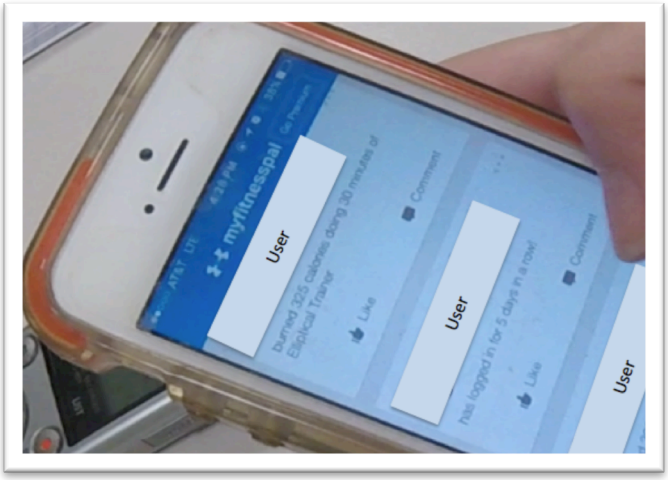
of eating disorders, tracking often leads not just to awareness but a *fixation on numbers*, which fuels eating disorder behaviors and changes their relationship with food. Food begins to be viewed as its caloric and macronutrient content rather than what it is (e.g., instead of seeing a chicken breast as chicken, users see it as protein, or instead of seeing a small apple as a piece of fruit, they view it as 78 calories ("Household USDA Foods Fact Sheet: Apples, Fresh," 2015).

In line with the quantified self movement, apps are incorporating features to help users more easily track numeric data related to food. For instance, barcode scanners allow users to quickly scan pre-packaged food, and the app recognizes calorie content and macronutrients. Some users only consume foods with barcode scanners, such as pre-packaged foods. Other research has also found these types of apps encourage eating pre-packaged and fast foods (Cordeiro et al., 2015), which often are not the healthiest option. In contrast, homemade foods, which are usually healthier options, are more difficult and tedious to log (Cordeiro et al., 2015). With features like the barcode scanner and the general focus on numbers, users develop a *rigid diet* because they become comfortable with specific foods that they are aware of the calorie content or "safe foods". Users limit themselves to these safe foods (often low-calorie foods), which means there is little variety to their diets.

In addition to a *fixation on numbers* associated with foods and a *rigid diet*, the quantified self movement coupled with our conception of appropriate app usage can lead to an *obsession* (about logging, food, weight, and exercise) and developing an *app dependency*. This *obsession* and *app dependency* is partly fueled by how much and how often we as designers, developers, and researchers think people should use our technology. Our idea of appropriate usage usually means users utilize apps consistently and long-term, which may promote *overuse*. However, app abandonment is almost always viewed as negative, and much research is dedicated to

understanding and reducing abandonment (Cordeiro et al., 2015; D. A. Epstein et al., 2016; Lazar et al., 2015). In addition to the quantification of food, exercise, and weight, many weight loss apps often reward users by showing their streak or number of days logged, as shown in Figure 8-5. For some users, this streak is hundreds of days.

Figure 8-5. Example of a logging streak (U04)



Because of the quantifications of behaviors and our idea of how often and long users should utilize apps, users often become obsessed with logging, which is in line with prior research. (Cordeiro et al., 2015). However, contrary to Cordeiro et al. (2015), users with eating disorder behaviors do not really "lose the habit" of logging because they feel the need to have control over their food, diet, weight, etc. Using apps was even described by some as an addiction, and many users feel the app is an integral part of their life and develop a dependency on it to the point of feeling as though they need the app and often returning to the app even after ceasing use.

Many users planned many facets of their life around tracking and consuming food, such as going out to eat, spending time with family, visiting friends, and doing schoolwork. Contrary to Cordeiro et al. (2015) who found that eating context was a barrier to journaling, instead of not logging, users with eating disorder behaviors will preplan for or avoid social engagements or

scenarios where they might be challenged to log. If users are unable to preplan or avoid these social engagements, they feel a great deal of anxiety, which perpetuates their eating disorder behaviors.

A number of users who described the app as obsessive or addictive also used the app to plan what they were going to eat in advance and then use that log as a strict rulebook of what they were allowed to eat. In this way, the app controlled their lives because rather than acting (eating) and then tracking, users track and then act. The app does not function as a tool to record behaviors in order for users to reflect and become more aware of their current behaviors; instead, the app is used to create a plan to which users must adhere. Any deviation from this regimen causes anxiety.

The quantified self movement also influences the visualizations and feedback weight loss apps provide. However, these visualizations and feedback often present a conflict between their intended purpose and their actual effects, which leads me to the visual cue clash. Visualizations and feedback within many popular weight loss apps rely on some quantification. Many users discussed the use of colors based on calorie numbers to denote positive and negative behaviors.

In MyFitnessPal, when users exceed their calorie budget, they are shown a red negative number, shown in the left of Figure 8-6. Users see a green positive number to indicate when they have either consumed fewer calories than their allotted daily budget or have burned enough calories through exercise to have remaining calories, which can be seen on the right of Figure 8-6. Instead of simply motivating users, this visualization in combination with the number-focus often results in users feeling a *high sense of achievement* when being under their calorie budget and an *extreme negative emotions*, such as guilt, shame, and embarrassment, when being over their budget. This is somewhat in contrast to prior research. For instance, Cordeiro et al. (2015)

found that while self-tracking apps made users feel guilty for exceeding their calorie allotment, users did not feel the same level of achievement for eating less than that allotment. This suggests that those who have a history of eating disorders or may be pre-disposed to developing one are affected by these visualizations differently than those users without eating disorders.

Figure 8-6. Visualizations from being over and under budget (U03)

The red number acts as punishment for users. In fact, "seeing the red" made users feel anxious and guilty. In order to alleviate these feelings, users exercise to "get back in the green" or not log when they knew they would exceed their budget. As Cordeiro et al. (2015) suggested, it is not necessary to make users feel so guilty for going over their budget, especially by little amounts, as this may actually cause users to feel badly, resort to extreme measures, or not use the app at all.

On the other hand, the green number acts as a reward for users. The remaining number in combination with the green color encourages users to try to eat under their allotted calories or purge (most often through exercise) to "remove" calories from the app. Consuming fewer calories or eliminating calories to get under budget gives users a sense of pride and achievement, which is intensified because of how the app shows food and calories.

The rewards and punishments users get from weight loss apps through these visualizations and the focus on the quantified self often promote *excess competition*. While many apps want to encourage competition, users with eating disorder behaviors often develop undue competitive behaviors. They want to continually beat themselves and the app by consuming fewer calories each day and often talk about how tracking through the app is a game, partially fueled by the feelings associated with seeing different visualizations.

Not only do these visualizations instill a sense of reward in punishment in users, but they also tend to be very limited. For instance, in MyFitnessPal, users see the red number regardless if they exceed their daily allotment by one or 1,000 calories, which does not make sense if the focus of these apps is promoting health. Again, the idea is to motivate users, but instead these design choices are negatively impacting users. Users talked about how they would feel negatively after consuming more than their calorie budget regardless of the number of calories. So why does MyFitnessPal use the same visualization no matter how many calories over users are? These visualizations may encourage extreme use, such as *restriction*, *compensatory behaviors*, and *logging avoidance* regardless of users' intentions. For instance, even when users set a weight gain goal, the app encourages eating under budget and discourages eating over budget through these red and green visualizations. These visual cues do not always match users' goals, which partially explains why trying to use the app for weight gain was problematic for users.

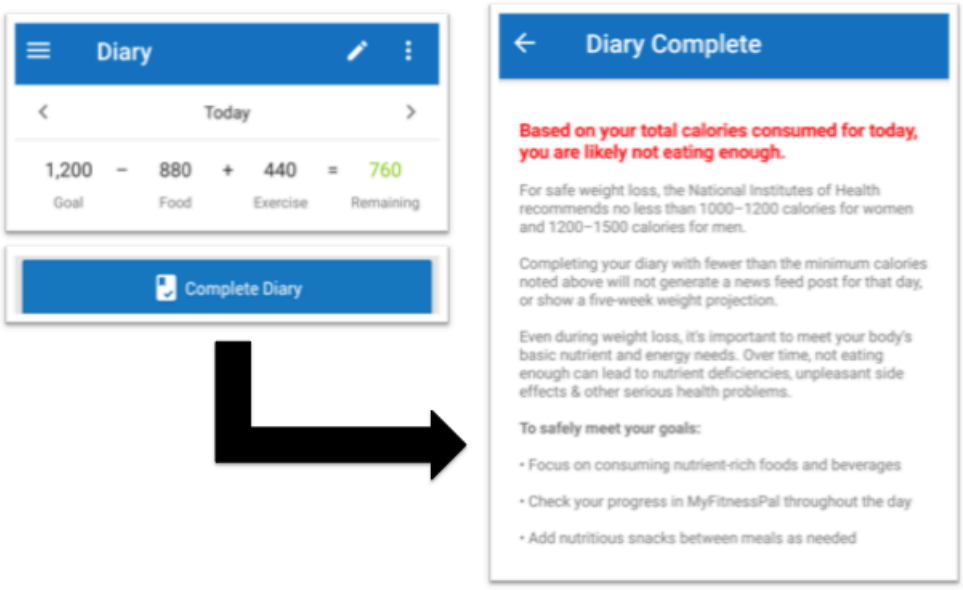
Lastly, as part of the visual cue clash, users get *motivation from (what are intended to be) negative messages* and visual cues. For example, in MyFitnessPal, there is a "Complete Diary" button at the bottom of each day's food log, as shown in Figure 8-7. Users can click this button to indicate that they are done logging for the day. When they click this button, they receive one

of two types of messages: either they are presented with a messages that states, “If everyday were like today, you would weigh X pounds in X weeks” or “Based on your total calories consumed for today, you are likely not eating enough”. The former visual cue is meant to motivate users in the appropriate context. For example, if a user is losing weight in a healthy way, its purpose is to encourage the user to continue those behaviors. However, what happens if the user if losing weight in an unhealthy way? The second cue is meant to act as a warning but often has the opposite effect. In many instances, users felt both messages motivated them to continue their extreme behaviors regardless of the content of the message.

Figure 8-7. Example of "Complete Diary" button on MyFitnessPal (U04)

One of the issues lies in the threshold that is used to determine with what visual users are presented. While these algorithms are proprietary to MyFitnessPal, at the time of this was written, MyFitnessPal seems to use a baseline of 1,000 calories consumed to determine which message the app shows. If users do not hit this 1,000 calories logged threshold, then they are shown the “Based on your total calories consumed for today, you are likely not eating enough” message, as show in Figure 8-8.

Figure 8-8. Example of food log and negative message

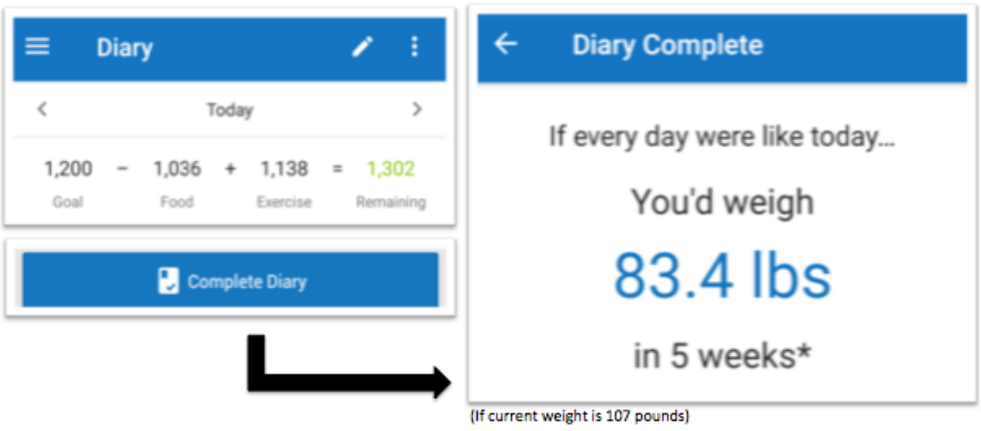


When the app showed this warning, users often took it as a sign they were doing something correctly and being dedicated because they consumed so little that they triggered that message within the app. Even when users feel judged by the warning, instead of consuming more calories, they add in food they did not eat in order to get the "If everyday were like today, you would weigh X pounds in X weeks" message. In that way, they would receive feedback on how much weight they could lose even if they had consumed more calories. Because they actually consumed less than recorded in the app, they could weigh even less than the app states.

If users consume over 1,000 calories, then the app presents "If everyday were like today, you would weigh X pounds in X weeks" message. This occurs regardless of how many calories users have remaining. For example, in Figure 8-9, the user has a starting weight of 107 pounds, and a daily calorie goal of 1,200 calories. She consumes 1,036 and burns 1,138 calories from exercise, which gives her 1,302 calories remaining. When she clicks "Complete Diary", she is shown that she would weight 83.4 pounds in 5 weeks. This is problematic because although she hit the 1,000 calories consumed threshold, the amount of exercise performed may indicate eating

disorder behaviors. Even though someone without an eating disorder may view this as a negative message, users with eating disorder behaviors found it motivating. When the app shows how many pounds users could weigh in a few weeks if they continued their current behaviors, then users think how quickly they could lose even more weight, which further promotes *excess competition* and also extreme behaviors, such as *restriction* and *compensatory behaviors*. The app does not take these types of behaviors into account.

Figure 8-9. An example of exceeding MyFitnessPal's threshold and the subsequent feedback



There are three primary aspects of weight loss app design that influence users' experiences of unintended negative consequences. These include the quantified self movement, our conception of appropriate usage, and the visual cue clash. By focusing on how these relate to the design of weight loss apps, I shed light on problematic features. In the next section, I provide suggestions for future weight loss app design.

8.3 Design Suggestions

My findings and the discussion of how these findings relate to app design help us to understand where we can make improvements to minimize unintended negative consequences and even some extreme use and focus more on promoting healthy behaviors. I explain how to begin thinking about addressing issues with the three aforementioned design-related areas: quantified

self movement, conception of appropriate usage, and visual cue clash. A summary of this section is shown in Table 8-2.

Design-Related Area	Problem	Suggestion
Quantified Self Movement	• Not all aspects of health can easily be quantified • Some quantifications are not good health indicators • Can trigger and exacerbate eating disorder behaviors	• Find new ways to acquire user needs and non-numeric yet quick and easy methods for tracking behaviors • Consult recommendations for health eating and exercise during design • Support healthy eating patterns, food variety, portion control, shifting to better food choices, and various eating contexts and limit unhealthy foods • Change exercise tracking to focus on performance and enjoyment not calories • Incorporate qualitative components to assess other aspects of health
Conception of Appropriate Usage	• Push users to log consistently over long periods of time • Tend to view breaks as negative • Can trigger and exacerbate eating disorder behaviors	• Reduce reminders to log daily • Encourage breaks • Reward for app engagement not actively logging or viewing numbers
Visual Cue Clash	• Try to use visualizations to motivate users but do not fully understand their effects • Warnings have opposite of intended effect or are avoided • Visual cues do not always match users' goals • Can trigger and exacerbate eating disorder behaviors	• Study effects of design and warnings more thoroughly and on different users at different times • Develop more nuanced design visualizations that better coincide with intended message and users' goals • Rethink unhealthy eating and exercise pattern thresholds for showing feedback

Table 8-2. Summary of suggestions to address weight loss app issues

Currently, we use numbers as indicators of health (e.g., weight, calories, etc.). While the quantified self movement has its merits, it is clear that the quantification of behaviors does not capture a full picture of health. In order to begin to reduce unintended negative consequences, we as designers, developers, and researchers, we need to focus less attention on quantification and the numbers associated with food, weight, and exercise. Instead, we must do our due diligence in understanding what a healthy lifestyle is and find ways to promote that with our technology. For example, rather than focus mostly on calories, we should design apps that help develop a healthy

eating pattern that includes fruits, vegetables, protein, dairy, grains, and oils, focus on food variety, nutrient density, and amount/portion sizes, help limit added sugars and saturated fats while reducing sodium intake, find ways to help people shift to healthier options, and help people in different settings (home, work, school, restaurants, etc.) eat healthy ("2015 – 2020 Dietary Guidelines for Americans (8th Ed.)," n.d.).

For physical activity, the focus should be less on exercise's relationship to calories and more on how much exercise, what types, ability to perform, and enjoyment. For instance, finding ways to promote exercise enjoyment can positively impact users not only through an increase in physical activity but also mental health. Studies have shown that exercising for enjoyment instead of for appearance is correlated with low self-objectification, low body dissatisfaction, and less disordered eating (Prichard & Tiggemann, 2005). By focusing on exercise as something enjoyable, something to make one healthy, the focus will be less on exercise as a means to lose weight or look "better" and thus improve overall mental health. Apps should also follow the physical activity guidelines set by the United States Department of Health and Human Services depending on a user's age and other factors ("2008 Physical Activity Guidelines for Americans," 2008). For instance, for adults ages 18 to 64, the United States Department of Health and Human Services recommends at least 150 minutes of moderate activity per week or 75 minutes of vigorous activity of both aerobic and muscle strengthening. However, any exercise is preferred to none, suggesting apps could find ways to encourage even small levels of activity to promote health ("2008 Physical Activity Guidelines for Americans," 2008).

In order to allow users to accurately and easily track food and exercise, designers, developers, and researchers should consider incorporating more sensor-based technology to understand user needs and actions while balancing users' privacy needs and concerns, especially

when dealing with health data and stigmatizing conditions like eating disorders. Is there a way we can automatically detect food and exercise needs by individual, including age, gender, height, weight, body fat, health, allergies, metabolism, etc.? We should also consider other ways to log food and exercise. While activity trackers and other wearables are becoming more popular, and more research is being done on detecting food content using sensors (Vu, Lin, Alshurafa, & Xu, 2017), these often still focus on quantification. There are other ways to denote what is healthy without the heavy number focus, such as through images. For instance, photos are providing a promising way for users to track food (Chung et al., 2017; Cordeiro et al., 2015). Perhaps we can develop individualized and automatic health ratings based both on the current food and physical activity guidelines and a user's individual needs.

Other important aspects of health not easily captured in many current weight loss apps include positive body image, mental health, and bodily functioning. For example, does a user feel good in her clothes? How is her self-esteem, emotion regulation, concentration, etc.? Is she depressed, anxious, etc.? Is she experiencing any pain or discomfort? Is she getting her period regularly (depending on age and other factors)? Is she less tired throughout the day, and does she have improved sleep? All of these things are important aspects of health, and even if users primary focus is weight loss, these factors may influence their needs and ability to lose weight. While it is important to include qualitative ratings, we need to balance data needs and user effort and find ways to make apps useful, easy to use, and aesthetically pleasing while ensuring users' privacy. We also have to realize that health is complex and extremely individualized, making tackling the challenges of the quantified self extremely difficult.

In addition to the quantified self movement, our conception of appropriate usage also needs to be further explored in order to minimize *obsession* and *app dependency* as well as

overuse. Currently, we tend to view consistent and long-term logging as positive, but it is not always appropriate. As a community, we have to ask ourselves: What is the endpoint for weight loss (and other types of health) apps? When and do we determine a success versus a failure? What role should they play in users' lives? Are they meant to be used everyday across a person's life or are there more finite periods? We have to stop pushing our idea of ideal and appropriate use and start to understand how people actually use these technologies "in the wild" and design around their natural patterns of use. This sentiment has recently been echoed in regards to activity trackers (Meyer, Wasmann, Heuten, El Ali, & Boll, 2017).

Despite numerous studies aiming to reduce app abandonment (Cordeiro et al., 2015; D. A. Epstein et al., 2016; Lazar et al., 2015), my findings show that abandonment is not always negative. In fact, for users with eating disorder behaviors, taking a break from apps can be beneficial. Many cited not using weight loss apps as a key component of recovery. We have to realize that breaks from apps may not be indicative of a failure. In fact, taking time off from apps can help users learn to listen to their body's signals of hunger and fullness and reduce their dependency on apps, which is important if we wish to promote health. Although we want people to use our technology long-term, we also must understand that this is not appropriate for all users and for some may even be harmful. Many apps currently contain reminders to log, but reducing these types of reminders and encouraging logging breaks may be beneficial to users. We can also develop ways to reward users for engaging with our apps but not viewing quantified behaviors or actively logging, such as an alternative app views during break periods.

A great deal of work has to be done in order to address the visual cue clash. Currently, we try to design to motivate users. In MyFitnessPal, red and green are used to emphasize positive and negative performance. These colors were likely chosen due to the connotations they already

have in society (e.g., red stop light, green stop light). However, these effects within the context of health and weight loss apps are not well studied. Studying these effects in relation to exercise and fitness goals within health apps and devices is crucial since the impact of color choice can vary from context to context (Gnambs, Appel, & Batinic, 2010). For instance, while red can negatively affect performance in some instances (Elliot, Maier, Moller, Friedman, & Meinhardt, 2007), red can have positive effects in the appropriate context, such as increasing appetite in restaurants (Singh, 2006). Thus, we need to examine the impact of color choice on users in order to find ways to balance emotion and sense of rewards and punishments by using different colors.

As mentioned before, the design is also very limited. For example, MyFitnessPal provides the same visualization regardless of how many calories users exceed their budget. Therefore, we need to develop more nuanced visualizations to motivate users without negatively impacting them. This may help reduce the *high sense of achievement*, *extreme negative emotions*, and *excess competition* as well as *restriction*, *compensatory behaviors*, and *logging avoidance*.

Lastly, we also have to be cautious about visual cues we use like warnings and motivational messages as these may have the opposite impact than we anticipated and result in users getting *motivation from negative messages*. Thus, more research is needed in order to test how these types of messages and visualizations impact different types of people at various stages of their *health journey*.

While fully addressing all of the issues related to the quantified self, conception of appropriate usage, and visual cue clash is not possible with one study, this research gives us insight into ways to begin to improve weight loss apps and other types of health technology. Although this research focuses on users with a history of eating disorders, redesigning apps to focus on health is beneficial to all users. Thus, while this research is specific to women with

eating disorder behaviors, they represent an extreme case that highlights problematic aspects of weight loss apps and the importance of understanding different types of users – even if they are not the intended or "ideal" user - when creating health technologies, such as weight loss apps.

8.4 General Insights from Conducting This Research

Because users did not use weight loss apps in just one way (e.g., to maintain their eating disorder or for recovery) and usage changes over time, we need to reconsider not only how we discuss technology, but also how we discuss users with eating disorders. One common narrative around eating disorders and technology is how users are "bad" because they promote eating disorders, post pro-eating disorder content, and use technology to maintain their eating disorders and how we should ban this content and stop these users. While the intent may be noble, viewing users in this negative light may further exacerbate their feelings of isolation and the stigma around eating disorders. Although some users do knowingly use weight loss apps to support unhealthy behaviors at some point, many users do not seek weight loss apps with this objective in mind. Many users explain their behaviors as spiraling out of control after beginning to use weight loss apps and falling back into old patterns even when they want to focus on recovery, which highlights the complex nature of eating disorders. Thus, we need to be sensitive to how we discuss individuals with eating disorders in our research.

Additionally, we should carefully consider other aspects of the research process, such as recruitment and interviewing. Because eating disorders are stigmatizing conditions, many people may be wary of being seen getting contact information from flyers. Thus, finding ways to make this process more discreet may be important for potential participants' privacy concerns and researchers' recruitment goals. While using listservs and social media can be useful, I had the most success posting paper flyers, particularly in restroom stalls where participants can covertly

obtain information for the study. Similarly, when conducting studies, it is crucial to understand that eating disorders and body image are sensitive topics. Thus, researchers should focus on building rapport, being empathetic, and truly listening to participants.

Finally, this research sheds lights on the occurrence of untreated and undiagnosed eating disorders among college women. Although most of the sample had not been clinically diagnosed with an eating disorder, many expressed very real and serious concerns and issues related to eating, exercise, and general well being. Additionally, most participants had never even heard of eating disorder recovery and treatment apps much less used them. Because of this, this dissertation does not focus on the development and design of eating disorder-specific technology. Instead, my goal is to challenge the current narratives around weight loss apps and other types of "health" technologies and find ways to make design changes that positively impact college women with eating disorders without taking away from the experience of other users.

8.5 Chapter Summary

This chapter focused on discussing the importance of main study's findings and providing general insights. First, I presented the concept of the *health journey*, a start of a framework for understanding individuals' experiences related to eating disorders and potentially other health conditions. Then I described *problematic aspects* of design and made *design suggestions*. I concluded with lessons learned and recommendations. The next chapter concludes this dissertation by summarizing my contributions, limitations, and future work.

9 CONCLUSION

College women, who are at increased risk of developing eating disorder behaviors and eating disorders (Berg et al., 2009; D. Eisenberg et al., 2011; V. M. Quick & Byrd-Bredbenner, 2013; Schwitzer, 2012; Schwitzer & Choate, 2015), are increasingly using weight loss apps (Fox, 2013; Fox & Duggan, 2012; "Mobile Fact Sheet," 2017; Smith, 2015). While many of these popular apps are showcased as a way for users to become healthier, their focus is primarily weight loss. This weight loss-focused approach may appeal to users because of society's obsession with thinness and dieting; however, it is a poor approach to promoting healthy behaviors. Weight loss apps tend to promote the thin ideal and encourage dieting and even unhealthy weight control methods, which may contribute to and exacerbate eating disorder behaviors in an already vulnerable population. Although researchers have studied the negative impact of technologies like social media and online pro-eating disorder communities (Andsager, 2014; Fardouly et al., 2015; Mabe et al., 2014; Meier & Gray, 2014; Stronge et al., 2015), there is limited understanding of the negative use and impact of weight loss apps among college women with eating disorder behaviors. While research has shown eating disorder-specific technology can be beneficial to users with eating disorders (Juarascio et al., 2015; Keski-Rahkonen & Tozzi, 2005; Tregarthen et al., 2015), much less is known about potential positive uses and impacts of weight loss apps in this context.

Although weight loss apps have not been thoroughly studied in the context of eating disorders, HCI researchers have focused a great deal of attention on weight loss apps and the quantified self for health (Berkovsky et al., 2012; Brown et al., 2006; Choe et al., 2014; Cordeiro et al., 2015; Goudarzi & Tomic, 2006; Hsu et al., 2014; Mueller et al., 2014; Rooksby et al., 2015; Stawarz et al., 2015; Toscos et al., 2006; Vyas et al., 2015; Walsh & Golbeck, 2014).

Much of this research considers weight loss apps to be a positive influence on users but neglects the potential negative implications. Additionally, while some research has focused on self-tracking for specific conditions (Mentis et al., 2017), eating disorders have largely been excluded.

This dissertation study aimed to address these gaps in research by examining the usage and unintended consequences (both positive and negative) of weight loss apps by college women with eating disorder behaviors. The research objectives of this study were provide *an understanding* of why college women with eating disorder behaviors use weight loss apps, provide *descriptions* of how college women with eating disorder behaviors use weight loss apps, and provide *descriptions* of the unintended negative and positive consequences. I first conducted a preliminary study to investigate the use of weight loss apps by users with eating disorder behaviors and user perceptions of these apps by examining users' profile data and forum posts. This preliminary study informed my main study because it showed that users with eating disorder behaviors are using weight loss apps and gave an initial look at how they perceive the impact of the app. In order to address the limitations of the preliminary study and answer my research questions, I then conducted the main study, which included surveys, think-aloud exercises, and semi-structured interviews with college women with eating disorder behaviors. The results of this research make an important contribution to our understanding of eating disorders, particularly in regards to app use, and health technology design. This final chapter describes these contributions and discusses future research directions.

9.1 Contributions

I began my main study by identifying three research questions, which were based on the limitations and findings of the preliminary study:

RQ1: Why do college women with eating disorder behaviors use weight loss apps?

RQ2: How do college women with eating disorder behaviors use weight loss apps?

RQ3: What are the unintended consequences (positive and negative) of weight loss apps for this population?

These research questions helped me address the following research objectives of this dissertation study:

1. Provide *an understanding* of why college women with eating disorder behaviors use weight loss apps to aid our understanding of user intentions and stop viewing users with eating disorder behaviors themselves as problematic,
2. Provide *descriptions* of how college women with eating disorder behaviors use weight loss apps in order to highlight the changing role technology plays in users' lives as well as the mutual shaping that occurs, and
3. Provide *descriptions* of the unintended negative and positive consequences to demonstrate how design choices may impact users.

These objectives led to the three contributions of this research: *a conceptual understanding of an individual's health journey, identification of problematic aspects of design*, and *design suggestions*. By studying the use and impact of weight loss apps in this context, I was able to provide a conceptual understanding of an individual's *health journey*, which highlights both the shifting role of technology and the mutual influence between an individual and technology. Through the descriptions of the unintended negative consequences, I was able to identify problematic aspects of weight loss apps, which can be used by researchers, designers, and developers in the study of and development of future weight loss apps and other types of personal health technologies. Then I made design suggestions to reduce unintended negative

consequences and promote healthy behaviors within other types of personal health technologies like weight loss apps.

9.1.1 Summary of findings

RQ1: Why do college women with eating disorder behaviors use weight loss apps?

I found that college women with eating disorder behaviors often select weight loss apps with the goal of losing weight or being more aware of what they eat. This is not distinctly different from users without eating disorder behaviors, suggesting that these women do not necessarily intend to support unhealthy behaviors. Their focus on weight loss is not surprising given society's pressure to be thin and weight loss industry. Additionally, many women were in a healthy weight range but simply unhappy with their current weight when they began using weight loss apps, which is consistent with prior studies on body dissatisfaction and weight loss.

RQ2: How do college women with eating disorder behaviors use weight loss apps?

Emerging from this research is a detailed description of how college women with eating disorder behaviors use weight loss apps. I found that usage shifts from extreme to recovery to non-use. Specifically, I identified six types of extreme use (overuse, restriction, compensatory behaviors, tracking in advance, logging avoidance, and app manipulation) and four types of recovery use (increased consumption, altered weight goals, different logging approach, and awareness tool).

RQ3: What are the unintended consequences (positive and negative) of weight loss apps for this population?

In terms of unintended consequences, negative consequences were prominent. I identified eight unintended negative consequences (fixation on numbers, rigid diet, obsession, app dependency, high sense of achievement, extreme negative emotions, motivation from negative messages, and

excess competition). Only one unintended positive consequence was identified (appropriate food intake).

9.1.2 Conceptual understanding of an individual's health journey

An intellectual contribution of this study is the conceptual understanding of an individual's *health journey*. This emerged from participants' reflections of the changing use and impact of weight loss apps. Even for one user, the role of the app shifted over time. Because weight loss apps are not always used but still may impact an individual's health, the health journey encompasses an individual's mental health both in relation to and outside of their technology usage. Although this is not a complete or refined conceptualization, the *health journey* is important because is emphasizes the need to understand context and the mutual shaping between technology and individuals. The *health journey* contributes to both HCI and psychology domains as it emphases the changing role of technology and the mutual influence between individuals and technology they use. It can be used to understand and identify patterns of use and impact, which can be used by healthcare professionals in the diagnosis and treatment process of eating disorders.

9.1.3 Identification of problematic aspects of design and design suggestions

Because research is lacking on the negative aspects of weight loss apps, this research contributes to our understanding of problematic design choices. In particular, I identified the quantified self, our conception of appropriate usage, and the visual cue clash as three areas that need reconsidered. Based on the issues expressed by users, I also provide design suggestions to address these three areas. Both the identification of problematic aspects and the design suggestions can be used by HCI researchers, designers, and developers in the study and development of weight loss apps and other types of personal health technologies. This is

important not only for users with eating disorder behaviors, which likely represent more users than app developers realize, but also all users. Eating disorders represent an extreme case that can more easily surface unintended consequences of and design issues with apps and other types of health technologies.

9.2 Limitations & Future Work

There are a number of limitations of this research, which future work could address. First, although I have in-depth data on participants' experiences from the think-aloud exercises and semi-structured interviews, I have a small subset of rather homogenous users (24 mostly white non-Hispanic participants). Thus, it is likely that not all uses, consequences, and perceptions are represented in this work. Future research should consider other factors that may influence the usage and impact of apps, such as race/ethnicity, gender, age, type of condition, and culture. While conducting this study was appropriate given the lack of research in the area, in the future, I aim to get a larger and more heterogeneous sample of participants as well as conduct a survey-based study, which may improve generalizability.

Similarly, this dissertation study did not differentiate usage or impact by specific eating disorder (anorexia nervosa vs. bulimia nervosa, for instance) nor stage of eating disorder (recovery vs. not). Use and impact may differ depending on type of eating disorder as well as stage. Therefore, future work needs to more thoroughly consider these factors. Additionally, studies should be extended to other types of eating disorders. For example, early work suggests weight loss apps may be especially useful for binge eating behaviors, which means apps may be useful for those with binge eating disorder.

This research captured the changing use and impact of weight loss apps. However, this was based on participants' reflections about their past and present use. Both the patterns of usage

and the *health journey* could benefit from an actual longitudinal study where usage, perceptions, and impact are investigated long-term and captured at specific points. Additionally, acquiring app data over time, such as food logs, weight loss, and goals, could be beneficial in further understanding the use and impact of weight loss apps. This would refine and further develop the *health journey*.

While participants' experience reflect a mutual influence between usage and unintended consequences, it is unknown if there is a directional relationship between them. For instance, do specific types of use cause particular unintended consequences? Do unintended consequences cause users to interact with the app in a particular way? In the future, research should explore whether or not a causal relationship exists.

The findings of this dissertation study suggest that specific design choices are problematic for users with eating disorder behaviors. However, these design features and choices themselves were not tested. HCI research in particular could benefit from experimental testing of these specific design aspects as well as participatory design of not only weight loss apps, but also other types of health technologies.

Finally, this research emphasizes the user's perception of weight loss apps, which is extremely important. However, it would be beneficial to investigate healthcare providers' evaluation and perceptions of weight loss app in the context of eating disorders. Comparing and contrasting these findings could provide valuable insights about the use and consequences of weight loss apps. This could be especially useful for understanding problematic aspects of apps, beneficial aspects of apps, and if and how healthcare providers discuss weight loss apps with patients and clients, and have major contributions in terms of design and recommendations for the diagnosis and treatment of eating disorders.

9.3 Closing Remarks

Between the college environment and societal pressures to be thin and beautiful, college women are at increased risk of developing eating disorders and eating disorder behaviors (Berg et al., 2009; Boero & Pascoe, 2012; Lawler & Nixon, 2011; Liechty, 2010; Low et al., 2003; Peñas-Lledó et al., 2015; Rohde et al., 2015). They use weight loss apps as a means to facilitate dieting, which is normalized in the United States even when weight loss is unnecessary. The use of weight loss apps by women with eating disorder behaviors is likely more common than many realize given the rates of dieting and weight loss among healthy weight and underweight women (Fayet et al., 2012; Yaemsiri et al., 2011). As this research highlights, these women cannot be viewed as problematic. Rather, we need to better understand how the use and impact of these apps is entangled with cultural norms and expectations. These users simply reflect the complexities of being human. Thus, we need to begin to study and design for users as the complex humans they are – by first understanding there is a mutual influence between individuals and technology and second, understanding the importance of context as technology's role in a user's life changes over time.

This dissertation study is important because it is among the first research to consider the role of weight loss apps in the context of eating disorders. It provides an understanding of why users with eating disorder behaviors turn to weight loss apps as well as descriptions of the types of usage and consequences of these apps. Findings of this research highlight the changing use and impact of weight loss apps and mutual influence between technology and individuals, which led to the development of the *health journey*.

Additionally, users discuss the impact of particular app features and design. Specifically, unintended negative consequences are pervasive, which led to the identification of problematic aspects of design and design suggestions. Ultimately, this research emphasizes the need for a

fundamental shift in how we think of health and weight loss apps and what qualifies as a "successful" app. Researchers, designers, and developers should reconsider using weight loss as a proxy for health as they may be feeding into dangerous cultural standards and ideals. Weight loss apps should not just track data because it is easy to quantify; instead, researchers, designers, and developers should focus on what factors are important to track for health and how to motivate users without negatively impacting them. While we may never design weight loss apps *for* users with eating disorder behaviors, understanding this population can lead to better weight loss apps and other types of health technologies for all users.

REFERENCES

2008 Physical Activity Guidelines for Americans. (2008). *U.S. Department of Health and Human Services*. http://doi.org/10.4085/1062-6050-44.1.5

2015 – 2020 Dietary Guidelines for Americans (8th Ed.). (n.d.). *U.S. Department of Health and Human Services and U.S. Department of Agriculture*. http://doi.org/10.1097/NT.0b013e31826c50af

About Adult BMI. (2015). Retrieved September 16, 2015, from http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/

Ackard, D. M., Croll, J. K., & Kearney-Cooke, A. (2002). Dieting frequency among college females: Association with disordered eating, body image, and related psychological problems. *Journal of Psychosomatic Research*, *52*(3), 129–136. http://doi.org/10.1016/S0022-3999(01)00269-0

Adams, A., & Cox, A. L. (2008). Questionnaires , in-depth interviews and focus groups Book Chapter and focus groups. *The Open University*, 1–34.

Adams, A., Lunt, P., & Cairns, P. (2008). A qualititative approach to HCI research. In *Research Methods for Human-Computer Interaction* (Cairns, Pa, pp. 138–157). Cambridge, UK: Cambridge University Press. Retrieved from http://www.cambridge.org/catalogue/catalogue.asp?isbn=9780521870122&ss=toc

Ahern, A. L., Bennett, K. M., Kelly, M., & Hetherington, M. M. (2011). A Qualitative Exploration of Young Women's Attitudes towards the Thin Ideal. *Journal of Health Psychology*, *16*(1), 70–79. http://doi.org/10.1177/1359105310367690

American Psychiatric Association (Ed.). (2013). *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)* (5th Editio). Washington, D.C. and London, England: American Psychiatric Publishing.

Andsager, J. L. (2014). Research directions in social media and body image. *Sex Roles*, *71*, 407–413. http://doi.org/10.1007/s11199-014-0430-4

Arcelus, J., Mitchell, A., Wales, J., & Nielsen, S. (2011). Mortality rates in patients with anorexia nervosa and other eating disorders. *Archives of General Psychiatry*, *68*(7), 724–731.

Baker, S. E., & Edwards, R. (2012). How many qualitative interviews is enough ? *National Centre for Research Methods Review Paper*, 1–42. http://doi.org/10.1177/1525822X05279903

Bannatyne, A., & Stapleton, P. (2016). Eating Disorder Patient Experiences of Volitional Stigma Within the Healthcare System and Views on Biogenetic Framing: A Qualitative Perspective. *Australian Psychologist*, 1–14. http://doi.org/10.1111/ap.12171

Bardone-Cone, A. M., & Cass, K. M. (2006). Investigating the impact of pro-anorexia websites: A pilot study. *European Eating Disorders Review*, *14*, 256–262. http://doi.org/10.1002/erv.714

Bardone-Cone, A. M., & Cass, K. M. (2007). What does viewing a pro-anorexia website do? An

experimental examination of website exposure and moderating effects. *The International Journal of Eating Disorders*, *40*, 357–548. http://doi.org/10.1002/eat

Becker, A. E., Thomas, J. J., Franko, D. L., & Herzog, D. B. (2005). Interpretation and use of weight information in the evaluation of eating disorders: Counselor response to weight information in a national eating disorders educational and screening program. *International Journal of Eating Disorders*, *37*(1), 38–43. http://doi.org/10.1002/eat.20063

Benowitz-Fredericks, C. a., Garcia, K., Massey, M., Vasagar, B., & Borzekowski, D. L. G. (2012). Body image, eating disorders, and the relationship to adolescent media use. *Pediatric Clinics of North America*, *59*, 693–704. http://doi.org/10.1016/j.pcl.2012.03.017

Bentley, F., Tollmar, K., & Stephenson, P. (2013). Health Mashups: Presenting Statistical Patterns between Wellbeing Data and Context in Natural Language to Promote Behavior Change. *ACM Transactions on Computer-Human Interaction*, *20*(5), 1–27. http://doi.org/10.1145/2503823

Berg, K. C., Frazier, P., & Sherr, L. (2009). Change in eating disorder attitudes and behavior in college women: Prevalence and predictors. *Eating Behaviors*, *10*(3), 137–142. http://doi.org/10.1016/j.eatbeh.2009.03.003

Berg, K. C., Peterson, C. B., Frazier, P., & Crow, S. J. (2012). Psychometric evaluation of the eating disorder examination and eating disorder examination-questionnaire: A systematic review of the literature. *International Journal of Eating Disorders*, *45*, 428–438. http://doi.org/10.1002/eat.20931

Berkovsky, S., Freyne, J., & Coombe, M. (2012). Physical Activity Motivating Games. *ACM Transactions on Computer-Human Interaction*, *19*(4), 1–41. http://doi.org/10.1145/2395131.2395139

Bijker, W. E., Hughes, T. P., & Pinch, T. J. (1987). *The Social Construction of Technological Systems: New Direction in the Sociology and History of Technology* (Vol. 1). MIT Press. http://doi.org/10.1177/030631289019001010

Boepple, L., & Thompson, J. K. (2014). A content analysis of healthy living blogs: Evidence of content thematically consistent with dysfunctional eating attitudes and behaviors. *International Journal of Eating Disorders*, *47*(4), 362–367. http://doi.org/10.1002/eat.22244

Boero, N., & Pascoe, C. J. (2012). Pro-anorexia Communities and Online Interaction: Bringing the Pro-ana Body Online. *Body & Society*, *18*, 27–57. http://doi.org/10.1177/1357034X12440827

Bohn, K., Doll, H. A., Cooper, Z., O'Connor, M., Palmer, R. L., & Fairburn, C. G. (2008). The measurement of impairment due to eating disorder psychopathology. *Behaviour Research and Therapy*, *46*(10), 1105–1110. http://doi.org/10.1016/j.brat.2008.06.012

Bohn, K., & Fairburn, C. G. (2008). The Clinical Impairment Assessment Questionnaire (CIA 3.0). *Cognitive Behavior Therapy and Eating Disorders*, 2–3.

Borzekowski, D. L. G., Schenk, S., Wilson, J. L., & Peebles, R. (2010). e-Ana and e-Mia: A content analysis of pro-eating disorder web sites. *American Journal of Public Health*, *100*(8), 1526–1534. http://doi.org/10.2105/AJPH.2009.172700

Bowler, L., Oh, J. S., He, D., Mattern, E., & Jeng, W. (2012). Eating disorder questions in

Yahoo! Answers: Information, conversation, or reflection? In *American Society for Information Science and Technology (ASIST)*. Baltimore, Maryland. http://doi.org/10.1002/meet.14504901052

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. http://doi.org/10.1191/1478088706qp063oa

Brown, B., Chetty, M., Grimes, A., & Harmon, E. (2006). Reflecting on health. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 1807–1812). http://doi.org/10.1145/1125451.1125794

Bulik, C. M., Sullivan, S. P., Fear, J., & Pickering, A. (1997). Predicotrs of the development of bulimia nervosa in women with anorexia nervosa. *The Journal of Nervous and Mental Disease*, *185*(11), 704–707.

Campbell, E. M., Sittig, D. F., Ash, J. S., Guappone, K. P., Dykstra, R. H. (2006). Types of unintended consequences related to computerized provider order entry. *Journal of the American Medical Informatics Association*, *13*(5), 547–556. http://doi.org/10.1197/jamia.M2042.Introduction

Campbell, M. (2009). Drop-out from treatment for the eating disorders: A problem for clinicians and researchers. *European Eating Disorders Review*, *17*(4), 239–242. http://doi.org/10.1002/erv.934

Casilli, A. A., Pailer, F., & Tubaro, P. (2013). Online networks of eating-disorder websites: Why censoring pro-ana might be a bad idea. *Perspectives in Public Health*, *133*(2), 94–95. http://doi.org/10.1177/1757913913475756

Castro, T. S., & Osório, A. J. (2013). "Fat and happy?" I'd rather die!' Online violence involving children: Pro-anorexia communities and dangerous eating behaviours on the web. In *Skins Visual Culture and Youth: A matter of belonging* (pp. 101–111). Inter-disciplinary Press.

Chancellor, S., Lin, Z. (Jerry), & De Choudhury, M. (2016). "This Post Will Just Get Taken Down ": Characterizing Removed Pro-Eating Disorder Social Media Content. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 1157–1162). San Jose, California, USA. http://doi.org/10.1145/2858036.2858248

Chancellor, S., Mitra, T., & De Choudhury, M. (2016). Recovery Amid Pro-Anorexia: Analysis of Recovery in Social Media. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 2111–2123). San Jose, California, USA. http://doi.org/10.1145/2858036.2858246

Chancellor, S., Pater, J., Clear, T., Gilber, E., & De Choudhury, M. (2016a). #thyghgapp: Instagram Content Moderation and Lexical Variation in Pro-Eating Disorder Communities. In *Computer Supported Cooperative Work and Social Computing (CSCW)* (pp. 1–13). San Francisco, CA: ACM.

Charters, E. (2003). The use of think-aloud methods in qualitative research: An introduction to think-aloud methods. *Brock Education Journal*, *12*(2), 68–82.

Choe, E. K., Lee, B., Munson, S., Pratt, W., & Kientz, J. A. (2013). Persuasive performance feedback: The effect of framing on self-efficacy. In *AMIA* (pp. 1–9). Washington, D.C.

Choe, E. K., Lee, N. B., Lee, B., Pratt, W., & Kientz, J. a. (2014). Understanding quantified-

selfers' practices in collecting and exploring personal data. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 1143–1152). Toronto, Ontario, Canada: ACM. http://doi.org/10.1145/2556288.2557372

Choudhury, M. De. (2015). Anorexia on Tumblr: A characterization study. *Proceedings of DH'15: 5th ACM Digital Health Conference*, 43–50. http://doi.org/10.1145/2750511.2750515

Chung, C.-F., Agapie, E., Schroeder, J., Mishra, S., Fogarty, J., & Munson, S. A. (2017). When personal tracking becomes social: Examining the use of Instagram for healthy eating. *Proceedings of the CHI Conference on Human Factors in Computing Systems*, 1674–1687. http://doi.org/10.1145/3025453.3025747

Cilliers, J., Senekal, M., & Kunneke, E. (2006). The association between the body mass index of first-year female university students and their weight-related perceptions and practices, psychological health, physical activity and other physical health indicators. *Public Health Nutrition*, *9*(2), 234–243. http://doi.org/10.1079/PHN2005846

Coker, E., & Abraham, S. (2014). Body weight dissatisfaction: A comparison of women with and without eating disorders. *Eating Behaviors*, *15*(3), 453–459. http://doi.org/10.1016/j.eatbeh.2014.06.014

Corbin, J. M. (1998). The Corbin and Strauss Chronic Illness Trajectory model: An Update. *Scholarly Inquiry for Nursing Practice: An International Journey*, *12*(1), 33–41.

Cordeiro, F., Bales, E., Cherry, E., & Fogarty, J. (2015). Rethinking the mobile food journal: Exploring opportunities for lightweight photo-based capture. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 1–10). Seoul, Korea: ACM. http://doi.org/10.1145/2702123.2702154

Cordeiro, F., Epstein, D. a, Thomaz, E., Bales, E., Jagannathan, A. K., Abowd, G. D., & Fogarty, J. (2015). Barriers and Negative Nudges: Exploring Challenges in Food Journaling. *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems - CHI '15*, 1159–1162. http://doi.org/10.1145/2702123.2702155

Counts, S., & Stecher, K. (2009). Self-Presentation of Personality During Online Profile Creation. *Proceedings of the Third International ICWSM Conference*, 191–194.

Creswell, J. W. (2007). *Qualitative Inquiry & Research Design: Choosing Among Five Approaches* (2nd ed.). SAGE Publications. http://doi.org/10.1073/pnas.0703993104

Creswell, J. W., & Miller, D. (2000). Determining validity in qualitative inquiry. *Theory into Practice*, *39*(3), 124–130.

Csipke, E., & Horne, O. (2007). Pro-eating disorder websites: Users' opinions. *European Eating Disorders Review*, *15*, 196–206. http://doi.org/10.1002/erv

Culbert, K. M., Racine, S. E., & Klump, K. L. (2015). Research Review: What we have learned about the causes of eating disorders - A synthesis of sociocultural, psychological, and biological research. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *56*(11), 1141–1164. http://doi.org/10.1111/jcpp.12441

Custers, K., & Van den Bulck, J. (2009). Viewership of pro-anorexia websites in seventh, ninth and eleventh graders. *European Eating Disorders Review*, *17*, 214–219.

http://doi.org/10.1002/erv.910

de Vries, H. J., Kooiman, T. J. M., van Ittersum, M. W., van Brussel, M., & de Groot, M. (2016). Do activity monitors increase physical activity in adults with overweight or obesity? A systematic review and meta-analysis. *Obesity*, *24*(10), 2078–2091. http://doi.org/10.1002/oby.21619

DiCicco-Bloom, B., & Crabtree, B. F. (2006). The qualitative research interview. *Medical Education*, *40*(4), 314–321. http://doi.org/10.1111/j.1365-2929.2006.02418.x

Donker, T., Petrie, K., Proudfoot, J., Clarke, J., Birch, M. R., & Christensen, H. (2013). Smartphones for smarter delivery of mental health programs: A systematic review. *Journal of Medical Internet Research*, *15*(11), 8–9. http://doi.org/10.2196/jmir.2791

Eaton, D. K., Kann, L. K., Kinchen, S., Shanklin, S., Flint, K. H., Hawkins, J., … Wechsler, H. (2012). Youth Risk Behavior Surveillance — United States, 2011. *Surveillance Summaries*, *61*(4), 1–163.

Eikey, E. V, & Booth, K. M. (2017). Recovery and Maintenance: How Women with Eating Disorders Use Instagram. In *iConference* (pp. 1–12). Wuhan, China.

Eisenberg, D., Nicklett, E. J. E. J., Roeder, K., & Kirz, N. E. N. E. (2011). Eating Disorder Symptoms Among College Students: Prevalence, Persistence, Correlates, and Treatment-Seeking. *Journal of American College Health*, *59*(8), 700–707. http://doi.org/10.1080/07448481.2010.546461

Eisenberg, D., Nicklett, E. J., Roeder, K., & Kirz, N. E. (2011). Eating Disorder Symptoms Among College Students: Prevalence, Persistence, Correlates, and Treatment-Seeking. *Journal of American College Health*, *59*(8), 70–707. http://doi.org/10.1038/nature13314.A

Elliot, A. J., Maier, M. a, Moller, A. C., Friedman, R., & Meinhardt, J. (2007). Color and psychological functioning: The effect of red on performance attainment. *Journal of Experimental Psychology: General*, *136*(1), 154–168. http://doi.org/10.1037/0096-3445.136.1.154

Engel, B., Reiss, N. S., & Dombeck, M. (2007). Prevalence, onset and course of eating disorders. Retrieved November 12, 2015, from https://www.mentalhelp.net/articles/prevalence-onset-and-course-of-eating-disorders/

English Oxford Dictionary: Journey. (2017). Retrieved from https://en.oxforddictionaries.com/definition/journey

English Oxford Dictionary: Trajectory. (2017). Retrieved April 26, 2017, from https://en.oxforddictionaries.com/definition/trajectory

Epstein, D. A., Caraway, M., Johnston, C., Ping, A., Fogarty, J., & Munson, S. A. (2016). Beyond Abandonment to Next Steps: Understanding and Designing for Life after Personal Informatics Tool Use. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 1109–1113). http://doi.org/10.1145/2858036.2858045

Epstein, D., Cordeiro, F., Bales, E., Fogarty, J., & Munson, S. (2014). Taming data complexity in lifelogs. *Proc DIS 2014*, 667–676. http://doi.org/10.1145/2598510.2598558

Ericsson, K. A., & Simon, H. A. (1980). Verbal Reports as Data. *Psychological Review*, *87*(3),

215–251. http://doi.org/10.1037/0033-295X.87.3.215

Fairburn, C. G., & Beglin, S. (2008). EDE-Q. In *Cognitive Behavior Therapy and Eating Disorders* (pp. 1–5). New York, USA: Guilford Press.

Fairburn, C. G., & Harrison, P. J. (2003). Eating disorders. *The Lancet*, *361*, 407–416. http://doi.org/10.1016/S0140-6736(03)12378-1

Fairburn, C. G., & Rothwell, E. R. (2015). Apps and eating disorders: A systematic clinical appraisal. *International Journal of Eating Disorders*, *48*(7), 1038–1046. http://doi.org/10.1002/eat.22398

Fan, C., Forlizzi, J., & Dey, a. (2012). A Spark Of Activity: Exploring Informative Art As Visualization For Physical Activity. In *The 14th International Conference on Ubiquitous Computing* (pp. 81–84). http://doi.org/10.1145/2384916.2384923

Fardouly, J., Diedrichs, P. C., Vartanian, L. R., & Halliwell, E. (2015). Social comparisons on social media: The impact of Facebook on young women's body image concerns and mood. *Body Image*, *13*, 38–45. http://doi.org/10.1016/j.bodyim.2014.12.002

Fardouly, J., & Vartanian, L. R. (2015). Negative comparisons about one's appearance mediate the relationship between Facebook usage and body image concerns. *Body Image*, *12*, 82–88. http://doi.org/10.1016/j.bodyim.2014.10.004

Fayet, F., Petocz, P., & Samman, S. (2012). Prevalence and correlates of dieting in college women: A cross sectional study. *International Journal Women's Health*, *4*, 405–411. http://doi.org/10.2147/IJWH.S33920

Ferreday, D. (2003). Unspeakable bodies: Erasure, embodiment and the pro-ana community. *International Journal of Cultural Studies*, *6*(3), 277–295.

Fielder-jenks, C. (2013). Weight Stigma Viewed Through the Eating Disorders Lens. Retrieved February 23, 2016, from http://bedaonline.com/wsaw2013/weight-stigma-eating-disorder-lens-chelsea-fielder-jenks/

Fitzsimmons-Craft, E. E. (2011). Social psychological theories of disordered eating in college women: Review and integration. *Clinical Psychology Review*, *31*(7), 1224–1237. http://doi.org/10.1016/j.cpr.2011.07.011

Flynn, M. a., & Stana, A. (2012). Social support in a men's online eating disorder forum. *International Journal of Men's Health*, *11*(2), 150–169. http://doi.org/10.3149/jmh.1102.150

Forman-Hoffman, V. (2004). High prevalence of abnormal eating and weight control practices among U.S. high-school students. *Eating Behaviors*, *5*(4), 325–336. http://doi.org/10.1016/j.eatbeh.2004.04.003

Fox, S. (2013). Health Online 2013.

Fox, S., & Duggan, M. (2012). Mobile Health 2012. *Pew Internet & American Life Project*. Retrieved from http://pewinternet.org/Reports/2012/Mobile-Health.aspx

Freyne, J., Brindal, E., Hendrie, G., Berkovsky, S., & Coombe, M. (2012). Mobile applications to support dietary change: Highlighting the importance of evaluation context. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 1781–

1786). http://doi.org/10.1145/2212776.2223709

Friedman, T. (2005). *Electric Dreams: Computers in American Culture*. NYU Press.

Fulk, J. (1993). Social Construction of Communication Technology Author. *The Academy of Management Journal*, *36*(5), 921–950.

Gaebel, W., Rossler, W., & Sartorius, N. (2016). *The Stigma of Mental Illness - End of the Story*. Springer. http://doi.org/10.1016/B978-0-12-397045-9.00170-1

Garner, D. M., Olmsted, M. P., Bohr, Y., & Garfinkel, P. E. (1982). The Eating Attitudes Test: Psychometric Features and Clinical Correlates. *Psychological Medicine*.

Gasson, S. (2003). Chapter VI Rigor In Grounded Theory Research : An Interpretive Perspective on Generating Theory From Qualitative Field Studies. *The Handbook of Information Systems Research*, 79–102. http://doi.org/10.4018/978-1-59140-144-5.ch006

Gies, J., & Martino, S. (2014). Uncovering ED: A qualitative analysis of personal blogs managed by individuals with eating disorders. *The Qualitative Report*, *19*(57), 1–15.

Gillen, M. M., Markey, C. N., & Markey, P. M. (2012). An examination of dieting behaviors among adults: Links with depression. *Eating Behaviors*, *13*(2), 88–93. http://doi.org/10.1016/j.eatbeh.2011.11.014

Gnambs, T., Appel, M., & Batinic, B. (2010). Color red in web-based knowledge testing. *Computers in Human Behavior*, *26*(6), 1625–1631. http://doi.org/10.1016/j.chb.2010.06.010

Goffman, E. (1959). The Presentation of Self In Everyday Life (pp. 135–146). http://doi.org/10.2307/258197

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The Qualitative Research*, *8*(4), 597–607. Retrieved from http://www.nova.edu/ssss/QR/QR8-4/golafshani.pdf

Goudarzi, V., & Tomic, S. (2006). PEDdo: Steps to a healthy lifestyle. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 1825–1830). Montreal, Quebec, Canada: ACM. http://doi.org/10.1145/1125451.1125797

Grimes, A., & Harper, R. (2008). Celebratory technology: New directions for food research in HCI. In *CHI '08* (p. 467). http://doi.org/10.1145/1357054.1357130

Guest, G. (2006). How Many Interviews Are Enough?: An Experiment with Data Saturation and Variability. *Field Methods*, *18*(1), 59–82. http://doi.org/10.1177/1525822X05279903

Gulec, H., Moessner, M., Mezei, A., Kohls, E., Túry, F., & Bauer, S. (2011). Internet-based maintenance treatment for patients with eating disorders. *Professional Psychology: Research and Practice*, *42*(6), 479–486. http://doi.org/10.1037/a0025806

Hacking Health: How Consumers Use Smartphones and Wearable Tech To Track Their Health. (2014). Retrieved August 8, 2016, from http://www.nielsen.com/us/en/insights/news/2014/hacking-health-how-consumers-use-smartphones-and-wearable-tech-to-track-their-health.html

Hackler, A. H., Vogel, D. L., & Wade, N. G. (2010). Attitudes Toward Seeking Professional Help for an Eating Disorder: The Role of Stigma and Anticipated Outcomes. *Journal of Counseling & Development*, *88*(4), 424–431. http://doi.org/10.1002/j.1556-

6678.2010.tb00042.x

Harper, K., Sperry, S., & Thompson, J. K. (2008). Viewership of pro-eating disorder websites: Association with body image and eating disturbances. *The International Journal of Eating Disorders*, *41*, 92–95. http://doi.org/10.1002/eat

Hoerr, S. L., Bokram, R., Lugo, B., Bivins, T., & Keast, D. R. (2002). Risk for disordered eating relates to both gender and ethnicity for college students. *Journal of the American College of Nutrition*, *21*(4), 307–314. http://doi.org/10.1080/07315724.2002.10719228

Hofkirchner, W. (2010). A taxonomy of theories about ICTs and society. *TripleC*, *8*(2), 171–176.

Household USDA Foods Fact Sheet: Apples, Fresh. (2015). *United States Department of Agriculture*. Retrieved from https://whatscooking.fns.usda.gov/sites/default/files/factsheets/HHFS_APPLES_FRESH_F510-515_2015.pdf

Hsu, A., Yang, J., Yilmaz, Y. H., Haque, M. S., Can, C., & Blandford, A. E. (2014). Persuasive technology for overcoming food cravings and improving snack choices. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 3403–3412). http://doi.org/10.1145/2556288.2557099

Hudson, J. I., Hiripi, E., Pope, H. G., & Kessler, R. C. (2007). The Prevalence and Correlates of Eating Disorders in the National Comorbidity Survey Replication. *Biological Psychiatry*, *61*(3), 348–358. http://doi.org/10.1016/j.biopsych.2006.03.040

Huon, G., & Lim, J. (2000). The emergence of dieting among female adolescents: age, body mass index, and seasonal effects. *The International Journal of Eating Disorders*, *28*(2), 221–225.

Jacobs, M., Clawson, J., & Mynatt, E. D. (2014). Cancer navigation: Opportunities and challenges for facilitating the breast cancer journey. In *Computer Supported Cooperative Work and Social Computing (CSCW)* (pp. 1467–1478). Baltimore, Maryland: ACM. http://doi.org/10.1145/2531602.2531645

Jacobs, M., Clawson, J., & Mynatt, E. D. (2014). My Journey Compass : A Preliminary Investigation of a Mobile Tool for Cancer Patients. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 663–672). Toronto, Ontario, Canada: ACM. http://doi.org/10.1145/2556288.2557194

Jacobs, M., Clawson, J., & Mynatt, E. D. (2016). A Cancer Journey Framework : Guiding the Design of Holistic Health Technology. In *Pervasive Health* (pp. 114–121). Cancun, Mexico. http://doi.org/10.4108/eai.16-5-2016.2263333

Jett, S., La Porte, D. J., & Wanchisn, J. (2010). Impact of exposure to pro-eating disorder websites on eating behaviour in college women. *European Eating Disorders Review*, *18*, 410–416. http://doi.org/10.1002/erv.1009

Johnsen, J.-A. K., Rosenvinge, J. H., & Gammon, D. (2002). Online group interaction and mental health: An analysis of three online discussion forums. *Scandinavian Journal of Psychology*, *43*, 445–449. http://doi.org/10.1111/1467-9450.00313

Juarascio, A. S., Forman, E. M., Timko, C. A., Herbert, J. D., Butryn, M., & Lowe, M. (2011). Implicit internalization of the thin ideal as a predictor of increases in weight, body

dissatisfaction, and disordered eating. *Eating Behaviors*, *12*(3), 207–213. http://doi.org/10.1016/j.eatbeh.2011.04.004

Juarascio, A. S., Manasse, S. M., Goldstein, S. P., Forman, E. M., & Butryn, M. L. (2015). Review of smartphone applications for the treatment of eating disorders. *European Eating Disorders Review*, *23*, 1–11. http://doi.org/10.1002/erv.2327

Kamal, N., Fels, S., & Ho, K. (2010). Online social networks for personal informatics to promote positive health behavior. In *Proceedings of 2nd ACM SIGMM Workshop on Social Media - WSM '10* (p. 47). http://doi.org/10.1145/1878151.1878167

Kamanga, U. (2016). *Investigating how health apps influence college students' health behavior*. Kansas State University.

Kazdin, A. E., Fitzsimmons-Craft, E. E., & Wilfley, D. E. (2017). Addressing critical gaps in the treatment of eating disorders. *International Journal of Eating Disorders*, *50*, 170–189. http://doi.org/10.1002/eat.22670

Keski-Rahkonen, A., & Tozzi, F. (2005). The process of recovery in eating disorder sufferers' own words: An internet-based study. *International Journal of Eating Disorders*, *37*, 580–586. http://doi.org/10.1002/eat.20123

Khovanskaya, V., Baumer, E. P. S., Cosley, D., Voida, S., & Gay, G. (2013). "Everybody Knows What You're Doing": A Critical Design Approach to Personal Informatics. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 3403–3412). http://doi.org/10.1145/2470654.2466467

Kim, J. W., & Chock, T. M. (2015). Body image 2.0: Associations between social grooming on Facebook and body image concerns. *Computers in Human Behavior*, *48*, 331–339. http://doi.org/10.1016/j.chb.2015.01.009

Kjeldskov, J., & Graham, C. (2003). A Review of Mobile HCI Research Methods. In *Mobile HCI* (L. Chittar, pp. 317–335). http://doi.org/10.1007/978-3-540-45233-1_23

Kling, R. (1994). Reading "all about" computerization: How genre conventions shape nonfiction social analysis. *The Information Society*, *10*(3), 147–172. http://doi.org/10.1080/01972243.1994.9960166

Krebs, P., & Duncan, D. T. (2015). Health App Use Among US Mobile Phone Owners: A National Survey. *JMIR mHealth and uHealth*, *3*(4), 1–12. http://doi.org/10.2196/mhealth.4924

Kummervold, P. E., Gammon, D., Bergvik, S., Johnsen, J.-A. K., Hasvold, T., & Rosenvinge, J. H. (2002). Social support in a wired world: Use of online mental health forums in Norway. *Nordic Journal of Psychiatry*, *56*(1), 59–65. http://doi.org/10.1080/08039480252803945

Kvale, S. (2006). Dominance Through Interviews and Dialogues. *Qualitative Inquiry*, *12*(3), 480–500. http://doi.org/10.1177/1077800406286235

LaRose, J. G., Leahey, T. M., Hill, J. O., & Wing, R. R. (2013). Differences in motivations and weight loss behaviors in young adults and older adults in the National Weight Control Registry. *Obesity*, *21*(3), 449–53. http://doi.org/10.1002/oby.20053

Lawler, M., & Nixon, E. (2011). Body Dissatisfaction Among Adolescent Boys and Girls: The

Effects of Body Mass, Peer Appearance Culture and Internalization of Appearance Ideals. *Journal of Youth and Adolescence*, *40*(1), 59–71. http://doi.org/10.1007/s10964-009-9500-2

Lazar, A., Koehler, C., Tanenbaum, J., & Nguyen, D. H. (2015). Why we use and abandon smart devices. In *UbiComp* (pp. 635–646). Osaka, Japan: ACM. http://doi.org/10.1145/2750858.2804288

Le Grange, D., Doyle, P. M., Swanson, S. a., Ludwig, K., Glunz, C., & Kreipe, R. E. (2012). Calculation of Expected Body Weight in Adolescents With Eating Disorders. *Pediatrics*, *129*(2), e438–e446. http://doi.org/10.1542/peds.2011-1676

Lewis, C., & Wharton, C. (1997). *Cognitive Walkthroughs*. *Handbook of Human-Computer Interaction* (Revised Ed). North Holland.

Li, I., Dey, A., & Forlizzi, J. (2010). A stage-based model of personal informatics systems. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (p. 557). Atlanta, Georgia: ACM. http://doi.org/10.1145/1753326.1753409

Li, I., Dey, A., & Forlizzi, J. (2011). Understanding My Data, Myself: Supporting Self-Reflection with Ubicomp Technologies. In *Proceedings of the 13th international conference on Ubiquitous Computing* (pp. 405–414). Beijing, China: ACM. http://doi.org/10.1145/2030112.2030166

Liechty, J. M. (2010). Body image distortion and three types of weight loss behaviors among nonoverweight girls in the United States. *Journal of Adolescent Health*, *47*(2), 176–182. http://doi.org/10.1016/j.jadohealth.2010.01.004

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Newbury Park, CA: Sage Publications.

Livingston, J. D., & Boyd, J. E. (2010). Correlates and consequences of internalized stigma for people living with mental illness: A systematic review and meta-analysis. *Social Science and Medicine*, *71*(12), 2150–2161. http://doi.org/10.1016/j.socscimed.2010.09.030

Ljotsson, B., Lundin, C., Mitsell, K., Carlbring, P., Ramklint, M., & Ghaderi, a. (2007). Remote treatment of bulimia nervosa and binge eating disorder: A randomized trial of Internet-assisted cognitive behavioural therapy. *Behaviour Research and Therapy*, *45*, 649–661. http://doi.org/10.1016/j.brat.2006.06.010

Low, K. G., Charanasomboon, S., Brown, C., Hiltunen, G., Long, K., Reinhalter, K., & Jones, H. (2003). Internalization of the Thin Ideal, Weight and Body Image Concerns. *Social Behavior and Personality: An International Journal*, *31*(1), 81–89. http://doi.org/10.2224/sbp.2003.31.1.81

Lupton, D. (2014). Self-tracking cultures: Towards a sociology of personal informatics. In *OzCHI '14* (pp. 1–10). Sydney, Australia: ACM. http://doi.org/10.1145/2686612.2686623

Lupton, D. (2016). *The Quantified Self*. John Wiley & Sons.

Lynn, A.L. (2012). Body Mass Index Trends and Nutrition Goals of College Students between 2007-2011. *Nutrition & Health Sciences Dissertations & Theses*, 38.

M. Bucchianeri, M., & Neumark-Sztainer, D. (2014). Body dissatisfaction: An overlooked public health concern. *Journal of Public Mental Health*, *13*(2), 64–69.

http://doi.org/10.1108/JPMH-11-2013-0071

Mabe, A. G., Forney, K. J., & Keel, P. K. (2014). Do you "like" my photo? Facebook use maintains eating disorder risk. *International Journal of Eating Disorders*, *47*, 516–523. http://doi.org/10.1002/eat.22254

Marshall, M. N. (1996). Sampling for qualitative research. *Family Practice*, *13*(6), 522–526. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/9023528

Maxwell, J. (2005). *Qualitative research design: An interactive approach* (Vol. 41). Thousand Oaks, CA: Sage Publications, Inc.

Mays, N., & Pope, C. (2000). Qualitative research in health care: Assessing quality in qualitative research. *BMJ*, *320*, 50–52. http://doi.org/10.1136/bmj.320.7226.50

McCormack, A. (2010). Individuals with eating disorders and the use of online support groups as a form of social support. *CIN: Computers, Informatics, Nursing*, *28*(1), 12–9. http://doi.org/10.1097/NCN.0b013e3181c04b06

Meier, E. P., & Gray, J. (2014). Facebook photo activity associated with body image disturbance in adolescent girls. *Cyberpsychology, Behavior and Social Networking*, *17*(4), 199–206. http://doi.org/10.1089/cyber.2013.0305

Mentis, H. M., Komlodi, A., Schrader, K., Phipps, M., Gruber-Baldini, A., Yarbrough, K., & Shulman, L. (2017). Crafting a View of Self-Tracking Data in the Clinical Visit. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 5800–5812). Denver, CO: ACM.

Meyer, J., Wasmann, M., Heuten, W., El Ali, A., & Boll, S. (2017). Identification and Classification of Usage Patterns in Long-Term Activity Tracking. *Proceedings of the CHI Conference on Human Factors in Computing Systems*, 667–678. http://doi.org/http://dx.doi.org/10.1145/3025453.3025690

Mobile Fact Sheet. (2017). Retrieved May 18, 2017, from www.pewinternet.org/fact-sheet/mobile/

Mohr, D. C., Burns, M. N., Schueller, S. M., Clarke, G., & Klinkman, M. (2013). Behavioral intervention technologies: Evidence review and recommendations for future research in mental health. *General Hospital Psychiatry*, *35*, 332–338. http://doi.org/10.1016/j.genhosppsych.2013.03.008

Mond, J. M., Hay, P. J., Rodgers, B., & Owen, C. (2007). Health service utilization for eating disorders: findings from a community-based study. *The International Journal of Eating Disorders*, *40*, 399–408. http://doi.org/10.1002/eat

Mueller, F., Marshall, J., Khot, R. A., Nylander, S., & Tholander, J. (2014). Jogging with technology: Interaction design supportging sport activities. *Proceedings of the CHI Conference on Human Factors in Computing Systems*, 1131–1134. http://doi.org/10.1145/2559206.2559209

Mulveen, R., & Hepworth, J. (2006). An interpretative phenomenological analysis of participation in a pro-anorexia internet site and its relationship with disordered eating. *Journal of Health Psychology*, *11*, 283–296. http://doi.org/10.1177/1359105306061187

Neumark-Sztainer, D. (2005). *"I'm, Like, SO Fat!": Helping Your Teen Make Healthy Choices about Eating and Exercise in a Weight-Obsessed World*. New York, NY: The Guilford Press. http://doi.org/10.1080/10640260500536342

Neumark-Sztainer, D., Wall, M., Guo, J., Story, M., Haines, J., & Eisenberg, M. (2006). Obesity, disordered eating, and eating disorders in a longitudinal study of adolescents: How do dieters fare 5 years later? *Journal of the American Dietetic Association*, *106*(4), 559–568. http://doi.org/10.1016/j.jada.2006.01.003

Neumark-Sztainer, D., Wall, M., Larson, N. I., Eisenberg, M. E., & Loth, K. (2011). Dieting and disordered eating behaviors from adolescence to young adulthood: Findings from a 10-year longitudinal study. *Journal of the American Dietetic Association*, *111*(7), 1004–1011. http://doi.org/10.1016/j.jada.2011.04.012

Neve, M., Morgan, P. J., Jones, P. R., & Collins, C. E. (2009). Effectiveness of web-based interventions in achieving weight loss and weight loss maintenance in overweight and obese adults: a systematic review with meta-analysis. *Obesity Reviews: International Association for the Study of Obesity*, *11*, 306–321. http://doi.org/10.1111/j.1467-789X.2009.00646.x

Nguyen, E., Modak, T., Dias, E., Yu, Y., & Huang, L. (2014). Fitnamo: Using bodydata to encourage exercise through google glass™. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 239–244). http://doi.org/10.1145/2559206.2580933

Nielsen, J., Clemmensen, T., & Yssing, C. (2002). Getting access to what goes on in people's heads? Reflections on the think-aloud technique. In *NordiCHI '02* (pp. 101–110). Amus, Denmark. http://doi.org/10.1145/572020.572033

Pater, J., Haimson, O., Andalibi, N., & Mynatt, E. D. (2016). "Hunger hurts but starving works:" characterzing the presentation of eating disorders online. In *Computer Supported Cooperative Work and Social Computing (CSCW)* (pp. 1–16). San Francisco, CA: ACM. http://doi.org/10.1145/2818048.2820030

Peebles, R., Wilson, J. L., Litt, I. F., Hardy, K. K., Lock, J. D., Mann, J. R., & Borzekowski, D. L. G. (2012). Disordered eating in a digital age: Eating behaviors, health, and quality of life in users of websites with pro-eating disorder content. *Journal of Medical Internet Research*, *14*(5). http://doi.org/10.2196/jmir.2023

Peñas-Lledó, E., Bulik, C. M., Lichtenstein, P., Larsson, H., & Baker, J. H. (2015). Risk for self-reported anorexia or bulimia nervosa based on drive for thinness and negative affect clusters/dimensions during adolescence: A three-year prospective study of the TChAD cohort. *The International Journal of Eating Disorders*, *48*(6), 692–9. http://doi.org/10.1002/eat.22431

Perloff, R. M. (2014). Social media effects on young women's body image concerns: Theoretical perspectives and an agenda for research. *Sex Roles*, 363–377. http://doi.org/10.1007/s11199-014-0384-6

Pierre Woog (Ed.). (1992). *The Chronic Illness Trajectory Framework: The Corbin and Strauss Nursing Model*. New York, NY: Springer Publishing Company, Inc.

Pina, L. R., Sien, S.-W., Ward, T., Yip, J. C., Munson, S. A., Fogarty, J., & Kientz, J. A. (2017). From Personal Informatics to Family Informatics. In *Proceedings of the ACM Conference*

on Computer Supported Cooperative Work and Social Computing (CSCW) (pp. 2300–2315). http://doi.org/10.1145/2998181.2998362

Price, M., Yuen, E. K., Goetter, E. M., Herbert, J. D., Forman, E. M., Acierno, R., & Ruggiero, K. J. (2014). mHealth: A mechanism to deliver more accessible, more effective mental health care. *Clinical Psychology and Psychotherapy*, *21*, 427–436. http://doi.org/10.1002/cpp.1855

Prichard, I., & Tiggemann, M. (2005). Objectification in fitness centers: Self-objectification, body dissatisfaction, and disordered eating in aerobic instructors and aerobic participants. *Sex Roles*, *53*(1–2), 19–28. http://doi.org/10.1007/s11199-005-4270-0

Purpura, S., Schwanda, V., Williams, K., Stubler, W., & Sengers, P. (2011). Fit4life: The design of a persuasive technology promoting healthy behavior and ideal weight. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (p. 423). http://doi.org/10.1145/1978942.1979003

Quantified Self: Self Knowledge through Numbers. (2015). Retrieved May 2, 2017, from http://quantifiedself.com/

Quick, V. M., & Byrd-Bredbenner, C. (2013). Disturbed eating behaviours and associated psychographic characteristics of college students. *Journal of Human Nutrition and Dietetics*, *26*(SUPPL.1), 53–63. http://doi.org/10.1111/jhn.12060

Quick, V. M., & Byrd-Bredbenner, C. (2013). Eating Disorders Examination Questionnaire (EDE-Q): Norms for US college students. *Eating and Weight Disorders*, *18*(1), 29–35. http://doi.org/10.1007/s40519-013-0015-1

Ransom, D. C., La Guardia, J. G., Woody, E. Z., & Boyd, J. L. (2010). Interpersonal interactions on online forums addressing eating concerns. *International Journal of Eating Disorders*, *43*(2), 161–170. http://doi.org/10.1002/eat.20629

Reba-Harrelson, L., Von Holle, A., Hamer, R. M., Swann, R., Reyes, M. L., & Bulik, C. M. (2009). Patterns and prevalence of disordered eating and weight control behaviors in women ages 25-45. *Eating and Weight Disorders*, *14*(4). http://doi.org/10.1007/BF03325116

Reinking, M. F., Alexander, L. E., & Louis, S. (2005). Prevalence of Disordered-Eating Behaviors Athletes and Nonathletes. *Journal of Athletic Training*, *40*(1), 47–51.

Riaz, S., & Sykes, C. (2015). Are smartphone health applications effective in modifying obesity and smoking behaviours? A systematic review. *Health and Technology*, 73–81. http://doi.org/10.1007/s12553-015-0104-4

Rodgers, R. F., McLean, S. A., & Paxton, S. J. (2015). Longitudinal relationships among internalization of the media ideal, peer social comparison, and body dissatisfaction: Implications for the tripartite influence model. *Developmental Psychology*, *51*(5), 706–713. http://doi.org/10.1037/dev0000013

Rohde, P., Stice, E., & Marti, C. N. (2015). Development and predictive effects of eating disorder risk factors during adolescence: Implications for prevention efforts. *International Journal of Eating Disorders*, *48*(2), 187–198. http://doi.org/10.1002/eat.22270

Rooksby, J., Rost, M., Morrison, A., & Chalmers, M. (2015). Pass the ball: Enforced turn-taking

in activity tracking. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 2417–2426). Seoul, Korea: ACM. http://doi.org/10.1145/2702123.2702577

Rooksby, J., Rost, M., Morrison, A., & Chalmers, M. C. (2014). Personal tracking as lived informatics. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 1163–1172). http://doi.org/10.1145/2556288.2557039

Rouleau, C. R., & Von Ranson, K. M. (2011). Potential risks of pro-eating disorder websites. *Clinical Psychology Review*, *31*(4), 525–531. http://doi.org/10.1016/j.cpr.2010.12.005

Sanderson, C. A. (2010). *Social Psychology*. John Wiley & Sons, Inc. http://doi.org/10.4135/9781446247198

Schwämmlein, E., & Wodzicki, K. (2012). What to tell about me? Self-presentation in online communities. *Journal of Computer-Mediated Communication*, *17*(4), 387–407. http://doi.org/10.1111/j.1083-6101.2012.01582.x

Schwitzer, A. M. (2012). Diagnosing, conceptualizing, and treating eating disorders not otherwise specified: A comprehensive practice model. *Journal of Counseling and Development*, *90*(3), 281–289. http://doi.org/10.1002/j.1556-6676.2012.00036.x

Schwitzer, A. M., & Choate, L. H. (2015). College women eating disorder diagnostic profile and DSM-5. *Journal of American College Health*, *63*(1), 73–8. http://doi.org/10.1080/07448481.2014.963110

Shade, L. R. (2003). Weborexics: The Ethical Issues Surrounding Pro-Ana Websites. *ACM SIGCAS Computers and Society*, *33*(7), 2. http://doi.org/10.1145/968358.968361

Sharpe, H., Musiat, P., Knapton, O., & Schmidt, U. (2011). Review Pro-eating disorder websites: facts, fictions and fixes. *Journal of Public Mental Health*, *10*(1), 34–44. http://doi.org/10.1108/17465721111134538

Shisslak, C. M., Crago, M., & Estes, L. S. (1995). The spectrum of eating disturbances. *The International Journal of Eating Disorders*, *18*(3), 209–219. http://doi.org/10.1002/1098-108x(199511)18:3<209::aid-eat2260180303>3.0.co;2-e

Singh, S. (2006). Impact of color on marketing. *Management Decision*, *44*(6), 783–789. http://doi.org/10.1108/00251740610673332

Smelser, N. J., & Baltes, P. B. (2001). Technological Determinism. In *International Encyclopedia of the Social & Behavioral Sciences* (1st ed., pp. 15495–15498). Elsevier.

Smith, A. (2015). "The Smartphone Difference." *Pew Research Center*. http://doi.org/10.1017/CBO9781107415324.004

Smolak, L., & Levine, M. P. (2015). Sociocultural Theories of Eating Disorders. In *The Wiley Handbook of Eating Disorders* (pp. 269–282). John Wiley & Sons, Ltd. http://doi.org/10.1002/9781118574089.ch21

Spettigue, W., & Henderson, K. A. (2004). Eating disorders and the role of the media. *The Canadian Child and Adolescent Psychiatry Review*, *13*(1), 16–19.

Stawarz, K., Cox, A. L., & Blandford, A. (2015). Beyond self-tracking and reminders: Designing smartphone apps that support habit formation. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 2653–2662). Seoul, Korea: ACM.

http://doi.org/10.1145/2702123.2702230

Stommel, W. (2008). Mein nick bin ich! Nicknames in a German Forum on eating disorders. *Journal of Computer-Mediated Communication*, *13*, 141–162. http://doi.org/10.1111/j.1083-6101.2007.00390.x

Stommel, W. (2009). *Entering an Online Support Group on Eating Disorders: A Discourse Analysis*. Amsterdam: Rodopi.

Stommel, W., & Koole, T. (2010). The online support group as a community: A micro-analysis of the interaction with a new member. *Discourse Studies*, *12*(3), 357–378. http://doi.org/10.1177/1461445609358518

Stommel, W., & Meijman, F. J. (2011). The use of conversation analysis to study social accessibility of an online support group on eating disorders. *Global Health Promotion*, *18*(2), 18–26. http://doi.org/10.1177/1757975911404764

Stover, C. M. (2014). *Elements of a Sensibility: Fitness Blogs and Postfeminist Media Culture*. The University of Texas at Austin.

Stronge, S., Greaves, L. M., Milojev, P., West-Newman, T., Barlow, F. K., & Sibley, C. G. (2015). Facebook is linked to body dissatisfaction: Comparing users and non-users. *Sex Roles*, *73*, 200–213. http://doi.org/10.1007/s11199-015-0517-6

Strother, E., Lemberg, R., Stanford, S. C., & Turberville, D. (2012). Eating Disorders in Men: Underdiagnosed, Undertreated, and Misunderstood. *Eating Disorders*, *20*(5), 346–355. http://doi.org/10.1080/10640266.2012.715512

Sullivan, P. F. (1995). Mortality in anorexia nervosa. *The American Journal of Psychiatry*, *152*(7), 1073–1074. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/?term=ullivan+PF+(1995):+Mortality+in+anorexia+nervosa.+Am+J+Psychiatry+152:1073?+1074.

Tan, T., Kuek, A., Goh, S. E., Lee, E. L., & Kwok, V. (2016). Internet and smartphone application usage in eating disorders: A descriptive study in Singapore. *Asian Journal of Psychiatry*, *19*, 50–55. http://doi.org/10.1016/j.ajp.2015.11.007

Teufel, M., Hofer, E., Junne, F., Sauer, H., Zipfel, S., & Giel, K. E. (2013). A comparative analysis of anorexia nervosa groups on Facebook. *Eating and Weight Disorders*, *18*, 413–420. http://doi.org/10.1007/s40519-013-0050-y

Thompson, C., & Park, S. (2016). Barriers to access and utilization of eating disorder treatment among women. *Archives of Women's Mental Health*, *19*(5), 753–760. http://doi.org/10.1007/s00737-016-0618-4

Tiggemann, M., & Zaccardo, M. (2015). "Exercise to be fit, not skinny": The effect of fitspiration imagery on women's body image. *Body Image*, *15*, 61–67. http://doi.org/10.1016/j.bodyim.2015.06.003

Toscos, T., Faber, A., An, S., & Gandhi, M. P. (2006). Chick clique: Persuasive technology to motivate teenage girls to exercise. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (Vol. 31, pp. 1873–1878). http://doi.org/10.1145/1125451.1125805

Tracy, S. J. (2010). Qualitative quality: Eight "big-tent" criteria for excellent qualitative research. *Qualitative Inquiry*, *16*(10), 837–851. http://doi.org/10.1177/1077800410383121

Tregarthen, J. P., Lock, J., & Darcy, A. M. (2015). Development of a smartphone application for eating disorder self-monitoring. *International Journal of Eating Disorders*, *48*(7), 972–982. http://doi.org/10.1002/eat.22386

Turner, D. W. (2010). Qualitative Interview Design: A Practical Guide for Novice Investigators. *The Qualitative Report*, *15*(3), 754–760. http://doi.org/http://www.nova.edu/ssss/QR/QR15-3/qid.pdf

Vartanian, L. R., Herman, C. P., & Polivy, J. (2007). Consumption stereotypes and impression management: How you are what you eat. *Appetite*, *48*, 265–277. http://doi.org/10.1016/j.appet.2006.10.008

Vu, T., Lin, F., Alshurafa, N., & Xu, W. (2017). Wearable Food Intake Monitoring Technologies: A Comprehensive Review. *Computers*, *6*(1), 4. http://doi.org/10.3390/computers6010004

Vyas, D., Fitz-walter, Z., Mealy, E., Soro, A., Zhang, J., & Brereton, M. (2015). Exploring physical activities in an employer-sponsored health program. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 1421–1426). Seoul, Korea. http://doi.org/10.1145/2702613.2732815

Wade, T. D., Keski-Rahkonen, A., & Hudson, J. (2011). Epidemiology of eating disorders. In *Textbook in Psychiatric Epidemiology (3rd ed.)* (M. Tsuang, pp. 343–360). New York: Wiley. http://doi.org/10.1002/9780470976739.ch20

Walsh, G., & Golbeck, J. (2014). StepCity: A preliminary investigation of a personal informatics-based social game on behavior change. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 2371–2376). Toronto, Ontario, Canada: ACM. http://doi.org/10.1145/2559206.2581326

Walstrom, M. K. (2000). "You know, who's the thinnest?": Combating surveillance and creating safety in copy with eating disorders online. *CyberPsychology & Behavior*, *3*(5), 761–783. http://doi.org/10.1089/10949310050191755

Wang, T.-L., & Lien, Y.-H. B. (2013). The power of using video data. *Quality & Quantity*, *47*, 2933–2941. http://doi.org/10.1007/s11135-012-9717-0

Wang, Y., Weber, I., & Mitra, P. (2016). Quantified Self Meets Social Media: Sharing of Weight Updates on Twitter. In *Proceedings of the 6th International Conference on Digital Health Conference* (pp. 1–12). http://doi.org/10.1145/2896338.2896363

West, P., Giordano, R., Van Kleek, M., & Shadbolt, N. (2016). The Quantified Patient in the Doctor's Office: Challenges & Opportunities. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 3066–3078). http://doi.org/10.1145/2858036.2858445

White, M., & Dorman, S. M. (2001). Receiving social support online: Implications for health education. *Health Education Research*, *16*(6), 693–707. http://doi.org/10.1093/her/16.6.693

Whitlock, J. L., Powers, J. L., & Eckenrode, J. (2006). The virtual cutting edge: The internet and adolescent self-injury. *Developmental Psychology*, *42*(3), 407–417.

http://doi.org/10.1037/0012-1649.42.3.407

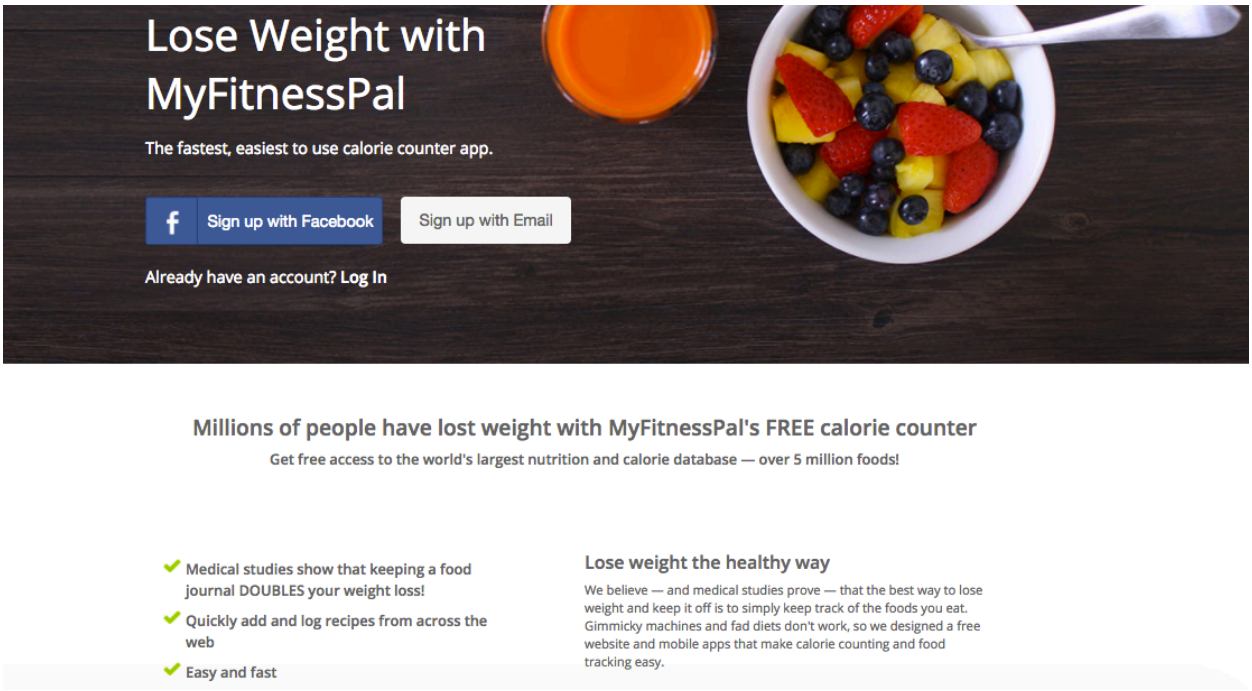
Whittemore, R., Chase, S. K., & Mandle, C. L. (2001). Validity in qualitative research. *Qualitative Health Research*, *11*(4), 522–537. http://doi.org/10.1177/104973201129119299

Williams, R., & Edge, D. (1996). The social shaping of technology. *Research Policy*, *25*, 865–899. http://doi.org/10.1016/0048-7333(96)00885-2

Woodruff, S. J., Hanning, R. M., Lambraki, I., Storey, K. E., & McCargar, L. (2008). Healthy Eating Index-C is compromised among adolescents with body weight concerns, weight loss dieting, and meal skipping. *Body Image*, *5*(4), 404–408. http://doi.org/10.1016/j.bodyim.2008.04.006

Yaemsiri, S., Slining, M. M., & Agarwal, S. K. (2011). Perceived weight status, overweight diagnosis, and weight control among US adults: the NHANES 2003–2008 Study. *International Journal of Obesity*, *35*(8), 1063–1070. http://doi.org/10.1038/ijo.2010.229

Appendix A: Example Screenshot from MyFitnessPal



This screenshot of MyFitnessPal's website[16] was captured on May 19, 2017.

I received permission to use MyFitnessPal screenshots from MyFitnessPal.

16 https://www.myfitnesspal.com/

Appendix B: Recruitment Flyer

Appendix C: Classroom Recruitment

RESEARCH PARTICIPANTS NEEDED

-Do you use weight loss apps?
-Have you ever had an eating disorder?
-Are you an 18-25 year-old woman?

Contact:
eveikey@psu.edu
949-438-1337

Compensation: $25

Purpose: To understand how women with eating disorders use weight loss apps

Goal: To develop better apps and address users' needs

Procedure: 20 min app exercise & 30 min interview

Qualifications: female, 18-25 years old, has/had anorexia or bulimia nervosa, & uses a weight loss app (e.g., Fitbit, MyFitnessPal, etc.)

If you want to participate or have questions, please email, text, or call Elizabeth, Ph.D. Candidate

Appendix D: Consent Form (April 20, 2016)

CONSENT FOR RESEARCH
The Pennsylvania State University

Title of Project: *Use and Perceptions of Weight Loss Apps by Women with Eating Disorders*
Principal Investigator: *Elizabeth Eikey*
Address: *exe145@psu.edu*
Telephone Number: *(949) 438-1337*
Advisor: *Dr. Lynette Yarger*
Advisor Telephone Number: *(814) 865-6458*
Subject's Printed Name: _____

We are asking you to be in a research study. This form gives you information about the research.
Whether or not you take part is up to you. You can choose not to take part. You can agree to take part and later change your mind. Your decision will not be held against you.
Please ask questions about anything that is unclear to you and take your time to make your choice.

1. **Why is this research study being done?**
   We are asking you to be in this research because you have been identified as someone who can help us better understand how and why *users* use weight loss apps, such as Fitbit, MyFitnessPal, LoseIt, etc. This research is being done to better understand how the needs of users with eating disorders, specifically women with a history of anorexia and/or bulimia nervosa. This includes understanding how and why weight loss apps are used. Approximately 20 people will take part in this research study.

2. **What will happen in this research study?**
   This study will consist of three parts: 1. A short survey, 2. An app think-aloud, and 3. An Interview. First, we will explain the study, provide you with your rights as a research participant, and ask for your consent. If you agree to take part in the research, you will be asked to sign this form.

   For part 1, we will ask you to complete a short survey about your age, ethnicity/race, and eating disorder history.

   For part 2, we will ask you to share your app with me. We will begin with what is called a think-aloud exercise, where you will do certain tasks on your weight loss app and speak out loud your thoughts about doing them. Think-alouds help us to understand not only how you use your app but also your thoughts about it. We will ask you how you do certain tasks and how you use certain features. During this, we would like to video record your app. We will not video record your face; we are only interested in being able to connect what you say to what you're doing on your app.

After the think-aloud, we will begin the interview. We will audio record your interview. During the interview, we will ask you additional questions about eating disorders, weight loss apps, and recovery apps. This will help us understand the benefits and drawbacks of weight loss apps and how we can design better apps to meet your needs and the needs of users like you.

3. What are the risks and possible discomforts from being in this research study?

There is a risk of loss of confidentiality if your information or your identity is obtained by someone other than the investigators, but precautions will be taken to prevent this from happening. The confidentiality of your electronic data created by you or by the researchers will be maintained to the degree permitted by the technology used. Absolute confidentiality cannot be guaranteed.

Additionally, there are minimal psychological risks as we will be discussing eating disorders. This may make you feel uncomfortable or experience negative feelings associated with your eating disorder.

Here is a list of resources for eating disorders:
At Penn State:
-The Center for Counseling and Psychological Services (CAPS); 814-863-0395
-The Nutrition Clinic; 814-863-0461
-https://studentaffairs.psu.edu/counseling/self-help_eating.shtml

Other:
-Nation Eating Disorder Association toll-free, confidential hotline; 1-800-931-2237
-http://www.nationaleatingdisorders.org/find-help-support

4. What are the possible benefits from being in this research study?

4a. What are the possible benefits to you?

One possible benefit from this study is having the ability to discuss your feelings and perceptions related to eating disorders. This experience can be viewed as an additional outlet to express emotions and ideas about your eating behaviors, app use, etc.

4b. What are the possible benefits to others?

Findings from this study can help us better understand the needs of people with eating disorders. By understanding your perceptions, we may be able to better address the needs of users like yourself. This study's results can also help us develop better weight loss apps, better eating disorder recovery apps, and highlight potential areas of discussion for healthcare providers and patients related to eating disorder diagnosis and treatment.

5. What other options are available instead of being in this research study?

You may decide not to participate in this research.

6. How long will you take part in this research study?

If you agree to take part, it will take you about 60 minutes to complete this research study.

7. How will your privacy and confidentiality be protected if you decide to take part in this research study?

Efforts will be made to limit the use and sharing of your personal research information to people who have a need to review this information.

- Your research records will be labeled with a code number and will be kept on a password-protected computer in a locked room.

In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

We will do our best to keep your participation in this research study confidential to the extent permitted by law. However, it is possible that other people may find out about your participation in this research study. For example, the following people/groups may check and copy records about this research.

- The Office for Human Research Protections in the U. S. Department of Health and Human Services
- The Institutional Review Board (a committee that reviews and approves research studies) and
- The Office for Research Protections.

Some of these records could contain information that personally identifies you. Reasonable efforts will be made to keep the personal information in your research record private. However, absolute confidentiality cannot be guaranteed.

8. Will you be paid or receive credit to take part in this research study?

You will receive $25 cash for your participation.

9. What are your rights if you take part in this research study?

Taking part in this research study is voluntary.

- You do not have to be in this research.
- If you choose to be in this research, you have the right to stop at any time.
- If you decide not to be in this research or if you decide to stop at a later date, there will be no penalty or loss of benefits to which you are entitled.

10. If you have questions or concerns about this research study, whom should you call?

Please call the head of the research study (principal investigator), *Elizabeth Eikey* at *(949) 438-1337* if you:

- Have questions, complaints or concerns about the research.
- Believe you may have been harmed by being in the research study.

You may also contact the Office for Research Protections at (814) 865-1775, ORProtections@psu.edu: if you:

- Have questions regarding your rights as a person in a research study.
- Have concerns or general questions about the research.
- You may also call this number if you cannot reach the research team or wish to offer input or to talk to someone else about any concerns related to the research.

INFORMED CONSENT TO TAKE PART IN RESEARCH

Signature of Person Obtaining Informed Consent

Your signature below means that you have explained the research to the subject or subject representative and have answered any questions he/she has about the research.

_____	_____	_____
Signature of person who explained this research	Date	Printed Name

(Only approved investigators for this research may explain the research and obtain informed consent.)

Signature of Person Giving Informed Consent

Before making the decision about being in this research you should have:

- Discussed this research study with an investigator,
- Read the information in this form, and
- Had the opportunity to ask any questions you may have.

Your signature below means that you have received this information, have asked the questions you currently have about the research and those questions have been answered. You will receive a copy of the signed and dated form to keep for future reference.

Signature of Subject

By signing this consent form, you indicate that you voluntarily choose to be in this research and agree to allow your information to be used and shared as described above.

_____	_____	_____
Signature of Subject	Date	Printed Name

Can we contact you to follow up at a later time? Please check the box that corresponds with your response.

- ❑ **Yes**
- ❑ **No**

Optional part(s) of the study

In addition to the main part of the research study, there is another part of the research. You can be in the main part of the research without agreeing to be in this optional part.

Optional Storage of Video Recordings for Future Research

In the main part of this study, we are collecting video recordings that may contain identifiable information from you. If you agree, the researchers would like to maintain these video recordings for future research or to be used in publications or at presentations.

- Any future studies may be helpful in understanding how users utilize weight loss apps and how to design better mobile health apps.
- It is unlikely that any future studies will have a direct benefit to you.

Your video recordings will be labeled with a code number.

- These recordings will be stored on a password-protected computer in a locked room.
- The length of time they will be used is unknown.
- You will be free to change your mind at any time.
- You should contact principal investigator if you wish to withdraw your permission for your recordings to be used for future research or publicly. The recordings will then be destroyed and not used for future research studies or shown publicly.

You should initial below to indicate what you want regarding the storage your video recordings for future research studies.
a. Your identifiable video recordings may be stored and used for future research studies to learn about, how users use weight loss apps and how to design better health apps.
_____ Yes _____ No

b. Your identifiable video recordings may be shared publicly at presentations or in publications.
_____ Yes _____ No

Signature of Person Obtaining Informed Consent

Your signature below means that you have explained the optional part(s) to the research to the subject or subject representative and have answered any questions he/she has about the research.

_____	_____	_____
Signature of person who explained this research	Date	Printed Name

Signature of Person Giving Informed Consent
Signature of Subject

By signing below, you indicate that you have read the information written above and have indicated your choices for the optional part(s) of the research study.

_____	_____	_____
Signature of Subject	Date	Printed Name

Appendix E: Updated Consent Form (August 16, 2016)

CONSENT FOR RESEARCH
The Pennsylvania State University

Title of Project: *Use and Perceptions of Weight Loss Apps by Women with Eating Disorders*
Principal Investigator: *Elizabeth Eikey*
Address: *exe145@psu.edu*
Telephone Number: *(949) 438-1337*
Advisor: *Dr. Lynette Yarger*
Advisor Telephone Number: *(814) 865-6458*
Subject's Printed Name: _____

We are asking you to be in a research study. This form gives you information about the research. Whether or not you take part is up to you. You can choose not to take part. You can agree to take part and later change your mind. Your decision will not be held against you.
Please ask questions about anything that is unclear to you and take your time to make your choice.

1. Why is this research study being done?
We are asking you to be in this research because you have been identified as someone who can help us better understand how and why *users* use weight loss apps, such as Fitbit, MyFitnessPal, LoseIt, etc. This research is being done to better understand how the needs of users with eating disorders, specifically women with a history of anorexia and/or bulimia nervosa. This includes understanding how and why weight loss apps are used. Approximately 20 people will take part in this research study.

2. What will happen in this research study?
This study will consist of four parts: 1. A demographic survey, 2. A survey on eating and exercise behaviors and attitudes, 3. An app think-aloud, and 4. An Interview. First, we will explain the study, provide you with your rights as a research participant, and ask for your consent. If you agree to take part in the research, you will be asked to sign this form.

For part 1, I will ask you to complete a short survey about your age, ethnicity/race, and eating disorder history.

For part 2, I will ask you to fill out a survey about your eating and exercise behaviors and attitudes. This survey is meant to help us understand the current status of your eating and exercise behaviors as well as your perceptions about your weight and shape.

For part 3, we will ask you to share your app with me. We will begin with what is called a think-aloud exercise, where you will do certain tasks on your weight loss app and speak out loud your thoughts about doing them. Think-alouds help us to understand not only how you use your app but also your thoughts about it. We will ask you how you do certain tasks and how you use certain features. During this, we would like to video record your app. We will not video record your face; we are only interested in being able to connect what you say to what you're doing on your app.

After the think-aloud, we will begin the interview. We will audio record your interview. During the interview, we will ask you additional questions about eating disorders, weight loss apps, and recovery apps. This will help us understand the benefits and drawbacks of weight loss apps and how we can design better apps to meet your needs and the needs of users like you.

3. What are the risks and possible discomforts from being in this research study?
There is a risk of loss of confidentiality if your information or your identity is obtained by someone other than the investigators, but precautions will be taken to prevent this from happening. The confidentiality of your electronic data created by you or by the researchers will be maintained to the degree permitted by the technology used. Absolute confidentiality cannot be guaranteed.

Additionally, there are minimal psychological risks as we will be discussing eating disorders. This may make you feel uncomfortable or experience negative feelings associated with your eating disorder.

Here is a list of resources for eating disorders:
At Penn State:
-The Center for Counseling and Psychological Services (CAPS); 814-863-0395
-The Nutrition Clinic; 814-863-0461
-https://studentaffairs.psu.edu/counseling/self-help_eating.shtml

Other:
-Nation Eating Disorder Association toll-free, confidential hotline; 1-800-931-2237
-http://www.nationaleatingdisorders.org/find-help-support

4. What are the possible benefits from being in this research study?
4a. What are the possible benefits to you?
One possible benefit from this study is having the ability to discuss your feelings and perceptions related to eating disorders. This experience can be viewed as an additional outlet to express emotions and ideas about your eating behaviors, app use, etc.

4b. What are the possible benefits to others?
Findings from this study can help us better understand the needs of people with eating disorders. By understanding your perceptions, we may be able to better address the needs of users like yourself. This study's results can also help us develop better weight loss apps, better eating disorder recovery apps, and highlight potential areas of discussion for healthcare providers and patients related to eating disorder diagnosis and treatment.

5. What other options are available instead of being in this research study?
You may decide not to participate in this research.

6. How long will you take part in this research study?
If you agree to take part, it will take you about 60 minutes to complete this research study.

7. How will your privacy and confidentiality be protected if you decide to take part in this research study?

Efforts will be made to limit the use and sharing of your personal research information to people who have a need to review this information.

- Your research records will be labeled with a code number and will be kept on a password-protected computer in a locked room.

In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

We will do our best to keep your participation in this research study confidential to the extent permitted by law. However, it is possible that other people may find out about your participation in this research study. For example, the following people/groups may check and copy records about this research.

- The Office for Human Research Protections in the U. S. Department of Health and Human Services
- The Institutional Review Board (a committee that reviews and approves research studies) and
- The Office for Research Protections.

Some of these records could contain information that personally identifies you. Reasonable efforts will be made to keep the personal information in your research record private. However, absolute confidentiality cannot be guaranteed.

8. Will you be paid or receive credit to take part in this research study?
You will receive $25 cash for your participation.

9. What are your rights if you take part in this research study?
Taking part in this research study is voluntary.

- You do not have to be in this research.
- If you choose to be in this research, you have the right to stop at any time.
- If you decide not to be in this research or if you decide to stop at a later date, there will be no penalty or loss of benefits to which you are entitled.

10. If you have questions or concerns about this research study, whom should you call?
Please call the head of the research study (principal investigator), *Elizabeth Eikey* at *(949) 438-1337* if you:

- Have questions, complaints or concerns about the research.
- Believe you may have been harmed by being in the research study.

You may also contact the Office for Research Protections at (814) 865-1775, ORProtections@psu.edu: if you:

- Have questions regarding your rights as a person in a research study.
- Have concerns or general questions about the research.
- You may also call this number if you cannot reach the research team or wish to offer input or to talk to someone else about any concerns related to the research.

INFORMED CONSENT TO TAKE PART IN RESEARCH

Signature of Person Obtaining Informed Consent

Your signature below means that you have explained the research to the subject or subject representative and have answered any questions he/she has about the research.

_____ _____ _____
Signature of person who explained this research Date Printed Name
(Only approved investigators for this research may explain the research and obtain informed consent.)

Signature of Person Giving Informed Consent

Before making the decision about being in this research you should have:

- Discussed this research study with an investigator,
- Read the information in this form, and
- Had the opportunity to ask any questions you may have.

Your signature below means that you have received this information, have asked the questions you currently have about the research and those questions have been answered. You will receive a copy of the signed and dated form to keep for future reference.

Signature of Subject

By signing this consent form, you indicate that you voluntarily choose to be in this research and agree to allow your information to be used and shared as described above.

_____ _____ _____
Signature of Subject Date Printed Name

Can we contact you to follow up at a later time? Please check the box that corresponds with your response.

- ❑ Yes
- ❑ No

Optional part(s) of the study

In addition to the main part of the research study, there is another part of the research. You can be in the main part of the research without agreeing to be in this optional part.

Optional Storage of Video Recordings for Future Research

In the main part of this study, we are collecting video recordings that may contain identifiable information from you. If you agree, the researchers would like to maintain these video recordings for future research or to be used in publications or at presentations.

- Any future studies may be helpful in understanding how users utilize weight loss apps and how to design better mobile health apps.
- It is unlikely that any future studies will have a direct benefit to you.

Your video recordings will be labeled with a code number.

- These recordings will be stored on a password-protected computer in a locked room.
- The length of time they will be used is unknown.
- You will be free to change your mind at any time.
- You should contact principal investigator if you wish to withdraw your permission for your recordings to be used for future research or publicly. The recordings will then be destroyed and not used for future research studies or shown publicly.

You should initial below to indicate what you want regarding the storage your video recordings for future research studies.
a. Your identifiable video recordings may be stored and used for future research studies to learn about, how users use weight loss apps and how to design better health apps.
_____ Yes _____ No

b. Your identifiable video recordings may be shared publicly at presentations or in publications.
_____ Yes _____ No

Signature of Person Obtaining Informed Consent

Your signature below means that you have explained the optional part(s) to the research to the subject or subject representative and have answered any questions he/she has about the research.

_____	_____	_____
Signature of person who explained this research	Date	Printed Name

Signature of Person Giving Informed Consent
Signature of Subject

By signing below, you indicate that you have read the information written above and have indicated your choices for the optional part(s) of the research study.

_____	_____	_____
Signature of Subject	Date	Printed Name

Appendix F: Consent Form Addendum (August 16, 2016)

ADDENDUM TO CONSENT FOR RESEARCH
The Pennsylvania State University

Title of Project: *Use and Perceptions of Weight Loss Apps by Women with Eating Disorders*
Principal Investigator: *Elizabeth Eikey*
Address: *exe145@psu.edu*
Telephone Number: *(949) 438-1337*

This consent form addendum gives you additional information about this research study, which will be discussed with you. If you have any questions, then please feel free to contact Elizabeth Eikey.

Since you signed the original consent form for this research study the following additional procedure has been added:

We added an online survey on eating and exercise behaviors and attitudes. This survey is meant to help us understand the current status of your eating and exercise behaviors as well as your perceptions about your weight and shape. It should take < 15 minutes to complete.

The other sections of the original consent form you signed are still applicable, including the potential benefits and risks. If you would like, the information in the original consent form may be reviewed with you.

Your continued participation in this research is voluntary. You may refuse to continue in the research study, now or any time in the future. If you decide to stop taking part in the research now or at a later date, there will be no penalty or loss of benefits to which you are entitled.

INFORMED CONSENT AND AUTHORIZATION TO CONTINUE TO TAKE PART IN RESEARCH
If you wish to participate, you will be emailed a link to the online survey. Your participation implies your voluntary consent to participate in the research. Please keep or print a copy of this form for your records.

Appendix G: Demographic Survey

T1 Participant ID Number (Entered by researcher)

T2 This short survey will ask you questions about your age, ethnicity/race, eating disorder, and app use. Please answer the questions honestly and to the best of your ability. If you have any questions, then please feel free to ask.

Q1 How old are you?
- ❍ 18 (1)
- ❍ 19 (2)
- ❍ 20 (3)
- ❍ 21 (4)
- ❍ 22 (5)
- ❍ 23 (6)
- ❍ 24 (7)
- ❍ 25 (8)

Q2 Which of the following best describes you?
- ❍ Asian, Asian American, or Pacific Islander (1)
- ❍ Black or African American (2)
- ❍ Native American or American Indian (3)
- ❍ White (Non-Hispanic) (4)
- ❍ Mexican or Mexican American (5)
- ❍ Puerto Rican (6)
- ❍ Other Hispanic or Latino (7)
- ❍ Multiracial (8)
- ❍ Other (9) _____
- ❍ Prefer not to answer (10)

Q3 Have you ever been diagnosed with an eating disorder by a professional? (It's ok if you have not been diagnosed by a professional.)
- ❍ Yes (1)
- ❍ No (2)

Q4 Do you currently have an eating disorder? (It can be undiagnosed or diagnosed.)
- ❍ Yes (1)
- ❍ No (2)
- ❍ Other (Please explain) (3) _____

Q4_1 What eating disorder(s) do you have? Select all that apply.
- ❑ Anorexia nervosa (1)
- ❑ Bulimia nervosa (2)
- ❑ Eating Disorder Not Otherwise Specified (EDNOS) or Other Specified Feeding or Eating Disorder (OSFED) (3)
- ❑ Other (Please explain) (4) _____

Q4_2 What eating disorder(s) did you have? Select all that apply.
- ❑ Anorexia nervosa (1)
- ❑ Bulimia nervosa (2)
- ❑ Eating Disorder Not Otherwise Specified (EDNOS) or Other Specified Feeding or Eating Disorder (OSFED) (3)
- ❑ Other (Please explain) (4) _____

Q4_EDNOS/OSFED Can you explain the behaviors associated with your EDNOS or OSFED (ex. bingeing)? This is just to give us a better understanding of your eating disorder.

Q4_3 How long have you had (or did you have) this eating disorder(s)?

Q5 Do you consider yourself....
- ❍ Currently in recovery from your eating disorder (1)
- ❍ Recovered from your eating disorder (2)
- ❍ Not recovered or not currently in recovery from your eating disorder (4)
- ❍ Other (Please explain) (3) _____

Q5_1 Would you like to be recovered or in recovery from your eating disorder?
- ❍ Yes (1)
- ❍ No (2)
- ❍ I'm not sure. (3)

Q6 What apps do you use for weight loss, fitness, and/or health?

Q7 Did your eating disorder begin before or after you started using weight loss apps?
- ❍ Before (1)
- ❍ After (2)
- ❍ I don't know. (3)

Q8 Is there anything else you would like to add?

T3 Thank you so much for filling out this survey! Now, we'll move on to the next survey. Please let the researcher know you are finished.

Appendix H: Eating and Exercise Behaviors and Attitudes Survey (EEBAS)

Q1.1 Please enter your User ID provided by the researcher:

Q1.2 By continuing the survey, you are providing your consent to participate in this added portion of this research. Added part - Survey on eating and exercise behaviors and attitudes: This survey will ask you about your eating and exercise behaviors and attitudes. This survey is meant to help us understand the current status of your eating and exercise behaviors as well as your perceptions about your weight and shape. This means that an addendum will be added to your original signed consent document and will serve as your consent document for this research. By clicking ">>", you agree to participate in the added part of this research.

Q2.1 This is a screening measure to help determine the status of your eating and exercise behaviors and attitudes. This is not designed to make a diagnosis of an eating disorder or take the place of professional consultation. Please answer the questions accurately, honestly, and completely as possible. There are no right or wrong answers. All of your responses are confidential.

Q2.2 What is your birthdate? Please include the month, day, and year. Please put it in mm/dd/yyyy format. (example 02/05/1994)

Q2.3 What is your height? Please put it as feet and inches (example: 5 feet 3.5 inches)

Q2.4 What is your current weight in pounds?

Q2.5 What was your highest weight in pounds? (excluding pregnancy if applicable)

Q2.6 What was your lowest adult weight in pounds?

Q2.7 (If you could be any weight,) what would your ideal weight in pounds be?

Q2.8 Over the past 3 to 4 months, have you missed any menstrual periods?
- ❍ Yes (1)
- ❍ No (2)

Q2.9 How many?

Q2.10 Are you taking the "pill"?
- ❍ Yes (1)
- ❍ No (2)

Q2.11 Mark a response for each of the following statements:

	Always (1)	Usually (2)	Often (3)	Sometimes (4)	Rarely (5)	Never (6)
Am terrified about being overweight. (1)	❍	❍	❍	❍	❍	❍
Avoid eating when I am hungry. (2)	❍	❍	❍	❍	❍	❍
Find myself preoccupied with food. (3)	❍	❍	❍	❍	❍	❍
Have gone on eating binges where I feel that I may not be able to stop. (4)	❍	❍	❍	❍	❍	❍
Cut my food into small pieces. (5)	❍	❍	❍	❍	❍	❍
Aware of the calorie content of foods that I eat. (6)	❍	❍	❍	❍	❍	❍
Particularly avoid food with high carbohydrate content (i.e., bread, rice, potatoes, etc.) (7)	❍	❍	❍	❍	❍	❍
Feel that others would prefer if I ate more. (8)	❍	❍	❍	❍	❍	❍
Vomit after I have eaten. (9)	❍	❍	❍	❍	❍	❍
Feel extremely guilty after eating. (10)	❍	❍	❍	❍	❍	❍
Am preoccupied with a desire to be thinner. (11)	❍	❍	❍	❍	❍	❍
Think about burning up calories when I exercise. (12)	❍	❍	❍	❍	❍	❍
Other people think that I am too thin. (13)	❍	❍	❍	❍	❍	❍
Am preoccupied with the thought of having fat on my body. (14)	❍	❍	❍	❍	❍	❍
Take longer than others to eat my meals. (15)	❍	❍	❍	❍	❍	❍
Avoid foods with sugar in them. (16)	❍	❍	❍	❍	❍	❍
Eat diet foods. (17)	❍	❍	❍	❍	❍	❍
Feel that food controls my life. (18)	❍	❍	❍	❍	❍	❍
Display self control around food. (19)	❍	❍	❍	❍	❍	❍
Feel that others pressure me to eat. (20)	❍	❍	❍	❍	❍	❍
Give too much time and thought to food. (21)	❍	❍	❍	❍	❍	❍
Feel uncomfortable after eating sweets. (22)	❍	❍	❍	❍	❍	❍
Engage in dieting behavior. (23)	❍	❍	❍	❍	❍	❍
Like my stomach to be empty. (24)	❍	❍	❍	❍	❍	❍
Have the impulse to vomit after meals. (25)	❍	❍	❍	❍	❍	❍
Enjoy trying new rich foods. (26)	❍	❍	❍	❍	❍	❍

Q2.12 In the past 6 months, have you:

	Never (1)	Once a month (2)	2-3 times a month (3)	Once a week (4)	2-6 times a week (5)	Once a day or more (6)
Gone on eating binges where you feel that you may not be able to stop? (Binges are defined as eating much more than most people would under the same circumstances and feeling that eating is out of control) (1)	❍	❍	❍	❍	❍	❍
Ever made yourself sick (vomited) to control your weight or shape? (2)	❍	❍	❍	❍	❍	❍
Ever used laxatives, diet pills, or diuretics (water pills) to control your weight or shape? (3)	❍	❍	❍	❍	❍	❍
Exercised more than 60 minutes a day to lose or to control your weight? (4)	❍	❍	❍	❍	❍	❍

Q2.13 In the past 6 months, have you lost 20 pounds or more in the past 6 months?

❍ Yes (1)

❍ No (2)

Q3.1 The following questions are concerned with the past four weeks (28 days) only. Please read each question carefully. Thank you.

Q3.2 Please mark the appropriate bubble. Remember that the questions only refer to the past four weeks (28 days) only. On how many of the past 28 days .....

	No days (1)	1-5 days (2)	6-12 days (3)	13-15 days (4)	16-22 days (5)	23-27 days (6)	Everyday (7)
Have you been deliberately trying to limit the amount of food you eat to influence your shape or weight (whether or not you have succeeded)? (1)	❍	❍	❍	❍	❍	❍	❍
Have you gone for long periods of time (8 waking hours or more) without eating anything at all in order to influence your shape or weight? (2)	❍	❍	❍	❍	❍	❍	❍
Have you tried to exclude from your diet any foods that you like in order to influence your shape or weight (whether or not you have succeeded)? (3)	❍	❍	❍	❍	❍	❍	❍
Have you tried to follow definite rules regarding your eating (for example, a calorie limit) in order to influence your shape or weight (whether or not you have succeeded)? (4)	❍	❍	❍	❍	❍	❍	❍
Have you had a definite desire to have an empty stomach with the aim of influencing your shape or weight? (5)	❍	❍	❍	❍	❍	❍	❍

Have you had a definite desire to have a totally flat stomach? (6)	❍	❍	❍	❍	❍	❍	❍
Has thinking about food, eating or calories made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)? (7)	❍	❍	❍	❍	❍	❍	❍
Has thinking about shape or weight made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)? (8)	❍	❍	❍	❍	❍	❍	❍
Have you had a definite fear of losing control over eating? (9)	❍	❍	❍	❍	❍	❍	❍
Have you had a definite fear that you might gain weight? (10)	❍	❍	❍	❍	❍	❍	❍
Have you felt fat? (11)	❍	❍	❍	❍	❍	❍	❍
Have you had a strong desire to lose weight? (12)	❍	❍	❍	❍	❍	❍	❍

Q3.3 Please fill in the appropriate number in the boxes on the right. Remember that the questions only refer to the past four weeks (28 days).Over the past four weeks (28 days) .....

	(1)
1. Over the past 28 days, how many TIMES have you eaten what other people would regard as an unusually large amount of food (given the circumstances)? (1)	
.....1a. On how many of these times did you have a sense of having lost control over your eating (at the time that you were eating)? (2)	
2. Over the past 28 days, on how many DAYS have such episodes of overeating occurred (i.e., you have eaten an unusually large amount of food and have had a sense of loss of control at the time)? (3)	
3. Over the past 28 days, how many TIMES have you made yourself sick (vomit) as a means of controlling your shape or weight? (4)	
4. Over the past 28 days, how many TIMES have you taken laxatives as a means of controlling your shape or weight? (5)	
5. Over the past 28 days, how many TIMES have you exercised in a “driven” or “compulsive” way as a means of controlling your weight, shape or amount of fat, or to burn off calories? (6)	

Q3.4 Please mark the appropriate number. Please note that for these questions the term “binge eating” means eating what others would regard as an unusually large amount of food for the circumstances, accompanied by a sense of having lost control over eating.

	No days (1)	1-5 days (2)	6-12 days (3)	13-15 days (4)	16-22 days (5)	23-27 days (6)	Everyday (7)
Over the past 28 days, on how many days have you eaten in secret? (Do not count episodes of binge eating.) (1)	❍	❍	❍	❍	❍	❍	❍

Q3.5

	None of the times (1)	A few of the times (2)	Less than half (3)	Half of the times (4)	More than half (5)	Most of the time (6)	Every time (7)
On what proportion of the times that you have eaten have you felt guilty (felt that you've done wrong) because of its effect on your shape or weight? (Do not count episodes of binge eating.) (1)	❍	❍	❍	❍	❍	❍	❍

Q3.6

	0-Not at all (1)	1 (2)	2-Slightly (3)	3 (4)	4-Moderatley (5)	5 (6)	6-Markedly (7)
Over the past 28 days, how concerned have you been about other people seeing you eat? (Do not count episodes of binge eating.) (1)	❍	❍	❍	❍	❍	❍	❍

Q3.7 Please mark the appropriate number on the right. Remember that the questions only refer to the past four weeks (28 days).Over the past 28 days .....

	0-Not at all (1)	1 (2)	2-Slightly (3)	3 (4)	4-Moderately (5)	5 (6)	6-Markedly (7)
Has your weight influenced how you think about (judge) yourself as a person? (1)	❍	❍	❍	❍	❍	❍	❍
Has your shape influenced how you think about (judge) yourself as a person? (2)	❍	❍	❍	❍	❍	❍	❍
How much would it have upset you if you had been asked to weigh yourself once a week (no more, or less, often) for the next four weeks? (3)	❍	❍	❍	❍	❍	❍	❍
How dissatisfied have you been with your weight? (4)	❍	❍	❍	❍	❍	❍	❍
How dissatisfied have you been with your shape? (5)	❍	❍	❍	❍	❍	❍	❍
How uncomfortable have you felt seeing your body (for example, seeing your shape in the mirror, in a shop window reflection, while undressing or taking a bath or shower)? (6)	❍	❍	❍	❍	❍	❍	❍
How uncomfortable have you felt about others seeing your shape or figure (for example, in communal changing rooms, when swimming, or wearing tight clothes)? (7)	❍	❍	❍	❍	❍	❍	❍

Q4.1 Please mark which best describes how your eating habits, exercising, or feelings about your eating, shape, or weight have affected your life over the past four weeks (28 days). Thank you.

Q4.2 Over the past 28 days, to what extent have your ...eating habits...exercising...or feelings about your eating, shape, or weight...

	Not at all (1)	A little (2)	Quite a bit (3)	A lot (4)
... made it difficult to concentrate? (1)	❍	❍	❍	❍
... made you feel critical of yourself? (2)	❍	❍	❍	❍
... stopped you going out with others? (3)	❍	❍	❍	❍
... affected your work or school performance? (4)	❍	❍	❍	❍
... made you forgetful? (5)	❍	❍	❍	❍
... affected your ability to make everyday decisions? (6)	❍	❍	❍	❍
... interfered with meals with family or friends? (7)	❍	❍	❍	❍
... made you upset? (8)	❍	❍	❍	❍
... made you feel ashamed of yourself? (9)	❍	❍	❍	❍
... made it difficult to eat out with others? (10)	❍	❍	❍	❍
... made you feel guilty? (11)	❍	❍	❍	❍
... interfered with you doing things you used to enjoy? (12)	❍	❍	❍	❍
... made you absent-minded? (13)	❍	❍	❍	❍
... made you feel a failure? (14)	❍	❍	❍	❍
... interfered with your relationships with others? (15)	❍	❍	❍	❍
... made you worry? (16)	❍	❍	❍	❍

Q5.1 You have completed the survey. Thank you! Your responses will help us understand your eating and exercise behaviors and attitudes. Please click ">>" to record your responses.

Q5.2 Would you like a copy of your responses and more information on the measures used? If you select yes, the researcher will email you.

❍ Yes (1)
❍ No (2)

Appendix I: Think-Aloud Exercise and Semi-Structured Interview Protocol

Introduction

Hello [participant's name], it's nice to meet you and thank you for taking the time to talk with me. Just to give you a brief background, I'm Lizz and I'm currently a Ph.D. candidate at Penn State in the College of IST, and the study that we are conducting is interested in *better understanding how weight loss apps are used and understood in relation to eating behaviors.*

(REVIEW CONSENT DOCUMENT; HAVE PARTICIPANT SIGN CONSENT DOCUMENT)

Here's how I got involved, here's why I'm interested…

To begin with, I'd like to just start with some background questions...

- Tell me a little bit about yourself…
- Major?
- Year?

Part 1 – Weight Loss App Think-Aloud

Weight Loss App Use

- Can you show me what app you use?
- Why did you choose this app?
- Can you show me how you set goals?
    - What goals do you have set? Why?
    - How do these goals affect your eating disorder?
    - How often do you change your goals?
- Can you show me visualizations that show your progress?
    - How do you use this information?
    - What do you like about these?
    - What do you dislike about these?
    - How do these visualizations affect your eating disorder?
- Can you show me community features or social interactions on the app?
    - How do you use these?
    - Do you use forums or messages?
        - What do you talk about with others?
        - Do they know you have an eating disorder?
        - Do you talk to others with eating disorders?
            - Why not?
            - If yes, how does that impact you and your eating disorder? (helpful/harmful?)
    - Why do you use these social features?
        - How does it help you?
        - How does it harm you?
    - How do these social features affect your eating disorder?
- Can you walk me through what a day is like for you explaining how and when you would use your weight loss app?
- Can you show me where you log food… How often do you log food and calories?

    - How has this affected you/your eating disorder?
- Can you show me where you log exercise… How often do you log exercise?
    - How has this affected you/your eating disorder?
- Can you show me where you log weight… How often do you log your weight?
    - How has this affected you/your eating disorder?
- Do you track anything else within the app?
- Do you always accurately input your food and exercise calories?
    - Why, why not?
- Do you ever exceed your calorie limit for the day?
    - Why, why not?
    - How do you feel?
    - What do you do?
- Do you ever eat under your calorie limit for the day?
    - Why, why not?
    - How do you feel?
    - What do you do?
- Can you show me something on the app you're proud of?
- Can you show me something on the app you're embarrassed by?
- Can you show me aspects/features of the app are helpful to you and your eating disorder?
    - How are they helpful?
    - Features/aspects that reduce eating disorder behaviors?
- Can you show me aspects/features of the app are not helpful to you and your eating disorder?
    - Why/how?
    - Features/aspects that worsen eating disorder behaviors?
- Can you show me aspects of this weight loss app you like?
    - Why/how?
- Can you show me aspects of this weight loss app you would change?
    - Why/how?

Part 2 - Interview Script

Eating Behaviors

- Can you explain to me what you think eating disorders are? There are no right or wrong answers.
- Have you ever been diagnosed with an eating disorder?
    - If yes,
        - What eating disorder?
        - When were you diagnosed?
        - Is this something you are currently dealing with?
            - Are you trying to recover from your eating disorder?
    - If not,
        - When did you begin to think you may have an eating disorder?
        - What made you think this?
        - What eating disorder do you think you have/had?
        - Is this something you are currently dealing with?

        - Are you trying to recover from your eating disorder?
- Are you currently in treatment?
    - If yes, can you explain how you are seeking treatment?
    - Did they ask you about weight loss apps?
        - If so, what did they talk about?
        - If not, why do you think they didn't ask you about it?
            - Did you talk to them about your weight loss app use?
                - If yes, what did you talk about?
                - If yes, what did they say about your using it?
            - If no, why didn't you bring it up?
    - Are there reasons preventing you from seeking treatment?

Mobile Weight Loss App Use

- How long have you used weight loss apps?
- Did you begin using weight loss apps before or after you found out about your eating disorder?
- What made you start using weight loss apps?
- In general, why do you use weight loss apps?
- Why did you seek out/choose this app?
    - What were your goals/objectives?
- Did you use other methods to track your behaviors before you used this app?
- What do weight loss apps provide that other types of technology or other types of apps cannot / what aspects of weight loss apps appeal to you that other types of apps or technology cannot?
    - Why did you use this app vs. other methods to track or other types of technologies?
- How have your behaviors changed since starting to use the app?
    - Do you think this is a positive or negative thing?
        - Why/why not?
        - How?
- Has your app use changed over time?
    - How has your app use changed over time?
    - Beginning, midst of eating disorder, end, now, etc….
- Have you ever set goals that you felt were unhealthy for you?
    - What types of goals?
    - How were they unhealthy?
    - Why did you set them?
- How are the goals you set in the app related to your recovery / not related to your recovery – or help you maintain your eating disorder?
- How has the app affected your eating disorder?
    - If applicable, how has the app affected your recovery?
    - How has the app affected your eating behaviors?
    - How has the app affected your exercise behaviors?
- Were there any instances where you felt the app positively affected you or your behaviors or your eating disorder?
    - Can you elaborate/how?

    - In what ways has the app helped you with your eating disorder?
- Have these weight loss apps helped reduce behaviors associated with your eating disorder or helped you during your eating disorder recovery?
        - If no, why do you think this is?
            - Do you think this is an issue? Why/why not?
        - If yes, are there specific features you find particularly helpful?
            - How are they helpful?
- Were there any instances where you felt the app negatively affected you or your behaviors or your eating disorder?
    - Can you elaborate/how?
    - In what ways has the app been harmful to you and your eating disorder?
- Have these weight loss apps hindered your recovery or worsened your eating disorder behaviors?
    - If no, why do you think this is?
    - If yes, are there specific features that…?
        - How did they…?
        - Do you think this is an issue? Why/why not?
- Can you describe a time when you felt particularly happy or accomplished when using your app?
- Can you describe a time when you felt negative emotions (such as being upset, sad, angry, or disappointed) when using your app?
- Can other users view your food and exercise log?
    - Why, why not?
    - Would you want to share your food and exercise data with others?
        - Who?
        - Why, why not?
- Can other users view your weight?
    - Why, why not?
    - Would you want to share your weight data with others?
        - Who?
        - Why, why not?
- Do you think your calorie budget is healthy for you?
    - Why, why not?
- Do you think your exercise regimen is healthy for you?
    - Why, why not?
- Do you think using this app is healthy for you?
    - Why? How?
    - Why not? Are there particular reasons you continue to use this app if you feel it's not the best for you?
- Would you encourage others who have (eating disorder) to use this app?
    - Why?
    - Why not?
- How could this app be changed to better suit your needs?
- How could this app be more helpful for eating disorder recovery?

Other Technology/Friends

- Do you use other types of technology to get information about eating disorders?
    - What types?
        - Social media? (Tumblr, Instagram, Twitter, blogs, Facebook, etc.)
        - Do you follow any particular hashtags or people?
    - Why do you use these?
    - How do you use these?
    - If no, why not?
- Do you use other types of technology to discuss eating disorders with other people?
    - What types?
    - Why do you use these?
    - How do you use these?
    - If not, why not?
    - How does interacting with other people affect you and your eating disorder?
- Do your friends or family use weight loss apps?
    - Do you use the same app?
    - How does your use compare to theirs?
    - Are you friends with them on the app if it's an option?
        - Why?
        - Why not?
    - Do you talk to them in the forums if the app has forums associated with it?
    - How does having friends or family that use the same app affect you and your eating disorder?

Eating Disorder Recovery Apps

- What do you know about eating disorder recovery apps?
- Have you ever used eating disorder recovery apps?
    - If not, why?
    - If so…
        - What types?
        - How have you used these?
        - How did you find out about these apps?
            - Did any experts ever recommend or discuss these apps with you?
        - What did you like about those apps?
        - What would you change about those apps?

Closing

- What else would you like to talk about?
- Do you have any questions for me?
- Thank you!

Appendix J: Non-Disclosure Agreement

IRB PROTOCOL #STUDY00004634

Confidentiality Agreement
Transcription and/or Translation Services

I, Rajiv Poddar, transcriptionist and/or translator, individually and on behalf of Scribie/CGBiz Corporation, do hereby agree to maintain full confidentiality in regards to any and all audiotapes, videotapes, electronic files, and oral or written documentation received from Elizabeth Eikey related to her research study titled Use and Perceptions of Weight Loss Apps by Women with Eating Disorders. Furthermore, I agree:

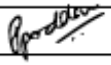
1. To hold in strictest confidence the identification of any individual that may be inadvertently revealed during the transcription of audio-taped or live oral interviews, or in any associated documents or files;
2. To not disclose any information received for profit, gain, or otherwise;
3. To not make copies of any audiotapes, videotapes, or computerized files of the transcribed interview texts, unless specifically requested to do so by Elizabeth Eikey;
4. To store all study-related audiotapes, videotapes, and materials in a safe, secure location as long as they are in my possession;
5. To return all audiotapes, videotapes, and study-related documents to Elizabeth Eikey in a complete and timely manner;
6. To delete all electronic files containing study-related documents from my computer hard drive and any backup devices.

Please provide the following contact information for the researcher and the transcriber and/or translator:

For Transcriber/Translator:	For Researcher:
Address: 41829 Albrae St, #109	The Pennsylvania State University
Fremont, CA 94538	323 IST Building University Park, PA 16802
Telephone: (866) 941 4131	Telephone: (949) 438-1337

I am aware that I can be held legally liable for any breach of this confidentiality agreement, and for any harm incurred by individuals if I disclose identifiable information contained in the audiotapes, videotapes, electronic files, and/or paper files to which I will have access. I am further aware that if any breach of confidentiality occurs, I will be fully subject to the laws of the State of Pennsylvania.

Transcriber/ Translator's Name Rajiv Poddar

Transcriber/Translator's Signature 

Transcriber/Translator's Name of Business and Title President & CEO

Date 07/09/2016

Appendix K: Summary of Usage Types

Major Theme	Subtheme	Definition
Extreme Use		
	Overuse	Using or checking the app too frequently, logging consistently (especially over long periods of time), and tracking food too precisely
	Restriction	Limiting one's calories and/or food groups; low calorie intake
	Compensatory Behaviors	Compensating for food intake through purging (most often through excess exercise but sometimes vomiting) or further calorie and food restriction
	Tracking in Advance	Logging foods before eating them; using log as a schedule; tracking then acting
	Logging Avoidance	Avoiding logging when users think they exceeded calorie budget; a way to manage negative emotions from exceeding budget
	App Manipulation	Finding ways to "trick" the app to provide a lower calorie goal or net fewer calories
Recovery Use		
	Increased Consumption	Logging additional calories and foods and focusing more on nutrition than strict calories
	Altered Weight Goals	Changing weight goals; weight gain goals or less extreme weight loss goals
	Different Logging Approach	Changing approach to and perceptions of logging; logging after eating; acting then tracking
	Awareness Tool	Using app to determine how little or how much one is eating and exercising; a way to balance intake and expenditure
Non-Use		Ceasing app use either temporarily or permanently due to focusing on eating disorder recovery or improving health or behaviors

Appendix L: Summary of Unintended Consequences

Unintended Consequence	Theme	Definition
Negative		
	Fixation on Numbers	Developing a fixation on numbers; acute awareness of calories, changed relationship with food, need for exactness
	Rigid diet	Developing a strict and rigid diet; eating same foods everyday; developing safe foods
	Obsession	Becoming obsessed with logging and developing obsessive thoughts around food; being "addicted" to the app
	App Dependency	Feeling that one needs app; developing anxiety when not using app; feeling safe and in control with app; not wanting to cease use
	High Sense of Achievement	Feeling extremely rewarded for eating under calorie and nutrient budget, compensating for food intake, and losing weight
	Extreme Negative Emotions	Feeling extreme negative emotions, such as guilt, embarrassment, and shame, especially when exceeding calorie budget
	Motivation from Negative Messages	Feeling motivated by warning messages and feedback that states low weight
	Excess Competition	Making calorie consumption/expenditure and weight loss a game; trying to beat app or self by netting fewer calories each day and/or being under budget
Positive		
	Appropriate Consumption	Aspects of app lead to users getting appropriate food intake; app acts as awareness tool, which leads to eating enough, balanced food intake and exercise, and reduced bingeing

Vita: Elizabeth Victoria Eikey

EDUCATION

August 2017 **Doctor of Philosophy in Information Sciences and Technology (IST)**
The Pennsylvania State University (August 2012-August 2017)
University Park, PA

December 2010 **Bachelor of Science in Psychology**
The Pennsylvania State University (August 2008-December 2010)
University Park, PA

EXPERIENCE

The Pennsylvania State University

2014-2017	*National Science Foundation (NSF) Graduate Research Fellow*
2016 Fall	*Teaching Fellow*, IST 301: Information and Organizations (48 students)
2012-2016	*Research Assistant*, Health Information Technologies Lab
2012 Fall	*Teaching Assistant*, IST 110: Information, People and Technology
2009-2010	*Undergraduate Research Assistant*, Relationships & Stress Research Lab
2008-2009	*Undergraduate Research Assistant*, Social Psychology & Neuroscience Lab

PUBLICATIONS & PRESENTATIONS

Peer-Reviewed Journal Publications: 3
Archived Conference Publications: 4
Conference Posters: 4
Doctoral Consortia and Workshop Papers: 5
Book Chapters: 2
Invited Research Talks: 8

SELECTED PUBLICATIONS

Eikey, E.V. & Reddy, M.C. 2017. "It's Definitely Been a Journey": A Qualitative Study on How Women with Eating Disorders Use Weight Loss Apps. Proceedings of the *ACM CHI Conference on Human Factors in Computing Systems (CHI '17)*. Denver, CO, p. 642-654. DOI: 10.1145/3025453.3025591. (Acceptance rate: 25%)

Eikey, E.V. & Booth, K. 2017. Recovery and Maintenance: How Women with Eating Disorders Use Instagram. *iConference 2017*. Wuhan, China. (Acceptance rate: 34.8%)

Eikey, E.V., Poole, E.S., & Reddy, M. 2015. Information Presentation in Health Apps and Devices: The Effect of Color, Distance to Goal, Weight Perception, and Interest on Users' Self-Efficacy for Accomplishing Goals. *iConference 2015*. Newport Beach, CA. (Acceptance rate: 36%)

Eikey, E.V., Murphy, A., Reddy, M., & Xu, H. 2015. Designing for Privacy Management in Hospitals: Understanding the Gap between User Activities and IT Staff's Understandings. International Journal of Medical Informatics. *International Journal of Medical Informatics (IJMI)*.

Eikey, E.V., Reddy, M., & Kuziemsky, C. 2015. Examining the Role of Collaboration in Studies of Health Information Technologies in Biomedical Informatics: A Systematic Review of 25 Years of Research. *Journal of Biomedical Informatics (JBI),* 57. p. 263-277. DOI:10.1016/j.jbi.2015.08.006.

Li, V., McDonald, D. W., **Eikey, E.V**., Sweeney, J., Escajeda, J., Dubey, G., Riley, K., Poole, E. S. and Hekler, E. 2014. Losing it Online: Characterizing Participation in and Online Weight Loss Community. Proceedings of the *ACM 2014 International Conference on Supporting Group Work (GROUP '14)*. (Acceptance rate: 30%)

Hekler, E.B., Dubey, G., McDonald, D., Poole, E., Li, V., **Eikey, E**. 2014. Exploring the relationship between changes in weight and utterances in an online weight loss forum. *Journal of Medical Internet Research (JMIR).*