

**Exploring technology as a tool to support healthy eating  
and food access**

by

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Exploring technology as a tool to support healthy eating and food access

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Food plays an important role in people's health and well being. Eating a healthy diet can improve overall health and reduce the likelihood of developing chronic illness. Although technology has shown promise in supporting healthy eating, more recent research has revealed that sociotechnical interventions may only have small, short-term effects on behavior. There are certainly many factors that influence people's eating behaviors including educational level, knowledge of cooking, self-efficacy, one's upbringing, and personal values. Sociotechnical interventions have primarily focused on psychosocial factors (e.g., self-efficacy, knowledge, values), overlooking environmental influences – those external to an individual that create the context in which behaviors take place. These environmental factors, such as the availability of healthy food and the prevalence of healthy and unhealthy food outlets, have a major influence on eating behavior, however few studies have considered the role that technology might play in addressing them.

This dissertation works at the intersection of technology and health behavior theory to understand how we can create effective healthy eating interventions and support people in engaging with their environment in a way that facilitates healthy eating. We built an Android application, Snack Buddy, to serve as a probe to explore the factors that affect people's eating behaviors. In doing so, we found that the environment was the most salient factor, leading us to further explore the role technology can play in helping people create healthier food environments for themselves. We discovered technology could support people in environmental restructuring – the practice of creating an environment supportive of healthy eating – and in navigating the constraints in their lives that prevent them from accessing healthy food. This last issue was especially important for people with low socioeconomic status and people who experience food insecurity. For these people, technology presents an opportunity to facilitate greater participation in how food environments are

architected and created, while at the same time expanding their own capacity to access healthy food. This dissertation finds that technology can expand their capacity by helping them exercise greater control in their lives and expand their social support network with people who face similar challenges.



## **Dedication**

To my parents who shaped me into the person I am today. Without their love, support, and guidance I would be lost. They believed in me even when I couldn't believe in myself.

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## Chapter 1

### Introduction

The prevalence of lifestyle-related illness, such as obesity, diabetes, and cardiovascular disease, has continued to rise in the United States over the past several decades. Unhealthy eating – characterized as a diet high in calories, saturated fats, and sugars and low in fruits, vegetables, and fiber – contributes to these negative health conditions [13, 91, 81] and can lead to a lower quality of life [78, 134]. Technology has shown great promise in promoting healthy eating and in supporting people in adopting healthier behaviors [131, 14]. Technologies designed using theories of human behavior have gained special attention because many researchers hope using theory will increase their effectiveness [106].

Lifestyle-related chronic diseases remain prevalent and in many cases, have continued to increase in prevalence [161], even in the face of the significant potential of technology and its increased adoption as a tool to support healthy behaviors [146]. In fact, a recent randomized controlled trial evaluating a technology-based intervention for weight loss – one of the first studies to look beyond 6-months to a year – found that intervention effects were small and short-lived [205]. Technology-based interventions are not alone, as most interventions targeting health behaviors have weak and short-term effects [135]. Sallis and Glanz propose that this is due to a focus on using individually-oriented theories that emphasize psychosocial determinants of health behaviors in the design of interventions [191]. It is true that most sociotechnical interventions to support healthy eating focus on these psychosocial factors and individual-oriented models of behavior (see Section 2.2). They suggest, instead, turning to ecological models and frameworks, which emphasize

the role of the environment – the external context in which health behaviors occur (e.g., the physical presence of stores and other food outlets, financial resources, cultural conditions). They argue that engaging with environmental factors may lead to the creation of more effective interventions.

Given this, sociotechnical interventions that engage with environmental factors could hold considerable potential to support healthy eating. However, there is no clear path to how technology could play a role in addressing these factors that, for the most part, appear outside the influence of individuals and, certainly, outside the reach of technology.

This dissertation works at the intersection of technology and health behavior theory towards the goal of supporting healthy eating. In doing so, it reveals the importance of environmental factors in driving eating behaviors and highlights opportunities for technology to bridge the intervention gap between psychosocial and environmental factors. This research, specifically, explores the following guiding questions:

- (1) How can we use technology to support healthy eating in low socioeconomic status (SES) communities?
- (2) What role might technology play in addressing the environmental factors that impede healthy eating?
- (3) How can we use behavior theory to inform the design of sociotechnical interventions?
- (4) How might technology support food access for people experiencing food insecurity?

In order to investigate these questions, we built an Android application, Family Snack Buddy, that engaged families living in a low SES community towards healthy snacking. The application was built around the core functionality of self-monitoring and provided feedback on the healthiness of snacks users ate along with recommendations for healthier snacks they could try. It also allowed family members to directly engage with each other through gaming and social comparison. In the first study, we conducted a twelve week field-trial of the application with 10 families living in a low SES community, where each family had two members participate – an adult caregiver (e.g., parent)

and an older, teen child. This study aimed to understand how participants used the application and identify potential mechanisms of action through which it may have affected their behavior.

In the second study, we built upon the positive feedback we received during our field-trial of Family Snack Buddy. We iterated upon the the application using a theory-based approach that more tightly coupled the design of specific application features to constructs from the Integrated Behavioral Model [158]. This new version of the application, Individual Snack Buddy, no longer engaged families, but instead focused on individuals and targeted several psychosocial factors that affect eating behavior – self-efficacy, instrumental attitudes, and descriptive norms. The application served as a technology probe [112] to elicit factors that affect snacking behaviors and explore the role that environmental factors play in those behaviors.

While our findings from the first two studies suggested that environmental factors were especially important, participants in Study 1 had greater difficulty in overcoming those factors given their low SES context. This would pose a challenge to people who wanted to create healthier environments for themselves and as a challenge to researchers in developing sociotechnical interventions supporting people in doing so. Considering this conundrum became the impetus for our final guiding question and for Study 3. This study aimed to take a step back from intervention development, in favor of better understanding the experiences and specific challenges faced by people who had barriers to food access – barriers that would prevent them from overcoming environmental factors that affected their behaviors. We developed a community-based participatory research project, in collaboration with Boulder Food Rescue, to explore the experiences of people facing food insecurity – people who had barriers to food access. Together, we conducted a two-week multimedia elicitation interview (MEI) study where we engaged people facing food insecurity in co-creating knowledge around their experience. Participants recorded pictures and videos of their experiences getting food, the barriers they face in getting food, and the tools that they use to do so.

## 1.1 Contributions

This dissertation contributes to the development of theory and to applied research practices in HCI. In regards to theoretical contributions, we build upon current models of thinking about the ways that the environment affects eating behaviors. Specifically, we expand the conceptualization of the food environment and characterize different food environments and their influence in detail. In our work we describe specific ways that people interact with the food environment. These interactions primarily centered around the availability and accessibility of food and through the level of control people had over their environment.

We identify two types of contributions to applied research practice in HCI – those related to design practice and those which expand our understanding of the lived experiences of people as grounds for informing design. Our contributions to design practice include identifying ways to design that consider and may influence environmental factors, proposing a novel approach to theory-based design, and developing principles to support theory-based design.

In the field of HCI, we expand our understanding of potential design spaces for technology through deep exploration of the lived experiences of people. This research makes significant contributions in this area by exploring the factors that affect eating behavior and how people experience their food environment. It also expands our understanding of the experience of food insecurity and what it means to be food secure. Our results emphasize the importance of respect and access not only to a sufficient quantity of food, but also to healthy foods that are culturally-appropriate and fit their dietary restrictions. Our research also characterizes the current practices of technology use by those people to support their efforts to access food and in doing so, reveals opportunities for designing to support food access.

Finally, this work opens up several avenues of future research and is, in some sense, the starting point for several important lines of inquiry. First, we introduce and conceptualize “environmental restructuring” into the discourse around health behavior technologies. Environmental restructuring is the process by which people alter their environment to support healthier behav-

iors [155]. Technologies could be designed around supporting these practices and, in turn, play a role in addressing the environmental factors that drive eating behaviors. Environmental restructuring also serves as an alternative paradigm to choice architectures [207]. Instead of making choices for people, environment restructuring seeks to give people the tools to be the architects of their own environments.

Secondly, our research suggests that we can design technology with people who experience food insecurity to support them in realizing greater food access. As a starting point, we suggest researchers explore the design of systems that help people discover and navigate food resources within the community, stretch their money further, support communication among people experiencing food insecurity, and exercise greater control in their lives. I underlined the word “with” above to emphasize one more important consideration in moving forward with this research agenda – it must be participatory and include people experiencing food insecurity as partners in the research, design, and development of these systems.

## Chapter 2

### Related Works

This work has been influenced by several lines of inquiry that span HCI, psychology, and public health. The goal of using technology to support healthy eating builds on a significant body of research across all of these fields. The prior research suggests that there is significant potential, but also challenges working at the intersection of technology and behavior theory [106]. The importance of the environment in understanding eating behaviors and its relative absence in the design and development of interventions is especially noted. In the following sections, I explore a focused subset of the prior research relevant to this work including research into the environmental factors that influence healthy eating, the design and use of sociotechnical interventions to support healthy eating, the use of behavior theory to design sociotechnical interventions, and food access and food insecurity. Table 2.1 describes the key takeaways from this previous research, as it relates to this work, and serves as a guide for exploring the literature.

#### 2.1 Environmental influences on eating behavior

There has been a significant body of research exploring the ways that people interact with their environment and how those interactions affect their eating behaviors [121]. Defining “the environment” and environmental factors is a significant challenge because there are different facets to the environment, all interacting, that operate at different levels [17]. Research studies have conceptualized and defined the environment differently. For example, King, Glanz, and Patrick borrow from the Merriam-Webster Dictionary and define the environment as “the circumstances,

Topic	Key takeaways
Environmental influences on eating behavior	<ul style="list-style-type: none"> <li>• The environment, defined as the the external context in which behaviors take place, has a major influence on eating behaviors</li> <li>• People have a reciprocal relationship with their food environment</li> <li>• Limited research has been done exploring the specific ways that people influence their environment to support healthy eating</li> </ul>
Sociotechnical interventions to support healthy eating	<ul style="list-style-type: none"> <li>• Previous work suggests that technology holds significant potential to support healthy eating</li> <li>• Most interventions focus on the psychosocial factors that influence behavior and few studies have acknowledged or aimed to address the environmental factors that affect behavior</li> <li>• Few studies consider of the unique context of low SES communities in intervention design</li> </ul>
Theory use in the design of sociotechnical interventions	<ul style="list-style-type: none"> <li>• Behavior theories present an opportunity for researchers to create more effective interventions</li> <li>• The application of behavior theory in the design of interventions is often vague and underspecified</li> <li>• There is a need for methods to support theory-based design of sociotechnical interventions</li> </ul>
Food access and food insecurity	<ul style="list-style-type: none"> <li>• Food access refers to the ability to acquire food (e.g., going to the store to buy food, picking up food from a food pantry)</li> <li>• Food insecurity means not having certain or stable access to an adequate quantity of food of high nutritional quality in a safe, culturally-appropriate way [47]</li> <li>• Much of the research has focused on defining and quantifying food access and food insecurity as opposed to understanding the experiences and challenges faced with food insecurity</li> <li>• Very little research in HCI has looked at the issue of food insecurity and has focused on service organizations that serve people who experience food insecurity</li> </ul>

Table 2.1: Overview of the main topics covered in the related works and the key takeaways from each.



objects, or conditions by which one is surrounded ... as well as the aggregate of social and cultural conditions that influence the life of an individual or community” [129]. They go on to identify two primary levels of impact for the environment – 1) the “me” domain, which represents individual-level behaviors and the way that the surrounding environment influences them and 2) the “we” domain which considers the aggregate behaviors of groups and larger population segments and the localities that influence them. Alternatively, Kamphuis and colleagues adopt a definition originally provided by Gielen and colleagues: “Environmental factors are those social and physical factors external to the individual, often beyond his or her personal control, that can be modified to support the behavior or influence the health outcome” [86, 121]. In adopting this definition, they developed a framework that included four categories of environmental factors – 1) accessibility and availability (i.e., the physical and financial accessibility and products and shops), 2) social conditions including relationships and social support, 3) cultural conditions, and 4) material conditions (such of one’s financial situation or social deprivation) [121]. Throughout this research, when discussing broadly the environment or environmental factors, we are referring to the environment as defined by this framework described by Kamphuis and colleagues.

There is a significant bias in the literature towards studies looking at certain environmental factors. Specifically, there have been substantial research efforts exploring the effects of income and SES, the geographic distribution and the accessibility of food outlets – places where food can be bought (e.g., grocery stores and restaurants), and other aspects of the built environment (i.e., transportation access) [36]. For example, previous research has found that the prevalence of supermarkets in neighborhoods is associated with healthier eating and lower rates of obesity [160, 159]. These studies focus on characterizing and quantifying the food environment, but give less attention to how people interact with those environments. The implication of focusing on these aspects of the environment is that policy changes are often viewed as the primary method of intervention to create healthier environments [191].

There has been much less attention given to how specific facets of these environments affect people’s behaviors on a smaller scale – what Sallis and Glanz call microenvironments [191], such

as the home and the workplace. Wansink and Sobal go a level deeper in their consideration of the food environment to consider microscale food environments, which they define as “small-scale foodspaces such as kitchens and tables that make food available for consumption and provide settings within which food is perceived in terms of environmental affordances and then food is selected and consumed” [218]. These microscale food environments include the kitchen itself, the tables on which food is served or prepared, and the plates or storage containers that are used to hold food. This work by Wansink and colleagues, along with other research [216, 84, 217], has served to characterize these different microscale food environments and also systematically explored the way that specific facets of these microscale environments affect behavior. However, little has been done to explore practices or interventions aimed at changing these environments [33].

Environments do not affect people in a unidirectional way. People also make efforts to change and adapt their environment to their needs. Social Cognitive Theory describes this as a reciprocal relationship called reciprocal determinism [149]. Other theories and frameworks also document this concept of bidirectional influence between people and their environment [192]. At a macro-level, bodies of people create policies and develop businesses and organizations that change the environment [109, 181]. At a micro-level, individuals and small social groups go to the grocery store to buy food and maintain certain foods in their homes and offices [222, 33]. The influence that people exert over their environment is less studied than interactions in the other direction. There have been a number of studies that identify macro-level changes that have been made by groups of people, organizations, or policy-makers [73, 201]. However, there are very few that have looked at the way individuals influence their own food environments to support healthier eating [33]. In the terms of King and colleagues, most work has focused on the “we” domain and not the “me” domain [129].

## **2.2 Sociotechnical interventions to support healthy eating**

There has been a growing body of research in computing fields aimed at designing interventions to support healthy eating. Some of these interventions focus on obesity prevention and weight

loss, while others more broadly aim to support healthy eating practices. Although there have been some interventions aimed at web-based or desktop computing platforms [113], these interventions have become increasingly rare in favor of mobile interventions [131]. In fact, in HCI, researchers have almost exclusively targeted mobile and ubiquitous computing platforms (see Table 2.2).

It is worth considering that few of these interventions have been developed with low SES or marginalized communities. Although Table 2.2 provides a sampling of the sociotechnical interventions for healthy eating, it captures a trend that is observed across the literature – few interventions are designed to consider the unique challenges faced by people with low SES. Researchers who have worked with low SES and marginalized communities have similarly acknowledged this disparity in the research developing health technologies [175, 40].

In the following two sections, I discuss specific aspects of the previous research using technology-based interventions to promote healthy eating. First, I consider interventions that aim to support healthier eating through individual factors and social support. Following that, I discuss interventions targeted at community and environmental factors. In considering the prior research generated around these two approaches, I hope to draw attention to a disparity between them. Individual and social-focused interventions, which focus on psychosocial factors that affect eating behavior (e.g., personal awareness, social support from friends), are more prevalent than those targeting community-level or environmental factors (e.g., food access, finding healthy food to purchase). Given the importance of environmental factors, as described in the prior section, we identify a valuable opportunity for technology to more actively engage environmental and community factors in the effort to support healthy eating.

### **2.2.1 Individual and social-oriented interventions**

Most of the sociotechnical interventions developed to support healthy eating have focused on individuals or their close social connections. Typical approaches to changing eating behavior include raising users’ awareness of their own behaviors [185, 74], teaching them about how to eat healthy [172, 119], facilitating goal setting [83], enhancing their self-efficacy or locus of con-

<b>Intervention</b>	<b>Platform</b>	<b>Target population</b>	<b>Theoretical work</b>	<b>Concepts/determinants targeted</b>
Mobile lifestyle coach (Gasser, 2006) [83]	Mobile application	General population	None specified	Social facilitation, motivation
PmEB (Tsai, 2007) [210]	Mobile application	General population	None specified	Awareness
EatWell (Grimes, 2008) [96]	Voicemail system	Low SES	None specified	Community-level environmental factors
MAHI (Mamykina, 2008) [147]	Mobile application	Diabetics	Sensemaking	Knowledge, awareness, logical of control
Nutrition Monitor (Dorman, 2010) [69]	Mobile application	General population	None specified	Awareness
ORBIT (Gerber, 2009) [85]	Text messaging	African-American women	None specified	Knowledge, motivation
It's Time to Eat (Pollak, 2010) [180]	Mobile application	Children	Social Cognitive Theory	Self-efficacy, attitudes
Let's Play! (Grimes, 2010) [97]	Mobile application	Low SES	Transtheoretical Model	Knowledge, awareness
DIMA (Connelly, 2012) [51]	Mobile application	Low SES	Social Cognitive Theory	Awareness, self-efficacy, knowledge
Lunchtime (Orji, 2013) [172]	Mobile application	General population	Transtheoretical Model, Social Learning Theory, Goal Setting Theory, Reinforcement Theory	Knowledge, attitudes
Attentive eating (Robinson, 2013) [185]	Mobile application	General population	Behavior Change Wheel	Awareness
Sensing Fork (Kadomura, 2014) [119]	Ubiquitous sensing device	Children	None specified	Knowledge, awareness, motivation
Crumbs (Epstein, 2016) [74]	Mobile application	General population	Mindful eating	Awareness, mindfulness

Table 2.2: Table highlighting a illustrative selection of prior research developing sociotechnical interventions to support healthy eating.

trol [51, 147], or facilitating social support [4]. Many of these interventions are built around a core self-monitoring functionality where users keep track of the foods that they eat [210]. In some interventions, self-monitoring is done by manually selecting the foods that are eaten through an application. In the POND application, users could log their eating behaviors by searching for individual foods they ate or by breaking down their foods into individual components (fat, whole grains, etc) and adding portions of those individual components [12]

Alternatively, some recent interventions have moved away from detailed logging of eating behaviors in favor of simpler data entry through taking pictures of foods that are eaten. Robinson and colleagues developed an attentive eating mobile phone application where users took pictures of their food and then reviewed those pictures when deciding what to eat next [185]. In their application, users did not provide information about the food itself, nor did this system try to infer this. Instead users annotated pictures with information about how they felt after eating the food. In the two different approaches to self-monitoring, there are trade-offs between the simplicity of data entry and the richness of the data captured.

Interventions that provide users the ability to self-monitor their eating behaviors typically provide other functionality that builds upon it. In the case of Robinson and colleagues’ attentive eating application, the application provided users the ability to review the prior foods they had eaten [185]. In MAHI, users could associate journal entries with pictures of the food that they took and then receive feedback and informational social support from a health educator [147].

In addition to self-monitoring based interventions, researchers have developed systems that focus specifically on educating users about how to eat healthy. These commonly take the form of educational games that challenge users to consider what healthy eating looks like [172, 119, 97]. In the LunchTime application designed by Orji and colleagues, users would play a game to try and select the best foods to meet a certain goal. For example, the user may chose their health goal as ‘managing weight,’ which tailors the game to challenge them to select the best foods that support weight management. They included a leader board and tied the application into Facebook to facilitate social interaction and motivate continued use. Gerber and colleagues took a different

approach to educating users about healthy eating [85]. Instead of using a game, they sent text-messages to participants with tips about how to eat healthy. Along with these educational messages, they also sent motivational messages and messages that participants created at the beginning of the study that they wanted themselves to receive.

### **2.2.2 Community-based and environmental interventions**

Although there have been a significant number of interventions targeting individual and social aspects of healthy eating, fewer have worked at the community-level or addressed environmental factors affecting eating behavior. One specific program of research, led by Dr. Andrea Grimes Parker, has focused heavily on community-oriented interventions to support healthy eating. The first study in this line of inquiry created a voice memory system, EatWell [96]. The EatWell system allowed people living in a specific community to call into a central system, using their own cell phones, and leave messages about their experiences trying to eat healthy in their community. The EatWell intervention aimed to support people throughout the community in eating healthy by giving them a platform to share their experiences and provide encouragement and tips for healthy eating. Although it was evaluated in a small study, the research suggested that there is significant potential in getting people to engage critically with their food environment. Specifically, they found that people were actively sharing suggestions for how to navigate the food environment to eat healthier [98].

They built upon the concept of EatWell by creating Community Mosaic, which similarly supported information sharing about healthy eating in the context of the local neighborhood [175]. However, the platform differed in that Community Mosaic used a large, touch-screen display embedded in a community space – a local YMCA. Users would send pictures and textual content to be displayed in the Community Mosaic using text and multimedia messaging from their personal cell phones. Others would then be able to see that content on the large display. Community members could also interact with the content by selecting a personal response to the messages from a preset list of response options such as “I’m inspired to try this” and “I want to learn more about this.”

Similar to the EatWell system, users gained greater awareness of how they could eat healthier in their community and felt a sense of camaraderie with others in trying to overcome the challenges presented by their environment.

Although somewhat different, Grimes Parker and colleagues also developed TalkBack, an online forum for youth to analyze and reflect on food advertisements [177]. This project also aimed to address environmental factors, specifically the media and advertising environment, which, as they explain, has a well-documented effect on eating behavior. This work expanded the conceptualization of the environmental factors that impact eating behavior to include the media and advertising environment. It provides additional support for the idea that technology has a role to play in addressing environmental factors, specifically by prompting the critical evaluation of one's environment.

This on-going research effort by Grimes Parker and colleagues has been substantially influential to our research. Their research emphasizes the importance of considering the cultural and environmental context in interventions – especially those designed with marginalized communities. Furthermore, their research suggests that technology can help raise awareness of how environmental factors affect one's behavior and can serve as a platform to convey information about ways to eat healthy in the face of environmental constraints.

In addition to this work by Grimes Parker and colleagues, there has been a specific area of research that touches on environmental factors affecting eating behaviors – grocery shopping. Although a number of research projects have looked at developing technologies that engage with users in the context of grocery shopping [120], only some of these have aimed to support healthier eating behaviors [199]. Both the Foodle project and Nutriflect focus on using the data from previous shopping trips, in the form of receipts, to provide users with feedback on their shopping behaviors and recommendations about healthier shopping choices in the future [183, 219]. These interventions aimed to raise awareness about current shopping behaviors and increase knowledge around how to shop healthier. Users may integrate this knowledge into practice, but they may not. To address this limitation, other researchers have created interventions that provide in-situ or just-in-time support

for healthy grocery shopping by actively engaging users while grocery shopping [199, 5].

Across both of these approaches for grocery shopping based interventions, research has been primarily conceptual, prototype-based, or focused on the technical challenges in building systems (e.g., algorithms to support healthier grocery recommendations). Few of these studies have reported on the experiences of people using these intervention in the context of grocery shopping. Furthermore, only one of these interventions has considered the unique experiences and challenges of grocery shopping in the context of low SES communities [144].

### **2.3 Theory use in the design of sociotechnical interventions**

Behavior theories can play an important role in the design of sociotechnical systems intended to change behavior. These theories provide designers with useful insights into how their systems can promote behavior change. Furthermore, a growing body of research in the fields of psychology and preventative medicine suggests that using theory in intervention design leads to more effective interventions [10, 89, 166]. If designers want to build effective systems that affect users' behaviors, then using behavior theory in the design process is likely to help.

In much of the prior research using theory to inform system design, behavior theory helps to inform the overall approach used in building an intervention [162, 145]. For example, with Shakra, researchers used Social Cognitive theory and the Transtheoretical Model to inform their high-level approach of focusing “on the social and communal aspects of exercise” while raising individual awareness [11]. They do not provide details on how the theory informed individual design decisions. This is quite common in HCI where researchers build systems to drive behavior change [172, 141]. When theory use is underspecified in the design process or reported vaguely, challenges may arise with replication and measurement. When researchers do not report the details of how theory informed their work, others cannot replicate their design approach or leverage it to improve their own systems. It also prevents researchers from being able to measure or understand whether the intervention was effective at operationalizing a specific theory.

Some researchers have used theory to inform detailed aspects of their system designs and ex-



explicitly note how theory informed the design of their interventions [30]. Consolvo et al. used several aspects of goal-setting theory in the development of the UbiFit Garden system including strategies for making goal commitment more effective such as incentives, feedback on goal performance, and enhancing the user’s self-efficacy towards goal completion [54]. They also used goal-setting theory to design the method by which goals are set – in their case allowing users to set their own goals, which goal-setting theory postulates are the most effective goals. Mamykina et al. also provided a more explicit explanation of how they used a sense-making framework to inform their design [147]. They allowed users to capture moments of ‘breakdown’ when their daily routines were interrupted. These moments were “when their diabetes becomes the center of their conscious thought and attention focused moments of reflection” as opposed to prompting users to reflect on unspecific experiences.

There has been a call for empirical research that explores “the ways in which behavioral theories can be translated into better designs” [106], however little research has explored methods that support this kind of empirical development. There is a need for research into approaches to design sociotechnical systems using behavior theory. Furthermore, there is a need for research that explores the way that design decisions can be guided by theory and how those design decisions ultimately affect the effectiveness and engagement with interactive systems. Although researchers have surveyed multiple behavior theories to develop design guidelines for behavior change applications [55], these guidelines, while useful, fail to provide guidance on translating a behavior theory into a sociotechnical intervention.

## **2.4 Food access and food insecurity**

Food access refers to having the ability and resources to acquire food [117]. Food access primarily refers to a physical experience, which means the ability to transport oneself to a source of food, procure food items, and physically move them to locations where they can be consumed or, alternatively, arranging for food to be transported to oneself. Embedded within this are issues of transportation, financial resources, and the presence and prevalence of food sources that offer foods that meet an individual’s needs [36, 33]. It’s important, in the context of discussing healthy

eating, to differentiate healthy food access, which describes the level of access an individual has to healthy foods, specifically [8].

More than with food access broadly, the literature has been primarily concerned with the lack of food access, an experience referred to as food insecurity. Specifically, the USDA defines food insecurity as a lack of access at all times to enough food for an active, healthy life [48]. According to this definition, the USDA, who measures food insecurity each year, has found that since 2008, the prevalence of food insecurity in the United States has remained fairly stable between 14% and 16% [48]. Coates argues that we should move away from a single indicator of food security and instead consider the different dimensions of food insecurity that more closely tie to the unique facets of the experience [47]. Accordingly, she proposes that we consider food sufficiency (quantity), nutrient adequacy (quality), cultural acceptability, safety, and certainty and stability. In our research, we adopt these five dimensions as being essential for food security and consider them as we discuss food insecurity.

Much of the research effort around food insecurity has been dedicated to defining food insecurity to then be able to measure and quantify it [117]. Being able to effectively measure food insecurity has enabled researchers to study food insecurity as a factor that affects other health and life issues. Researchers have extensively examined the link between food insecurity and obesity and found there to be a consistent association, especially in women and children [64, 223, 174]. Factors like gender, marital status, and food stamp participation may mediate these effects [79]. Furthermore, food insecurity has been linked to chronic diseases such as hypertension and diabetes [196, 197]. Studies have also found that food insecurity may contribute to decreased mental health status [151], lower academic achievement [118], and continued cycles of poverty [169].

The major negative impacts of food insecurity and its relatively unwaivering prevalence suggest a need for research that explores factors that contribute to food insecurity and strategies to address it. Gorton, Bullen, and Mhurchu conducted a review of the literature exploring the environmental influences that affect food insecurity in high-income countries [93]. They found evidence that the most strongly supported factors associated with food insecurity were economic factors

(e.g., income and living expenses), mental health, cooking skills, immigration and acculturation, and education level. Access to transportation, though a common factor in qualitative work, did not appear to have an effect when controlling for financial resources. They found very little research exploring the effects of embarrassment, emotional wellbeing, or shame on food insecurity.

Research exploring the experiences of people who face food insecurity affirmed that the challenges around limited financial resources and education (both broadly and about preparing food) were prevalent contributors to food insecurity [108, 174]. Qualitative studies also added that transportation and mobility, especially amongst older adults and people with disabilities [226, 111], was a major challenge [61, 62]. Not only did they find issues in getting to food outlets, but also in getting food back to its final destination (e.g., a home). Quandt and colleagues found different dimensions to the experience of food insecurity among Latino immigrant families [182]. Participants in their research experienced different types of effects of food insecurity – quantitative (e.g., less food to eat, having to skip meals), qualitative (e.g., eating lower quality food), and psychological effects (e.g., fear, stress, trauma, and embarrassment). Although researchers have described the psychological and emotional effects caused by food insecurity [204, 95], little work has looked at how these experiences, in turn, contribute to food insecurity.

We identified one line of inquiry addressing food insecurity within computing research. Dombrowski and colleagues studied the practices of service organizations who work to address food insecurity in their community [68]. Specifically they studied how a community outreach organization helped people navigate the government benefits system. Building upon this work, they also conducted a study with food non-profits to understand their information needs and how technology can support the staff at those organizations in better connecting people with food resources [67]. Both of these studies focused on organizations working to serve people who experience food insecurity. However, to our knowledge, no research, inside or outside of the field of computing, has studied technology use in the context of food insecurity nor has any research been done to explore the use of technology to support food access among people experiencing food insecurity.

## Chapter 3

### Research design and overview

In this chapter, I provide an overview of the research done as part of this dissertation and identify how the three individual studies connect together to explore the questions posed in my thesis. Figure 3.1 provides an overview of the aims of this dissertation and outlines the three dissertation studies and their key takeaways. In the overview diagram, the guiding questions are informed by the review of previous research and aimed at addressing gaps identified in the literature (see Section 2).

As we identified in reviewing the related research, little work has been done to consider low SES communities in the design of sociotechnical interventions to promote healthy eating. Furthermore, previous research has suggested that using behavior theory to inform intervention design may increase the likelihood of creating effective interventions. These two findings from our review of the literature motivated our initial goal of using technology informed by behavior theory to support healthy eating in low SES communities.

Our prior field work with a low SES community in Denver, Colorado informed the design and development of a family-oriented mobile application that focused on supporting healthier snacking. We focused on snacking because members of the community believed unhealthy snacking was a prevalent barrier to improved health [128]. We primarily used Social Cognitive Theory to inform the design of the application, Family Snack Buddy, as this theory considered the interactions between social, cognitive, and environmental factors that affected behaviors. Using Social Cognitive Theory (see Appendix A), we designed the application to primarily target psychosocial factors that

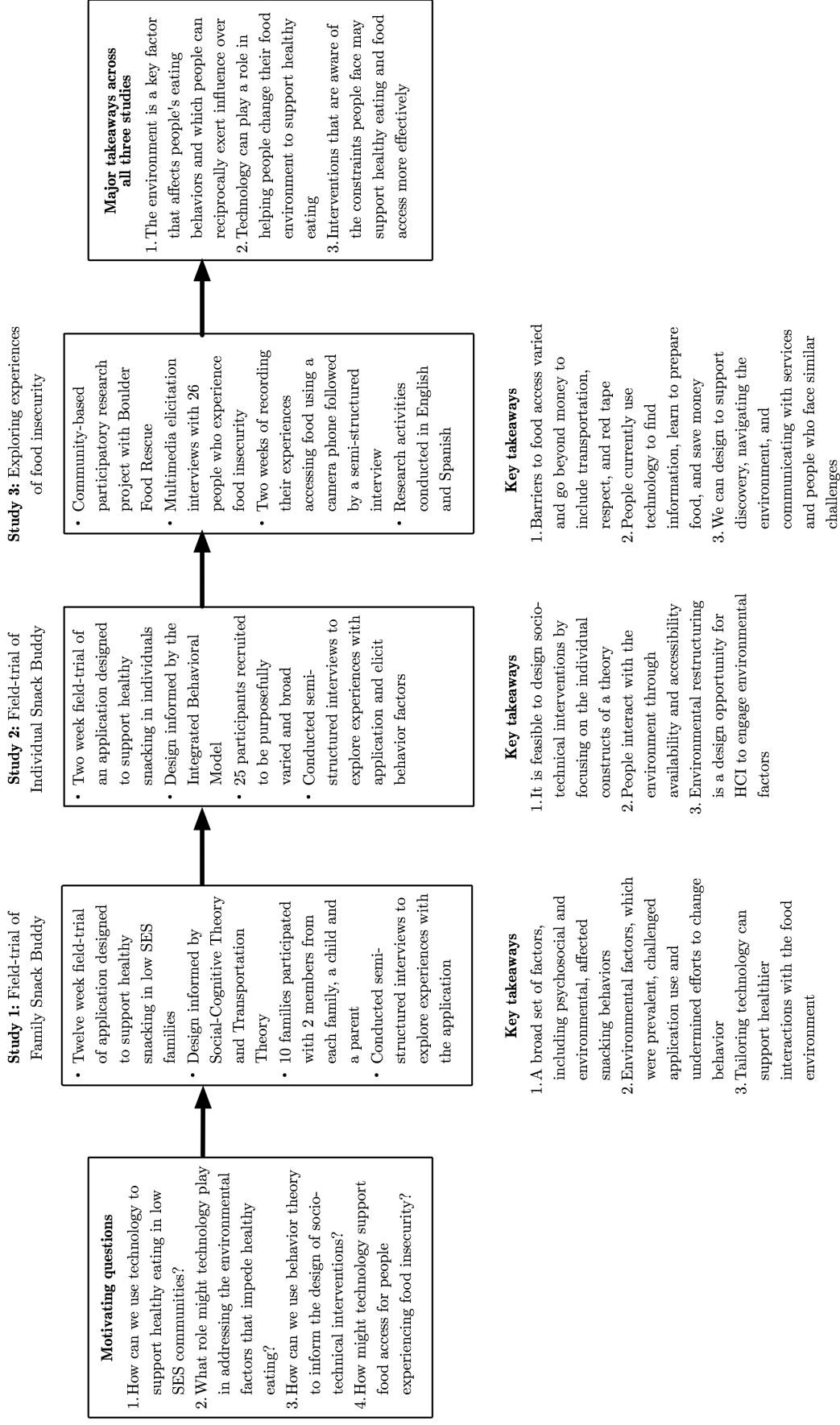


Figure 3.1: Overview of the three dissertation studies, the guiding questions that informed them, the key takeaways for each, and the major takeaways across all three.

influenced behavior, such as awareness, knowledge, and self-efficacy, because these were viewed as more tractable for a technology-based intervention. The application also provided users the option to engage through either of two user interfaces – one designed for adults in the family that focused on simple interactions that made it easy to see the snacking history of others in the family and one designed for youth in the family that provided a narrative game.

Since we designed the application with a specific community, we wanted to explore their experiences using it and understand how well it fit their needs. To do so, we conducted a twelve week field-trial of Family Snack Buddy with the community that we had designed the application with. In total, 10 low SES families from the community participated in the study. Two individuals participated from each family – a primary caregiver (an adult who primarily cared for the family) and a secondary caregiver (older teen child). Five families, 10 participants in total, were part of an intervention group that used the application and five families, an additional 10 participants, served as a control group and did not use the application at all during the study. In focusing on the experiences of the intervention group, as they used the application, we found that they had an overwhelmingly positive experience, but in some cases, environmental constraints, such as a lack of financial resources or their busy schedules, undermined their ability to fully engage with the application and its recommendations. The small field-trial revealed that a broad set of factors, including self-efficacy, perceived norms, attitudes, and the environment, influenced their snacking behaviors.

Based on the success of our field-trial of Family Snack Buddy, we wanted to iterate on the application and study it further. Specifically, we wanted to explore ways to more directly and clearly use health behavior theory to inform the design of Snack Buddy. We identified that our use of theory to inform the design of Family Snack Buddy was not as clear as it could have been. For example, there were aspects of Social Cognitive Theory, such as reciprocal determinism, which we did not consider. We also did not clearly reason how specific aspects of the application would facilitate sociostructural support. This vague use of theory in some areas of our design was a limitation consistent with other HCI research using behavior theory to inform intervention design [106].

In exploring how we could better use behavior theory in designing the application, we first considered the theoretical framework we wanted to use. In the first study, we found several factors that affected participants’ eating behaviors that we had not originally anticipated, such as intentions and descriptive norms. Some of these constructs were not well-represented in Social Cognitive Theory, prompting us to consider using a different theoretical framework. We chose the Integrated Behavioral Model (see Appendix A) to guide our iteration as it better encapsulated the factors we identified in Study 1 and provided well-defined constructs that we could design around. In order to focus on the use of theory in design, we consolidated the application around a single interface and focused on the experiences of individuals with the application. This meant the updated version of Snack Buddy, Individual Snack Buddy, was built to be used by individuals instead of multiple people in a family and, therefore, we removed features like family messaging and comparing snacking healthiness with other family members. This made it easier to understand how the application would affect users by removing the confounding variables of multiple interfaces and social interactions between users.

To explore the extent to which our theory-informed design addressed the factors we targeted in its design, we conducted a two week field-trial. We purposefully recruited participants from across a wide range of experiences – people of all ages, SES, and experience using health apps – to gain a broader perspective on the application. This also allowed us to explore how well facets of the application that we carried over from Family Snack Buddy, such as the star feedback and healthier snack suggestions, would be perceived outside of the context in which it was designed. In the two week field-trial, participants used the theory-informed, individual version of the application on their own Android phone for two weeks. After using the application, we conducted a semi-structured interview with each participant to explore their experiences using the application and how the application affected their beliefs and behaviors.

As in Study 1, participants gave significant attention to the environmental factors that affected their snacking behaviors and, more generally, their eating behaviors. They discussed how the availability of food – the extent that foods were present at the time of eating (e.g., the presence



Figure 3.2: An illustrative diagram to help describe how we conceptualize the relationship between food access, availability, and accessibility. Having access to food (i.e., having the resources and abilities to acquire food) allows a person to increase the availability of food. They can then manipulate the accessibility of that food (i.e., the food that is available) to make it easier to choose, prepare, and consume.

of lettuce in the home or an apple at work) – and the accessibility of food – the ease in which available foods could be chosen and eaten (e.g., having an apple on the kitchen counter instead of stored in the lowest drawer of the refrigerator) – greatly affected what they ate. Both studies suggested that the practice of environmental restructuring – “alter[ing] the environment in ways so that it is more supportive of the target behaviour” [155] – was common and useful for supporting healthier eating. Environmental restructuring involved manipulating the availability and accessibility of foods through practices such as grocery shopping to purchase more food, hiding unhealthy foods in hard to reach places, and bringing healthier foods to social events. These studies suggested that technology could play a role in addressing environmental factors by supporting practices of environmental restructuring.

One avenue of research we could have pursued would have been designing sociotechnical interventions that support environmental restructuring. However, these first two studies revealed a more fundamental issue affecting eating behavior – food access. Food access, defined as the the ability to acquire food (e.g., going to the store to buy food), determined, in large part, the foods that an individual had available to them in the first place (see Figure 3.2). In Study 2, participants, for the most part, had regular access to healthy foods, which allowed them to purchase these foods and increase the availability of them. Participants in Study 1, however, lived in a low SES community and had greater barriers to food access. They had a more difficult time changing the availability and accessibility of healthy food because they had less access to healthy food. Simply put, one cannot rearrange an empty cabinet.



Participants in our first study identified their lack of food access as a core factor that prevented them from eating healthy. A number of other studies have similarly found that food access and food security – the ability to access enough food for an active, healthy life on a regular basis – are major factors in healthy eating [125, 152]. However, our thinking had previously been that the issue of food access was outside the influence of technology. We considered that technology could not build new grocery stores or decrease the market cost of fruits and vegetables. This originally led us to focus on psychosocial factors in developing Snack Buddy, which we perceived to be more tractable for technology. Nonetheless, the topic of food access remained important and unexplored, motivating the guiding questions of the third study of this dissertation – is there a role for technology in providing greater access to healthy food for people? And if so, what might its role be?

These two questions ultimately informed the design and conduct of the final study of this dissertation, a community-based participatory research project to explore the experiences that people have with food insecurity. We wanted to explore the issue of food insecurity because, by definition, people who experience food insecurity are those with the most limited access to food. These are people who would likely benefit from greater support in accessing food. This study aimed to understand the barriers that people experiencing food insecurity face in accessing healthy food and ways that they currently use technology to support food access, if any. Understanding these two issues revealed opportunities for technology and specific strategies for designing with the community of people experiencing food insecurity.

## Chapter 4

### Study 1: Field-Trial of Family Snack Buddy

In the first study, we sought to explore the potential for using technology to support healthy eating behaviors in low SES communities. We conducted a twelve week field-trial of an Android application, Family Snack Buddy, designed to promote healthy snacking with low SES families. In total, twenty participants from ten families participated in the study. Each family had a primary caregiver, typically a parent who provided the majority of care for their family including cooking, cleaning, shopping, and providing income, and a secondary caregiver, typically an older teen in the family who helped cook, care for their siblings, and assisted with household chores. In this study we aimed to understand how participants used the application, the limitations of the application, and the effects that participants reported the application having on their beliefs and behaviors.

#### 4.1 Mobile Application: Family Snack Buddy

The Family Snack Buddy application (see Figure 4.1) was designed using an iterative, user-centered design process including two years of needs assessment studies, one year of prototyping studies, and one year of development [128, 126]. Family Snack Buddy was designed in partnership with a specific low SES community in Denver to support healthy snacking within families living in the community. The application provided users the ability to enter snacks that they ate (Figure 4.2b), receive healthier snack suggestions (Figure 4.2c), view their own personal snack history (Figure 4.2d), and compare their snack healthiness with other people in their family who were using the application (Figure 4.2a).

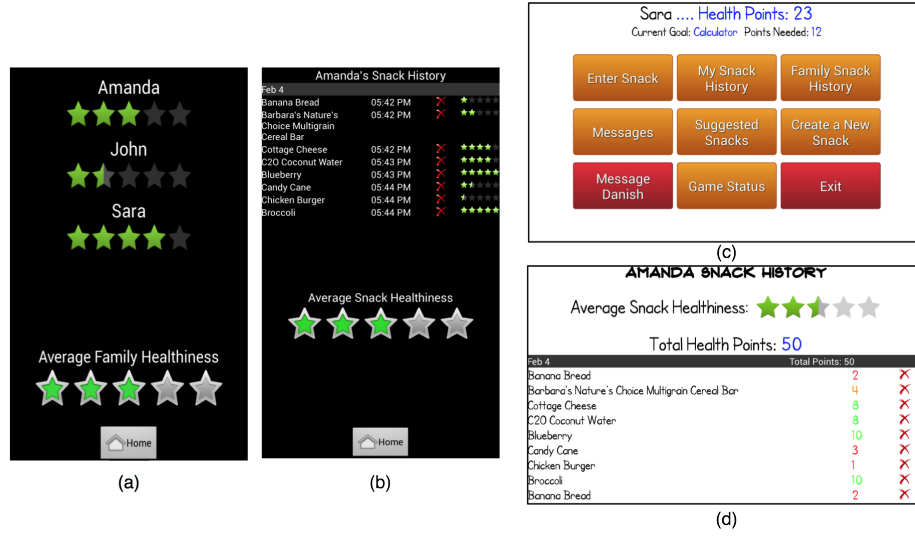


Figure 4.1: Example screens for the two separate user interfaces. Figures (a) and (b) belong to the informational interface and (c) and (d) belong to the gaming interface.

As shown in Figure 4.2b, users could enter their snacks using one of three different input mechanisms – 1) touch-based selection from categorized lists, 2) voice input, and 3) typing the name of the snack. To keep the interactions simple and reduce the need for numeracy skills, when users entered a snack, they would not input portion size or any other information about the snack. They simply logged the fact that they had eaten a specific food as a snack. After users entered a snack, they received feedback about its healthiness in the form of 0.5 to 5 stars based on the Fooducate database<sup>1</sup>. The healthiness ratings had a granularity of 0.5 stars (i.e., 0.5 stars, 1 star, 1.5 stars, etc). Healthier snack suggestions were typically the same type of food (e.g., a salty or sweet snack) and within 1–2 star improvement from what was input to facilitate small, manageable improvements. We did not include price information in the application because our prior work suggested that community members, who we designed the application with, did not want this information displayed [126].

We designed the application to have two different, demographic-targeted interfaces to meet the distinct design preferences of both primary and secondary caregivers. We learned about these

<sup>1</sup> <http://fooducate.com>

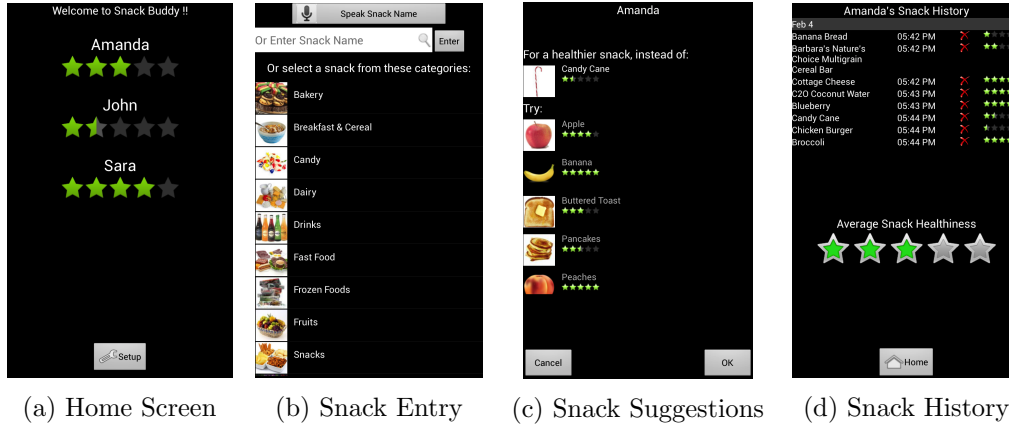


Figure 4.2: Family Snack Buddy interface for different features.

preferences during prototyping research we conducted during an earlier study [126, 127]. The participants could use either of these interfaces, however each interface was designed specifically for one caregiver type – the *informational interface* (Figure 4.1a and b) for primary caregivers and the *gaming interface* (Figure 4.1a and b) for secondary caregivers. The informational interface was designed to support primary caregivers’ management of their family snacking and prioritized simplicity in providing snack healthiness information. Primary caregivers could view the detailed snacking history for both themselves and the secondary caregiver participating from their family. However, secondary caregivers could not see the detailed snacking history of their primary caregiver. Instead they could only view the overall, average snack healthiness of the other family members, which was represented in the form of a five star average rating across all of the snacks they entered. We made this design decision because, in our previous research, primary caregivers suggested that they needed more information about their families’ snacking behaviors to make improvements and they were concerned about altering family power dynamics if their dependents could view this information.

The gaming interface provided a narrative-based game where users selected a human avatar and helped the avatar progress through various stages of life by eating healthy snacks. Users helped their avatar achieve different life goals including getting an education, attending college, and buying

a house. These goals were achieved by accumulating snack healthiness points, which were awarded for entering snacks in the application. For example, they could eat a couple healthy snacks to get 20 healthiness points and buy their avatar a calculator. Acquiring the calculator would then contribute towards the 65 points required for their avatar to progress from primary school to college. They received more points for entering healthier snacks, so users progressed faster in the game by eating healthier snacks. Snacks were worth between one (e.g., Hot Cheetos) and ten (e.g., carrot) healthiness points. The narrative game was informed by informal conversations with young people in the community who regularly talked about how they wanted achieve major milestones in life – they hoped to go to college, get a job, and own a home.

#### **4.1.1 Theoretical foundation for application design**

The design of both interfaces and the underlying application was informed by Social Cognitive Theory [18]. Additionally, the gaming interface was informed by Transportation Theory [94]. Here I provide a brief overview of both theories and the ways that they informed the design of Family Snack Buddy. More detailed descriptions of both theories can be found in Appendix A.

##### **4.1.1.1 Social Cognitive Theory and Family Snack Buddy**

Social Cognitive Theory (SCT) emphasizes the relationship between an individual, their beliefs, and their environment. According to SCT, behavior is determined by an interplay of social and cognitive factors that are driven by our sociodemographics [19]. The most central construct in SCT is self-efficacy, which is an individual’s belief of control over their actions and their capability to perform a specific behavior. Secondly, SCT suggests that individuals have outcome expectancies, which are their perceptions of the possible consequences of their actions. These perceptions will drive behavior and in part mediate the effects of self-efficacy on behavior. Additionally, SCT includes goals and sociostructural factors as key concepts that can drive behavior. Sociostructural factors include both facilitators (things that support the behavior) and impediments (things that prevent the behavior). Lastly, in the context of this research, a core tenet of SCT is reciprocal

determinism, which suggests that people are affected by their environment, but that they also exert influence over their environment.

Self-efficacy refers to an individual’s belief in their abilities to organize and enact a certain behavior. It is unlikely that an individual will engage in a behavior if they do not believe that they will be successful in doing so. Previous research suggests four primary routes to enhance self-efficacy – personal experience (specifically personal mastery experiences), vicarious experiences, verbal persuasion by experts or trusted people, and emotional arousal [52].

Family Snack Buddy was informed by SCT in that we designed features that were intended to enhance self-efficacy, sociostructural facilitation from the family, and outcome expectations. Family Snack Buddy was designed to increase self-efficacy through: (1) positive, vicarious experiences by providing family members with the ability to see and learn from each other’s snacking progress and (2) reflection on their personal experiences via their personal snacking history. Family Snack Buddy also promoted self-efficacy by providing small, actionable recommendations for healthier snacks that users could deliberate and act upon. Providing “baby steps” towards healthier eating was a way to increase the likelihood that users would have personal mastery experiences by which they could increase their self-efficacy.

We aimed to enhance a key sociostructural facilitator, the family [49], by providing individuals with the ability to view family members’ aggregate snacking healthiness. This was in the form of both an average star rating across all the snacks a user entered and a sum of the snack healthiness points they received from entering snacks. We provided users with star-based feedback on the healthiness of each individual snack, which abstracted away details about the nutritional content of snacks. This feedback was intended to be easily understood by participants who may have low numeracy or health literacy and help them develop outcome expectations of how specific snacks would affect their health.

#### 4.1.1.2 Transportation Theory and Family Snack Buddy

Transportation Theory suggests that individuals' beliefs and attitudes are affected whenever they engage in an immersive narrative like an interactive story [94]. The decisions people make during the narrative can induce changes in their beliefs about performing a behavior, which can in turn affect the likelihood of them performing a behavior once they have left the narrative. Creating an emotional response to the narrative experience is one of the best ways to facilitate transportation.

Transportation theory informed our creation of a long, narrative game as part of the gaming interface, where the user develops a long-term relationship with their virtual avatar who has a relatable life, as opposed to a short, single play game such as *OrderUP!* [97] or *LunchTime* [172]. The avatar's ability to progress through life was directly affected by the eating behaviors of the user, mapping the narrative to their snacking choices. Furthermore, the narrative of the game was designed to tie into the specific interests and hopes that participants expressed to us during informal conversations about their lives. By using specific life goals that participants hoped to achieve in their real lives, we hoped to generate an emotional response to the game.

## 4.2 Study design

The twelve week field-trial included twenty participants from ten families – each family had a primary and a secondary caregiver participant. Five families (10 participants) were assigned to the intervention group and five families (10 participants) were assigned of the control group, which did not use the application during the study and was intended to control for the effects of study participation, such as interaction with researchers and data collection methods. Each participant received \$120 for participating in the study – \$60 Walmart gift cards were distributed at the midpoint of the study and then again at the end of the study.

The field-trial, as shown in Figure 4.3, consisted of eight meetings over the twelve weeks. At the first meeting, individuals completed a background questionnaire, a snacking awareness survey, and a produce availability questionnaire (see Appendices B and C). The latter two were informed

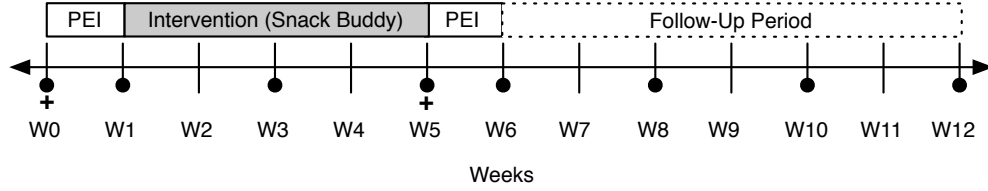


Figure 4.3: Overview of the 12 week field-trial study design. The intervention and control groups participated in the PEIs (2 total) and all meetings (noted with a • on the week). We conducted 2 semi-structured interviews about application use with the intervention group at W3 and W5. Every meeting included a 24-hour recall (8 in total). Meetings that included the pre/post snacking awareness and produce availability survey (see Appendices B and C) are noted with a +. The intervention group used Family Snack Buddy during the intervention period while the control group did not.

by validated instruments [72, 136]. All participants also completed the snacking awareness and produce availability surveys after the intervention period to assess pre/post changes.

After the first meeting, all participants, those both in the intervention and control groups, were instructed to take pictures of the food that they ate for one week as part of the photo-elicitation interviews (PEI) [46]. In this study, we used PEIs to learn about the eating behaviors for both the intervention and control group participants. The PEIs were not a component of our intervention, though it’s important to acknowledge that this method provided an opportunity for behavior reflection separate from the intervention components. At the end of the first week, we conducted the PEI with participants, which were semi-structured interviews guided by the pictures they took. We reviewed each picture with participants and asked them to discuss the food and the context around it. Although the focus of the PEIs was the specific foods that they ate, broader issues around healthy eating and the factors that influenced their eating behaviors often came up, which were captured. The PEIs were video recorded and transcribed for analysis.

After completing the PEI, participants were purposively assigned to the intervention group or control group in an attempt to balance gender and ethnicity. We provided Android phones with Family Snack Buddy to all intervention participants and trained them on how to use the application. After the training, we instructed them to use Family Snack Buddy to monitor their snacks for four weeks. During this same time, the control group did not use the application, but instead returned



to their normal activities for four weeks. Mid-way through the four-week intervention period, we met individually with all participants. We met with the intervention participants to capture their early experiences using the application while it was fresh in their minds and we met with the control group to ensure the same amount of contact for both groups.

After the four week intervention period, we met with all participants, both in the intervention and control groups. At this time we conducted another semi-structured interview with the intervention group about their experience with Family Snack Buddy. All participants were again instructed how to capture pictures as part of a post-intervention period, week-long PEI study. Both the semi-structured interview and the PEI were video recorded and transcribed for analysis.

Following the post-intervention PEI, participants began a 6-week follow-up period where they met with us at 3 time points to complete 24-hour food recalls. Additionally, across the 12-week study, we conducted a 24-hour food recall at each of the eight participant meetings (see Figure 4.3). The 24-hour food recall is a validated food-survey method [150] used in nutrition-related research where we asked participants to identify all the foods and snacks they ate during the 24-hours before the meeting, with the goal of gaining insights into their eating behaviors.

#### 4.2.1 Participants

We worked with the Bridge Project<sup>2</sup>, an education opportunity program situated in various public housing neighborhoods in Denver, to recruit participants. The Bridge project serves a primarily low SES, racially and ethnically diverse community by providing after-school tutoring and academic support to over 500 K-12 children in the community. In 2013, 72% of the children qualified for free and reduced lunch. We worked with this population because previous research suggested that 87% of the children living in the community had modifiable risk factors for developing a lifestyle-based, chronic illness such as diabetes or hypertension [23]. This community had been involved with previous research towards developing the Family Snack Buddy application [128, 126].

In total, we recruited 10 families from the Bridge community. Each family had two members

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<sup>2</sup> <http://www.denverbridgeproject.org/>

	PC Intervention	PC Control	SC Intervention	SC Control
<b>Mean age</b>	40.4	43.4	14.2	13.8
<b>Age range</b>	31 - 46	32 - 58	13 - 15	12 - 18
<b>Female</b>	5	5	4	4
<b>Male</b>	0	0	1	1

Table 4.1: Age and gender demographics; PC = Primary Caregivers, SC = Secondary Caregivers

participate – one primary and one secondary caregiver. The detailed demographic information for participants is summarized in Tables 4.1 and 4.2. We balanced gender between the two groups and had all female primary caregivers and predominantly female secondary caregivers across both groups.

#### 4.2.2 Analysis

We used an inductive, qualitative analysis of the transcribed interviews where we used open-coding to identify emergent categories grounded in the data [190]. These categories were discussed with the research team and iterated on to develop key, high-level themes. Although we did not use any formal methods of researcher triangulation or inter-coder reliability, the team used informal investigator triangulation and peer debriefing to review several exemplary quotes related to each theme to ensure that they appropriately reflected the theme [142]. On an exploratory basis, we analyzed differences between and within subjects using paired t-tests and analysis of variance (ANOVA) for snack awareness survey responses and produce availability survey responses. We controlled for baseline survey responses in our analyses.

	PC Intervention	PC Control	SC Intervention	SC Control
<b>White</b>	1	2	1	2
<b>Hispanic/Latino/Chicano</b>	3	2	3	2
<b>Black/African American</b>	0	1	0	1
<b>Asian American</b>	1	0	1	0

Table 4.2: Race and ethnicity demographics; PC = Primary Caregivers, SC = Secondary Caregivers

## 4.3 Findings

### 4.3.1 Application use

We found that participants used Family Snack Buddy consistently throughout the four-week intervention period. Over the four weeks, we found that they used Family Snack Buddy nearly every day – an average of 6.8 days during week one, 6.4 days during week two, 5.7 days during week three, and 6.3 days during week four. Although use decreased over time (see Figure 4.4), a common finding in previous research on mobile health applications [71, 51], participants still entered an average of 2.7 snacks/day during the last week of the study.

Participants reported an overwhelmingly positive experience with the application and several participants asked if it would be possible to continue using it after the study. PC2<sup>3</sup> and PC5, for example, asked if they could have the application on their own phones to continue using it. Similarly, secondary caregivers inquired if they could keep the application or if it was on Google Play to download: *“I would like to see this application out on mobile phones. This application was good ... I tried some other apps on Google Play, but they weren’t as good as this one”* (SC6).

#### 4.3.1.1 Use of the demographic-targeted interfaces

We asked participants about which Family Snack Buddy interface, either the informational or gaming interface, they preferred since they had the ability to switch between them. Generally, all participants preferred and used the interface designed for them – primary caregivers used the informational interface and secondary caregivers used the gaming interface. This was true even though most participants tried both interfaces, at least for a short time. Participants also suggested that the ability to switch between the two interfaces was not very useful and that there was no need to switch to the other interface.

Primary caregivers did not express a great interest in gaming. After using Family Snack Buddy for two weeks, PC4 said that she just preferred the informational interface: *“I didn’t use*

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<sup>3</sup> PC[#] indicates a primary caregiver and SC[#] indicates a secondary caregiver. Participants with the same number were from the same family (e.g., PC2 and SC2 are from the same family)

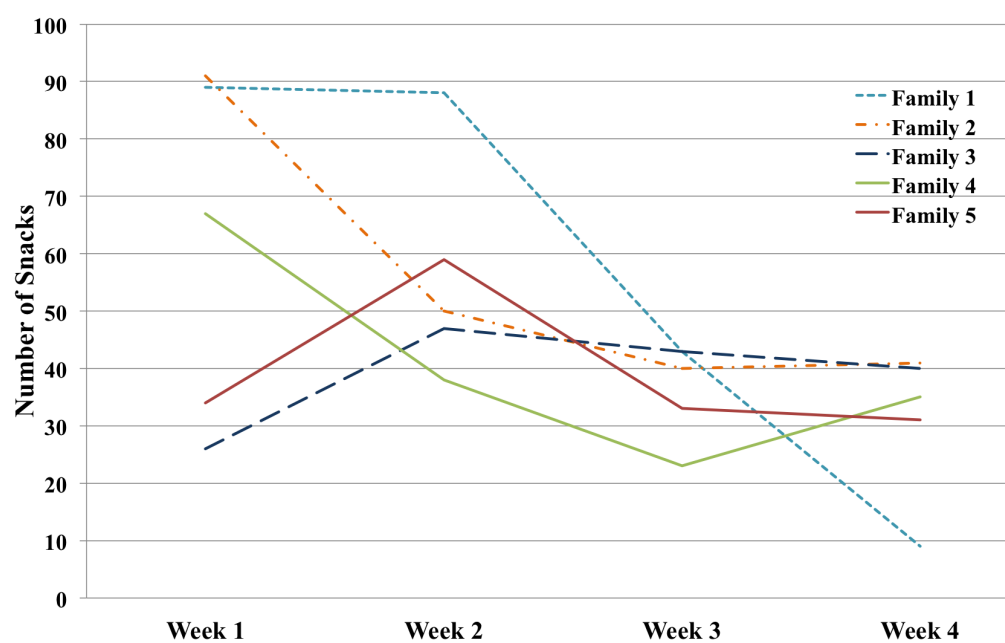


Figure 4.4: Average number of snacks entered per week, by family. During week 4, Family 1 reported having a family emergency, accounting, in part, for the sharp decrease.

*[the gaming interface]. I did switch over and kind of looked at it, but I didn't mess with it. I preferred the [informational interface]*". PC2 also mentioned feeling similarly about gaming: *"I didn't use the game because I don't know how to do games. I'm lucky I know how to use the phone."* Most primary caregivers felt less confident using smartphones and perceived the gaming interface as more complicated which, in part, led to their hesitance in using that interface. Primary caregivers also stuck with the informational interface because it met their needs. PC6 explained: *"I just did the parent one. That was fine. I liked seeing the stars, and be like 'oh, okay I'm doing a good job'"*.

Secondary caregivers preferred the gaming interface because it was "fun" and "cool," while the informational interface was "dull" and "boring." SC4 noted her preference for the gaming interface after trying both: *"I went to [the informational interface] like once ... it wasn't really as cool ... I don't know, I thought the game one was more fun"*. The game engaged and motivated secondary caregivers to eat healthier foods: *"I like the game status, it shows me what I have already earned. It motivates me to keep going"* (SC5). SC6 exemplified how the gaming interface engaged secondary caregivers – he entered 23 snacks in week three, beat the game, and then entered just 4 snacks the following week. A family emergency in week 4 may have compounded his decreased input. However, he discussed feeling less engaged and bored with the application after beating the game.

#### **4.3.2 Family interactions and engagement**

We designed Family Snack Buddy to engage the family as a unit in moving towards healthier eating. Family members described how their eating practices were intricately tied to their family and that they ate healthier when eating together with their family. Primary caregivers acted as the gatekeeper to much of the food and snacks that their children ate, however there was a significant amount of collaboration between family members in deciding what foods to purchase and prepare.

For primary caregivers, Family Snack Buddy helped them worry less about what their children were eating and helped them plan, prepare, and purchase food. First, primary caregivers were comforted that they had the ability to view the family snacking details of their children because,

normally, they often did not know what their children ate throughout the day:

“I don’t always know what he is eating throughout the day. I only know what he is having when he is with me, and see in that, he is willingly putting in what he is eating. So yeah I enjoy that, I like that” (PC6)

Having greater awareness of their children’s behaviors decreased their uncertainty of what the secondary caregivers were eating, creating greater peace of mind. This was best exemplified by PC3, who had repeatedly described worrying about what SC3 ate at school or when she was not around. However, after using the application for four weeks, she described feeling less uncertain about SC3’s eating behaviors and gained a greater sense of control over the issue: *“I know she’s not like, eating stuff, like if I have the non – the less healthy stuff in the house, I know she’s not eating that, she’s eating stuff that I would prefer her to eat”*.

Secondly, the application prompted primary caregivers to prepare snacks ahead of time for their children and purchase healthier foods for the home. For example, PC4, who was a mother of four and worked full-time, mentioned that the awareness of her children’s eating habits motivated her to plan meals to ensure they were eating healthy: *“It is useful because then I can view my kids’ snacks if they are not eating healthy at school. Or view what they are putting in because maybe then I can have something planned out where they make sure they go to school with something [healthy]”*. Primary caregivers discussed purchasing healthier foods, especially fruits, more often when they were at the grocery store. PC2 described how she used the suggestions from the application to purchase fruits *“instead of candies or cookies”*. We also found an increase in the self-reported, post-intervention availability of fruits that the intervention group had in their homes compared to the control group that approached significance,  $F(1,17)=3.42$ ,  $p=.082$ , suggesting that the intervention group participants either purchased more fruits or became more aware of the fruit they had in their home.

For secondary caregivers, Family Snack Buddy motivated them to eat healthier and gave them new ideas of foods to eat. Secondary caregivers described an increased motivation to eat healthier that came from a greater awareness of their parents’ snacking behaviors. When they were

aware that their parents ate healthy, they wanted to improve their own behaviors. SC4 described how seeing her mother eat healthy motivated her to do so: *“I don’t really eat healthy and I noticed that my mom does, so I’m like ‘maybe I should eat more healthy,’ cus I think it’s better to eat healthier like now since I’m younger so it becomes a habit when I’m older”* (SC4).

Secondary caregivers identified new snack ideas through seeing primary caregivers’ behaviors. Some of these ideas came directly through the application as several secondary caregivers looked at the primary caregivers’ phones to see the snacks that they were eating for new snack ideas: *“Yeah, and like, I see what she’s eating, and I’m like, ‘hm, maybe I should have some.’ But if it’s gross, I’m like ‘no thank you’”* (SC2). Other ideas came from being more aware of what the primary caregivers were eating when they were together: *“if mom were [eating] something healthy, like bananas, then I would be like, ‘yeah! let’s get bananas’”* (SC3). As SC3 described, when secondary caregivers got new ideas, since they often were not in charge of purchasing food in the household, they would ask their primary caregiver to get specific, healthier snacks.

Lastly, secondary caregivers repeatedly discussed how they compared their own behavior with their primary caregiver. This was often in the context of the game, but also outside the game: *“I see what she’s doing and in mine it says she’s [eating] healthier than me, so then I’m like ‘oh crap’ so then I really think about it and then I choose a healthy food over a fat food”* (SC4). Secondary caregivers described instances of when they would compare a snack choice they made with their primary caregiver’s snack healthiness to get a sense of whether the snack was more or less healthy than what their primary caregiver was eating. SC3 compared her snack choices with her mother’s snack healthiness level throughout the study. When she found that her mother was eating healthier, she internalized a belief that she could eat healthier – a belief around her own self-efficacy – and would say to herself, *“oh wow, okay I think I can improve this.”*

#### 4.3.3 Behavior change

During our conversations, participants indicated that Family Snack Buddy affected their eating behaviors in a positive way. There was a statistically significant improvement in the relative

portion of fruits that participants reported in their diet in the PEI,  $F(1,17)=4.89$ ,  $p=.041$ . On average, the intervention group increased the ratio of fruits to the rest of their diet by 7%, while the control group remained stagnant. We did not, however, find a significant difference between the two groups in the ratio of vegetable consumption,  $F(1,17)=.89$ ,  $p=.35$ . The qualitative analysis of the PEIs and semi-structured interviews supported the finding that Family Snack Buddy had a positive effect on participants' eating behavior. Participants identified specific foods, like Hot Cheetos, that they replaced with healthier foods, such as strawberries. Some of these changes were driven by the recommendations of the application, such as with SC6: *"it showed me some healthier snacks, like when I had a Gatorade, it showed MIO<sup>4</sup> as the healthier choice."* We confirmed that SC6 added MIO several times after receiving the recommendation, even though he had never entered it before, suggesting that he had adopted the snack based on the recommendation.

Participants discussed the ways that the application helped them eat healthier:

"I actually really slowed down on snacking. I didn't realize how much snacking I was actually doing until I started doing that and then, so, I've really slowed down on my snacking" (PC2)

PC2 noted here that she was specifically trying to snack with less frequency. Other participants described other aspects of their eating behaviors that they improved such as working towards eating a more diverse diet or eating out less. PC5, for example, discussed preparing foods and snacks at home as one way to reduce the frequency of eating out: *"before I [used the application], 90% of the time I don't cook. So but, now since I [started using the application] I try to cook more at home."*

#### 4.3.4 Potential mechanisms for change

Although we did not measure theoretical constructs, the questionnaires and qualitative findings suggested several mechanisms by which the application may have affected users. In this study, we identified five potential mechanisms of action by which Family Snack Buddy may have affected

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<sup>4</sup> MIO is a sports drink, similar to Gatorade, that had a higher star healthiness rating than Gatorade



users – 1) increased awareness of their behaviors; 2) enhanced self-efficacy; 3) improved sociostructural support; 4) shifting norms towards healthy eating in the family; 5) changes to the home environment in which food behaviors and decisions were taking place (e.g., having more fruit in the house).

#### 4.3.4.1 Awareness

Participants described an increased awareness of personal snacking behaviors that enabled them to make healthier snacking decisions. SC4 summarized this change in awareness when she said, *“I was always like, I don’t eat a lot, but I do. I actually do eat a lot, and I do eat unhealthy. And so it made me realize I need to start eating better for myself.”* Although awareness may not be sufficient or necessary for behavior change, it can play an important role in helping individuals recognize a need for change and identify areas to make improvements. For example, participants described becoming more aware of specific snacks they ate too often or too infrequently, which they could then work to reduce or increase:

“Yeah I noticed I was eating a lot ... less vegetables, I noticed I wasn’t, we weren’t having vegetables and stuff, or I was eating too much candy going in there putting in candy. I’m going in there and like, ‘I’m putting in candy again?’” (P6)

Many participants associated an increased awareness of their snacking habits with increased intentions to eat healthier, as suggested by SC4: *“I’m starting to be like oh, I need to be more healthier and I try, when I go to the store or something, I usually am like – ‘let’s get this instead of this.’ Like with Hot Cheetos.”* Behavior theories suggest that, although intentions do not guarantee behavior change, they are one of the strongest predictors of change [53].

#### 4.3.4.2 Self-efficacy

Although we did not objectively measure the effect of the application on self-efficacy, the qualitative data suggests that participants increased their self-efficacy regarding eating healthier foods. In the semi-structured interviews, participants used phrases like “I can” and “I know” that

implied they were confident in their ability to adopt a healthier diet and ready to take action. SC2 told us how she acted on a healthier snack suggestion from the application and ate a chicken burger instead of a ground beef hamburger. After adopting the suggestion to eat a chicken burger, SC2 reviewed the next set of suggestions and was confident that she could act on the information in the future. Participants successfully adopted small changes recommended by Family Snack Buddy, thereby potentially improving their self-efficacy and making them more confident about adopting future dietary changes. They also discussed reflecting on their previous snacking habits, through the personal snack history, to see where they had done well in the past and areas where they could improve in the future: *“Every time I entered something I would see what I ate before. To see if it was healthier than what I ate last time”* (SC2). Being able to reflect may have increased their self-efficacy for acting in the future.

#### **4.3.4.3 Family support**

Family members provided support for each other directly and indirectly through the application. Participants would send their family members reminders through the messaging feature to eat healthy snacks and to make sure they were entering their snacks. Families would discuss the snacks that they entered into the application, their progress in the game, and their overall snack healthiness. The application also sparked broader conversation about healthy eating within families such as for the family of PC2 who started looking at the nutritional information on the packaging of their snacks with the entire family, not just those using the application. PC4 started a weekly cooking rotation with her family where different family members picked a meal to cook and received support from the rest of the family in preparing it. Participants told us that they felt a sense of shared commitment and support having another family member using the application, as opposed to just using it on their own:

“Like she’ll be like ‘are you typing in your foods?’ and I’m like ‘yeah, are you?’ and she’ll be like ‘a couple days I haven’t, but I need to’ and I’m like ‘oh okay’ so yeah we’ll remind each other or we’ll talk about what we have been eating” (SC4)

#### 4.3.4.4 Norms

Primary caregivers established healthy norms within Family Snack Buddy by eating healthy snacks and maintaining a high average snack healthiness. Secondary caregivers, as the oldest children in the family, also helped establish family norms around eating, though outside the application:

“[my siblings] copy what I eat, so if I eat something healthy then they will follow me and eat something more healthy. So [it’s important to] choose the foods that are better for you, than foods that are not” (SC4)

Our conversations with participants suggested that users became more aware of their family members’ snacking behaviors. An awareness of the primary caregivers healthy snacking successes helped the secondary caregivers develop a sense that healthy eating was important and something they should be doing. SC2 described how she would grab her mom’s phone to look at what foods her mom was eating. SC2 found these interactions, where she could see this information, as valuable in motivating her own snacking: *“you could see what your mom was eating throughout the day and were like she is eating healthy maybe I should be eating healthy.”* The influence of family awareness also may have worked in the other direction where the children influenced their parents. Because the parents knew that their children could see the healthiness of their snacks, they described eating healthier to model better behaviors for their children. Several primary caregivers discussed the importance of modeling healthy behaviors and creating a culture within the family where they are constantly working towards making healthier snacking choices. For example, when discussing the responsibility for preparing healthy foods P4 stated: *“I want them to have ideas and us all do it, instead of them just having mom do it.”* Here comments suggested a desire to change their family culture.

#### 4.3.4.5 Environmental changes

Participants described how they changed their environment to better facilitate healthy snacking. We found an increase in the self-reported availability of fruits that the intervention group had

in their homes compared to the control group at the post-intervention period that approached significance,  $F(1,17)=3.42$ ,  $p=.082$ . Furthermore, participants reported having more fruits available in their homes after using Family Snack Buddy:

“usually I’d have a bag of chips or something, but like, now I still have chips, but like I’ve been, my mom’s been buying fruit now so we’ve like been eating oranges and stuff” (SC2)

These changes could be attributed either to purchasing more fruits or simply being more aware of the fruits available. Participants described how they used the application when they went grocery shopping to explore new snack ideas that they could purchase. Some primary caregivers, like PC4, started to pack healthy snacks for their children to bring to school because they noticed their kids were entering unhealthy snacks at school.

SC5 also highlighted how she was changed her environment to support healthy snacking by packing healthier foods for work instead of purchasing foods or packing unhealthy snacks: *“Like I go to work, I work, at the bridge project, I bring dinner there because I stay there late so I eat there and I usually bring junk food and so my friends would share it with me because they liked that, but lately I have been bringing fruits and all that healthy stuff.”* The qualitative and quantitative data suggest that participants actively changed the environments where they ate food, such as their homes, work, and school. Motivating users to bring more fruits into their homes may, in part, account for the positive effects we found on the healthiness of snacks reported by the intervention group and the increase we found in the amount of fruit in their diet.

#### **4.3.5 Barriers to healthy eating**

In discussing their eating behaviors, participants described several barriers that prevented them from eating healthier. The most prevalent of these included challenges with accessing healthy foods (both with physically accessing them and with affording them) and their busy schedules and life demands.

#### 4.3.5.1 Challenges with healthy food access

For most participants, they were able to identify at least one grocery store that they could shop at on a regular basis. They also identified other food outlets that they would use to access food such as restaurants, corner markets, and convenience stores. The choice of store they used to get food often depended on the convenience of the store: *“Yeah, and it needs to be quick and nearby. You can go to a fast food place or a 7-11 and grab something quick like that”* (PC6). Food outlets that sold primarily unhealthy foods, like fast food restaurants and convenience stores, were inherently more convenient and took less time to access. This improved the access of unhealthy foods, which ultimately affected participants’ food choices and eating behaviors.

Stores that were on the way to another activity were especially convenient because they could save time by stopping en route. This idea of coupling food access with other trips to save time and effort was a common practice we heard about:

“I stopped because I wanted a coffee. So then I end up getting like a – the yogurt and I saw the fresh food and I got a salad. I was like, ‘oh yeah they got salads that are really good there so you should try it’ ... It was good. The salad was really good. ... [It was on the way] to work, yeah I had to stop and get gas” (PC4)

Those who did not have access to a car, instead relying on the public transit system or walking, had the greatest difficulties in physically getting food. They ultimately had more limited options in terms of getting food, especially healthy, fresh foods:

“It depends on the area [you] live in. So accessibility to a store that actually has the fruits and vegetables offered. In our neighborhood it’s more convenience stores close, and they don’t really offer the healthy foods. So it just, it’s ... accessibility and transportation: getting to a further location to get the healthier stuff that [you] need or want”

Cost was by far the most common barrier that participants described to getting healthy food and, more broadly, to eating healthy food in general. Participants felt confident that healthy foods, especially fresh fruits and vegetables, were more expensive than other foods:

“[We don’t eat healthier] because of the price. The food. [It’s] more expensive than unhealthy, mmhmm, because you can buy a TV dinner for a dollar, with all the sodium, or you know, all the stuff then to prepare a whole meal for \$30-\$40 for a family. And you can spend less than that. Say your family is 6 [people], 6 TV dinners for a dollar and feed everybody or a hamburger then to prepare ... Or sometimes at King Soopers (a chain supermarket) it is 10 for \$10 so you can buy 10 of them and have all these meals to then prepare a whole full meal, instead of buy the chicken, buy the vegetables, the vegetables and fruits are my most expensive thing when I go to the grocery store.” (PC4)

#### 4.3.5.2 Eating what’s available

One of the major reasons that participants stated for not being able to make a healthier choice or change their behavior was that they often ate whatever was available. This could be in the context of a job, such as PC3 who would snack on popcorn and soda because she worked at a movie theater and it was there, or at school where some meals and snacks were served to the students:

“The ones that are the big meals that is just how Boys and Girls Club does their snack. It is a rounded meal that they consider a snack because they are giving it before 5 o’clock. But they call it snack so that when the kids are over there after school it looks like a meal. But that is our snack but it tides us over to dinner too.” (SC3)

In some cases, the issue of availability undermined the ability of Family Snack Buddy to support behavior change. For example, PC3 described how she never adopted the healthier snack suggestions because she was going to eat what was already available to her: *“No, I’ve never done that (referring to trying a healthier snack suggestion) because it’s usually whatever’s available. Because if I’m at work it’s usually just the easiest thing to get ‘cus – for me it’s the easiest thing to snack on at work is the popcorn so – thats just what’s available right there.”* (PC3)

PC6 also felt that the snack suggestions were not as beneficial as they could have been because she was limited to the snacks that were available to her. Getting just-in-time feedback about the snack she was about to eat was actually frustrating for her, because there was nothing she could realistically do about it. She felt like there was some benefit in terms of learning about healthier

snacks for the future, but that came at the price of creating frustration and a sense of helplessness:

“I guess the suggestions of the snacks that are suggested when there were snacks on there that I did find on the app and then it gave some suggestions to those. I see those being helpful, however they weren’t very helpful to me because I felt in that moment I am going to eat what I have right there and for the snack – the suggested snacks or meals it is like I am not going to go and run out and get that snack in that moment but I guess for future reference or whatever it might be helpful. ... And then I felt that kind of defeats the purpose of the app if it gives suggestions of what you could eat at that time.” (PC6)

#### 4.3.5.3 School environments challenge healthy eating

Both primary and secondary caregivers raised significant concerns about the lack of access to healthy food in the school environment. In fact, they believed that the environment greatly facilitated unhealthy snacking and eating. Most families that participated qualified for free and reduced lunch, so secondary caregivers often ate the lunches prepared by school. Many schools also offered breakfast, so secondary caregivers would eat two meals provided by the school. This meant that a majority of their meals were under the control of the school food program. Primary caregivers expressed serious concerns about the quality of these meals and were concerned because they were primarily unhealthy foods like pizza and hamburgers: *“At school they can only have you know, they serve pretty much the same things every day like what she says she takes her pizza every and of course she is going to pick pizza of whatever obviously like whatever.”* (PC5) Secondary caregivers provided more insight into the fact that most of the schools they attended provided a mix of healthy and unhealthy options. However, they told us that there were more options for unhealthy foods there and that those foods were also the most appetizing. Their decisions, in this case, appeared to be both influenced by the school food environment and the options they had available as well as their own preferences.

Vending machines were also a major facilitator to unhealthy eating present in schools. Almost all secondary caregivers discussed getting food from a vending machine or at least “whenever [they] have money” to do so (SC3). During the PEI, SC1 took pictures of several snacks that came from vending machines, all of which were chips. When we asked whether she bought food from the

vending machines often, she responded, *“Mmhhh if I am hungry and I don’t have time to eat lunch or I won’t eat school lunch at all. So if I am hungry just to fill in before to work if I have money on me I’ll just get water and some chips.”*

#### 4.3.5.4 Busyness and a lack of time

Participants highlighted how their busy lives made it more difficult to eat healthy. They often found themselves grabbing whatever food was the most convenient for them at the time. This was especially common as they traveled from one responsibility to the next:

“[McDonalds] is real close. Mostly we just go to McDonalds, but occasionally we go to Wendys. [McDonalds] is convenient – it’s close. Cus it’s usually like [there’s] many of them. Our usual day where we go and come back there’s like exactly two McDonalds soooo, I mean if we’re like at the other end where we pick up my son from school – there’s a McDonalds there. If he’s hungry or somebody is hungry we’ll just stop there and get something to eat while we’re on the way to whatever. Or we’ll come here to the one that’s right down the street from us.” (PC2)

This level of busyness was common amongst primary caregivers who often worked multiple jobs, had to coordinate transportation and care for their children, and were ultimately in charge of putting food on the table. Not only did this get in the way of physically getting food, but it also made it very difficult to plan or prepare food for the family. When we asked SC4 about the meals her family ate, she stated they were often microwave meals because they didn’t have time to prepare anything else: *“No it is like microwave-able. Yeah that is mostly what [we] eat because [we] don’t have time for much else.”*

PC3 described how both time and cost interacted to make it basically impossible for their family to eat healthier foods:

“Usually the healthier the food the more expensive it is. A lot of people won’t get fruits and vegetables because they are expensive so they go for all the starchy foods which are the way the store is. They just – because they are cheaper and easier to fix. So it’s kind of the combination of the time to make certain things and for the most part I think the cost of everything. And like I know I don’t get organic because that is even more expensive than regular fruits and vegetables.” (PC3)



Navigating busy schedules was also common amongst the secondary caregivers who described schedules filled with school, extra-curricular activities, work, and social demands. SC1 explicitly stated that she believed her unhealthy eating behaviors were caused by her schedule: *“I notice a lot of unhealthy stuff I am eating and then it’s like – oh I shouldn’t be eating this but I have no other choice because it is there and I got to go.”* In our conversations with SC1, she described working close to 20 hours each week while going to high school and completing her schoolwork. She would wake up around 5:30a each morning to get to school and then immediately after school head to work, sometimes missing lunch and only getting a snack between school and work. Usually she wouldn’t arrive back at home until around 7 or 7:30p, which was sometimes after the rest of her family had eaten dinner. If she did not have a lot of schoolwork, she might heat up the meal or sit down with her mom to eat something quickly. If not, she would grab whatever was sitting out or sometimes even forgo eating. Amongst all these missed meals, she described going to a convenience store or fast food restaurant to grab something quick when she was really hungry. Although many of the secondary caregivers did not work jobs, they described similarly hectic schedules that led to grabbing whatever was convenient when they found themselves to be hungry.

#### 4.4 Discussion

Overall, participants responded enthusiastically to our application and described positive experiences. They appreciated the ability to receive feedback on snack healthiness, review their snack history, see family snacking information, and get snack suggestions. Although we found a decrease in the number of snacks entered over the four weeks, participants were still engaged at the end of the study – using the application almost every day. Furthermore, the decrease in snacks over the four weeks may be confounded with actual changes in their behavior, as some participants described eating fewer snacks as an outcome of using the application.

We attribute participants’ positive response and continued use, in part, to providing different user experiences that met the distinct needs of primary and secondary caregivers and engaged the entire family. Based on participants feedback, we believe that the demographic-targeted interfaces

were an effective way to engage two different groups of users that had different needs and interests with respect to behavior change. Our findings also suggest that facilitating interactions between family members may have helped contribute to continued use of the application. Participants focused on the family aspects of the application and highlighted the importance of their family when it came to their eating behaviors. We report on the family-aspect of the application in more detail and provide insights into how to design to support family engagement in another publication [194].

During the post-intervention interview and during the PEIs, we discussed participants' beliefs around healthy snacking and their snacking behaviors. Using Family Snack Buddy prompted participants in the intervention group to reflect about their behaviors and the factors that influenced them. Having a prototype application that people can use in their everyday lives served as a useful probe to explore their lived experiences [112]. Participants reported being more aware of their behaviors, which in turn, may have enabled them to more readily discuss those behaviors. Furthermore, they were able to describe specific ways that the application affected their beliefs and cognitions around healthy eating, suggesting a greater awareness or understanding of the factors that affected their behaviors. The application brought to the forefront the topic of snacking and, in some cases, challenged their current perceptions and beliefs around those behaviors. These moments, when individuals are forced to consider their own beliefs, are periods of learning and can be effective at helping people articulate factors that are underlying their behaviors [24].

In the remainder of the discussion, I focus on the ways that we can consider the environmental barriers that people face in the design of technologies to support healthy eating. I discuss several specific ideas, which include tailoring educational content to fit the context of the user, prompting long-term thinking, and supporting people in planning ahead. Lastly, I discuss how family engagement may be a strategy through which we can activate people towards restructuring their environment to make it more supportive of healthy eating.

#### 4.4.1 Supporting change in the face of environmental barriers

In our study, we found that environmental factors significantly affected participants' eating behaviors. These factors included access to healthy foods, their financial resources, the foods that were readily available to them (related to access), and their busy lives. Family Snack Buddy was an application that primarily tried to change behavior by enhancing knowledge and targeting psychosocial constructs such as self-efficacy. Yet, Family Snack Buddy had an unanticipated effect on participants' food environment. They described how, during their time using the application, they took action to address environmental factors that were affecting their behavior. SC2, for example, described how her family had started buying more fruit, especially oranges, which made it easier for her to eat healthy snacks. Other participants described changes in grocery shopping practices as well as packing lunches and snacks to increase the availability of healthy food at work or school.

Participants would often return to the issue of their environment and the barriers it created, even when discussing how Family Snack Buddy increased their knowledge of healthy snacking or affected their self-efficacy around making healthier choices. For example, PC3 described appreciating the healthier snack suggestions and the snack healthiness ratings because they helped her learn about better choices she could be making. However, she acknowledged often ignoring the healthier snack suggestions because she usually ate whatever was available and felt like she had little choice about that. Many participants described being constrained by what was available, even if they were motivated about eating healthier, had developed specific ideas for healthier snacks they could eat, or had greater intentions to snack healthier. They were limited by their ability to access healthy food, something directly influenced by their environment – their financial resources, their physical surroundings in terms of the convenience or relative access of stores with healthy options, the school environment, and other life demands that affected their time.

Interventions developed in the context of low SES communities would benefit from both acknowledging what people can access as well as supporting people in making healthy options more

available to themselves. Our findings suggest that increasing participants awareness, knowledge, and self-efficacy around healthy eating may have prompted them to engage in “environmental restructuring” where they tried to create environments that supported healthier eating [153]. However, directly supporting people in altering their environments may be even more effective than indirectly prompting these practices through other constructs.

Although the idea of influencing environmental factors is considered in many theories of health behavior, for example in the concept of reciprocal determinism in SCT [149], few sociotechnical interventions have tried to address these factors. Most sociotechnical systems designed to support behavior change focus on cognitive (e.g., knowledge, motivation, self-efficacy) [162, 51, 220, 30, 80] or social factors (e.g., social norms, social support) [145, 141, 54]. Certainly, technologists will not be able to single handedly develop systems and interventions that solve issues of poverty or install new grocery stores in communities where none currently exist. However, our research suggests several ways that designers and researchers can address environment factors in their work and in the interventions they develop.

#### **4.4.1.1 Tailor recommendations and education to the context**

When providing recommendations about healthier behaviors an individual can engage in, whether it’s a specific healthier food they can eat or a place they can go to exercise, it’s important to ground it in the user’s reality. For example, it would not be useful to suggest foods that users are unable to access because they cannot afford it or because they do not have access to a nearby store that sells it. We attempted to address this, to a lesser extent, by tailoring our recommendations to be small changes in healthiness, so we were not asking them to make huge changes in their diet. However, our recommendations did not consider the cost of items, their cultural-appropriateness, nor the extent to which an individual could access them.

Community members suggested they did not want price information explicitly included in the application, in our previous research [126], in the form of the actual price of foods or the relative price. However, the focus on the cost of foods as a barrier to eating healthier in this study suggests

that it should be considered in some way. In our previous work, participants were worried about being discouraged if healthier foods were more expensive, so seeing price in the application would reinforce the barriers they faced around affording healthy snacks. However, implicitly including this factor, by tailoring healthier snack suggestions based on price to recommend alternatives that are equal in price or cheaper would be a way to situate the application within the context of the users. In this way, price information is not visible to users and we avoid setting them up for failure by recommending snacks that prove to be too expensive once they go to purchase them.

It is also important that content aimed at increasing knowledge of healthy eating does not ask users to engage in behaviors that are outside of their means. Teaching people about eating a certain number of portions of fresh fruits and vegetables each day, when they don't have the ability to access fresh fruits and vegetables on a consistent basis, would be problematic and could discourage them from even trying. In fact, receiving a healthier snack suggestion that was outside of a participants ability to access was reported as a major frustration with Family Snack Buddy. Instead, we can teach users about how to eat healthy within the context of what is available to them. When thinking about Family Snack Buddy, we could have considered the types of foods that participants were already eating and recommend the healthiest of these, knowing that they had been previously able to access that food and, therefore, more likely to be able to do so again. In that way, we are helping increase their knowledge of how to eat healthy – knowing which snacks are healthier than others – while working within the constraints of their environment.

We found that even within a single community there were differences between participants' ability to access different foods. Tailoring at the community-level may even be too broad. Living in the exact same neighborhood and having a similar SES, but having no car versus having a car, for example, made a significant difference in the ability to access foods.

Asking participants about their context and the specific environmental barriers they face, as part of the interaction with a system, may help facilitate tailoring. This requires an understanding of the factors that are relevant in the first place – for example whether an individual has a car, their primary forms of transportation, and their monthly or weekly food budget. From there, we could

design applications to elicit feedback from users about how well information in the application fit their needs, relative to those factors. For example, users could provide feedback to the application about whether specific snack recommendations were outside their price range or unfeasible for other reasons – such as a lack of access or unfamiliarity. One could envision a simple interaction where the user could tap on a dollar sign icon next to each recommendation to identify a recommendation as too expensive. This is one of the major benefits of interactive systems over other modalities for supporting health behavior interventions. If we can learn about the individual’s context, over time, with simple, quick interactions, we can better tailor the information that we provide.

#### **4.4.1.2 Prompt long-term thinking**

Certainly, many healthy foods can be more expensive and an overall healthier diet is more expensive than a less healthy diet [116]. However, there may be items that people can purchase that fit their budget or that can be cheaper than other options. Specifically, buying healthy foods that transport easily would be cheaper than buying prepared or pre-packaged foods at convenience stores or fast food restaurants, which often mark up prices. Certainly, if we consider a single decision about what a person will eat, it may appear that a single, packaged food will be more affordable. But if we can help people consider the bigger picture of their diet across a number of days, they may start to recognize the value in investing more money up-front to save money in the long-term. These kinds of investments and plans, that may appear more expensive at first glance, can be rendered in a way that it emphasizes the long-term benefit, especially in terms of dollars, given the importance of cost among participants. Paying more money up front for a large bag of fruit may seem cost prohibitive, but once that cost is broken down across a number of days or a number of people, it will likely be more affordable than a prepared meal from the local corner store.

#### **4.4.1.3 Support for planning ahead**

Participants often described challenges making time to cook and prepare meals. They also emphasized a need for convenient, easy to grab food. This suggests that they may only have the

time to prepare a few meals or snacks within a given week. This is, in part, a challenge that could be alleviated by planning ahead to prepare a small number of meals and snacks that could last for multiple days and be portable. Interactive systems could be supportive in this endeavor, especially with an understanding of an individual’s schedule and identifying times that they could fit in preparing a meal that would last them a few days.

Another case where planning ahead can be valuable is in making stops at the grocery store. Participants often described situations where they would eat food from fast food restaurants or convenience stores because it better fit their schedules and was on the way from one location to another. For example, PC6 stopped and grabbed coffee and food at 7-11 because she was already going there to get gas. If stops at grocery stores were made just as convenient, or at least more convenient, participants may be more likely to make trips to the store. Helping participants plan ahead to stop at the grocery store, as parts of other trips and activities, could support them in shopping more often. At least one participant suggested they already tried to incorporate this practice – including stops at the grocery store as part of trips to other places – as a strategy to make it easier to shop more regularly. And given the challenges that participants described facing with their busy schedules, systems could help people plan grocery shopping as part of their other trips.

#### **4.4.2 Restructuring the home environment through family engagement**

Previous research has found that families often do not discuss health issues, especially if those conversations cause distress about the consequences of health behaviors [21, 105], yet family social support is important in behavior change [99]. By targeting the family, our application facilitated support between family members in working towards healthier snacking. Family members encouraged each other to eat healthier snacks and had dialog around healthy eating and snack ideas outside the application. They had conversations on topics ranging from the nutritional labels on food to what snacks were the healthiest. By getting participants discussing healthy eating as a family, we may have created some inertia towards making changes in the home environment that

would support healthy eating. For example, secondary caregivers provided examples of times that they requested their parents buy healthier snacks when they went to the grocery store. The home environment affects the snacks that are available, the meals that family members eat, how much they eat, and the food preferences that children develop [99]. We found that purchasing groceries was a family activity for many families, so having multiple family members advocating for healthier purchases may help increase the availability of healthier snacks, such as fruit. Increased availability of healthy foods would in turn improve the likelihood that families would eat healthier items. In addition, we found that family members noticed healthier options in their environment and brought those items with them to work and school. Engaging the family around the topic of healthy eating may be a strategy to activate people towards restructuring their environment to make it healthier.



## Chapter 5

### Study 2: Field-trial of Individual Snack Buddy

The field-trial of Family Snack Buddy suggested that there were important factors influencing eating behavior beyond those we had originally considered in using Social Cognitive Theory to inform its design. Specifically, we looked at specific psychosocial constructs that emerged, such as self-efficacy, norms, and intentions, to inform design because these constructs presented a clear path for informing design. To explore this further, we iterated on the Snack Buddy application and added specific theory-informed features. We then conducted a two week field-trial of the updated version of Snack Buddy to study the application and to explore the factors that affected participants snacking and eating behaviors, with an eye towards the environmental factors that we identified as prevalent in the first study. By better understanding these environmental factors, we hoped to unveil ways for technology to play a role in addressing them.

#### 5.1 Individual Snack Buddy with theory-based features

In the first study, participants described several mechanisms through which they felt the application affected them. The mechanisms that participants described resembled concepts from a number of health behavior frameworks – Social Cognitive Theory, the Theory of Planned Behavior, socioecological approaches, among others. Furthermore, participants described their beliefs around healthy eating when discussing their interactions with the applications. We found that the Integrated Behavioral Model (see Appendix A) best fit our needs to inform the iteration of Snack Buddy because it integrates the constructs from different behavior theories that have the

greatest empirical support. This includes the majority of the concepts that we identified in Study 1, such as self-efficacy, norms, intentions, and environmental factors. Because of this we selected the Integrated Behavioral Model as the guiding framework for Study 2.

The Integrated Behavioral Model (IBM) proposes that there are three direct determinants of behavior – 1) the intentions an individual has to perform a target behavior; 2) environmental factors; and 3) skills and abilities (see Appendix A). Intentions are, in turn, directly affected by three main constructs – attitudes, perceived norms, and personal agency [158]. Attitudes (composed of instrumental and affective attitudes) represent an individual’s overall feelings of favorableness towards performing a behavior. Perceived norms (including both descriptive and injunctive norms) reflect the social pressures that an individual feels to perform a behavior. Personal agency (composed of self-efficacy and perceived behavioral control) represents an individual’s perceived ability to overcome barriers and the extent that they feel they have control over their performance of a behavior. These three constructs are considered indirect determinants of behavior because they influence intentions, which in turn affects behavior.

In order to focus on providing a single experience for users with the construct-specific features, we consolidated Snack Buddy around a single interface based on the *informational interface* from Family Snack Buddy. By doing so, we removed the potential confounding variable of interface type that may affect users’ experiences and allowed us to focus on the needs of adult participants by providing a polished user experience. This individual-focused version of Snack Buddy, Individual Snack Buddy, maintained the core features of Family Snack Buddy – entering snacks, receiving star-based feedback, receiving healthier snack suggestions, and creating new snacks to be added to the snack database (see Figure 5.1). However, we removed the family engagement components of the application including the messaging, family snack history, and multiple interfaces. We also made improvements to the application based on the feedback from users during Study 1, which included the addition of a passive reminder system and user interface enhancements to improve data entry and viewing.

The reminder system prompted users to enter their snacks for the day or use a specific feature

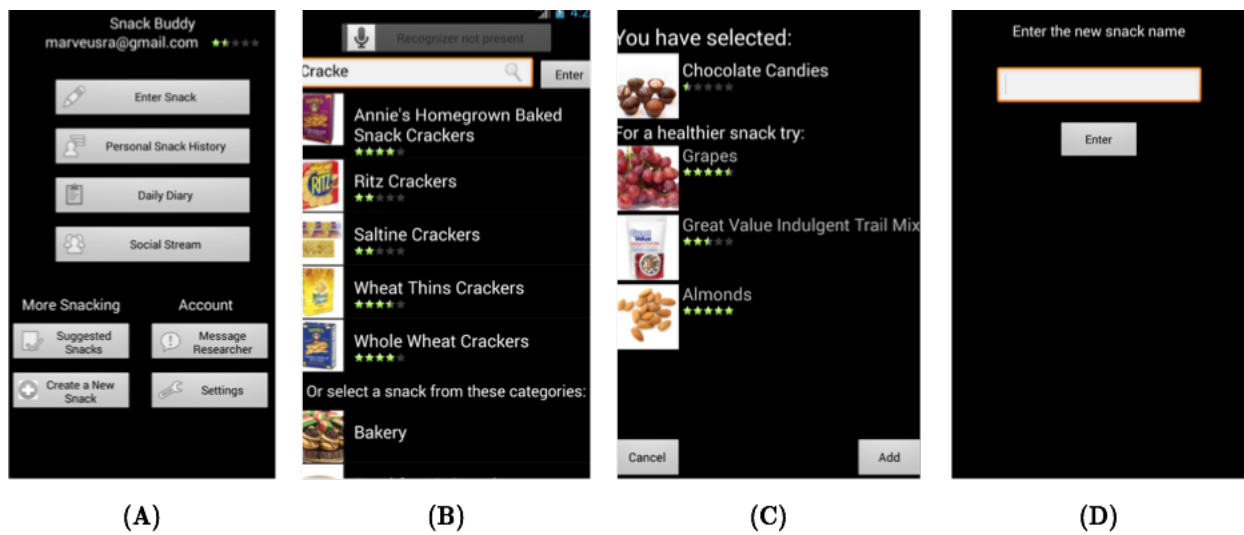


Figure 5.1: Screenshots of the new home screen and features that remained from Family Snack Buddy. Figure (A) is the home screen for the application. Figure (B) is the snack selection screen where users could log a snack they had eaten by typing or speaking (using voice recognition) the name of a snack or selecting it from a categorized list. Figure (C) is the snack entry confirmation screen where they would receive star feedback on the healthiness of the snacks they entered along with healthier snack alternatives. Figure (D) is the interface for creating a new snack that did not already exist in the snack database.

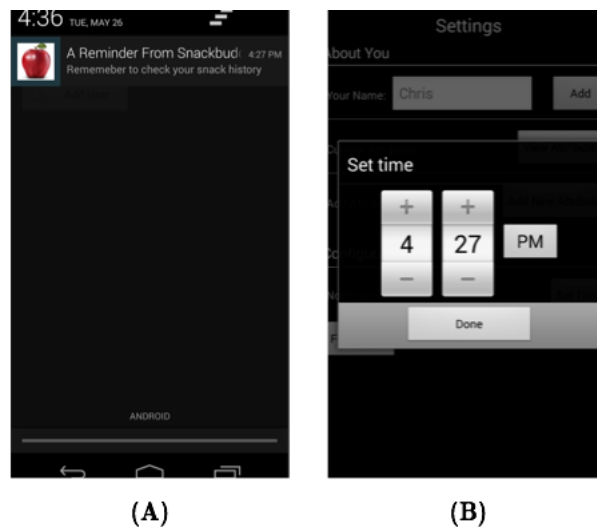


Figure 5.2: Screenshots of the reminder system. Figure (A) shows the reminder popping up on the user's home screen. Figure (B) shows how the user could set the time when the reminder triggered.

in the application that they used least recently (see Figure 5.2.A). We based the passive reminder system on previous work, which did not utilize vibrations or sounds to alert users, but instead put a text alert on the users' lock screen so that they would see it the next time they looked at their phone [26]. To ensure consistency across users, the reminder triggered once per day for everyone, however they could customize the time for the alarm to trigger (see Figure 5.2.B).

### 5.1.1 The design approach: Construct-to-Feature Design (C2F)

Based on the IBM, we developed features for the application that specifically targeted constructs of that theory. During this iteration, we identified the need for a construct-oriented approach to theory-based design that could guide our process and achieve the goal of more tightly integrating our design with behavior theory. Through our design and development process, we developed a novel approach called Construct-to-Feature design. The approach was inspired by the idea of dismantling studies in psychology where a full intervention or theory is decomposed into its components, so that each can be studied independently and in combination [25, 198]. In considering the design of a sociotechnical intervention, dismantling at the individual feature level presented a natural separation.

Through this approach, we first selected a health behavior theory that fit the target behavior and had well-defined constructs. We selected the IBM as our guiding framework because our previous research suggested it broadly encapsulated constructs that affected participants' snacking behaviors. After selecting a guiding framework, we chose the constructs that we felt our application was best situated to address and that were likely to affect participants' snacking behaviors. In the IBM, the constructs predicting intentions co-vary and interact, however they are proposed to independently affect intentions, which in turn influences behavior. Furthermore, these constructs are well-defined in their conceptualization and measurement, making the design process clearer. Of these well-defined constructs specified in the IBM, we selected three – self-efficacy, instrumental attitudes, and descriptive norms – as they were constructs distinctly described by participants in Study 1.

Briefly, self-efficacy, which is one part of the larger personal agency construct in the IBM, is an individual’s confidence in their abilities to perform a behavior in the face of obstacles and barriers. Instrumental attitudes are the cognitive aspect of attitudes that are driven by an individual’s assessment of the potential outcomes, negative and positive, of engaging in a behavior. Lastly, descriptive norms are the observational component of the perceived norms construct in the IBM and represent an individual’s assessment of what other people do, largely informed by what they see other people do. A more detailed description of these constructs and the IBM can be found in Appendix A.

### **5.1.2 The design of construct-informed features**

For each selected construct, we identified evidence-based strategies to create change within the construct. We relied heavily upon work by Michie and colleagues, which involved identifying behavior change techniques targeted to affect behavior determinants across theories [154, 153] as well as literature surrounding each construct. This enumerated a potential design space for each feature. The goal was to create a single feature for each construct that could be situated within the application. We also aimed to create features that had a high level of specificity for its target construct, meaning they had a high likelihood of affecting the target construct and a low chance of affecting other constructs within the theory. In the following sections, I describe the process for designing each individual feature.

#### **5.1.2.1 Personal snack history**

The personal snack history aimed to increase participants’ self-efficacy by highlighting their previous healthy snacking accomplishments – a well-documented strategy for building confidence in enacting a target behavior [143]. It is an implementation of the “Focus on past success” behavior change technique (BCT), which is targeted at improving one’s self-belief through reviewing personal accomplishments [155]. Bandura suggests that this approach of bringing attention to personal accomplishments is one route to enhance self-efficacy [19]. The personal snack history listed all the

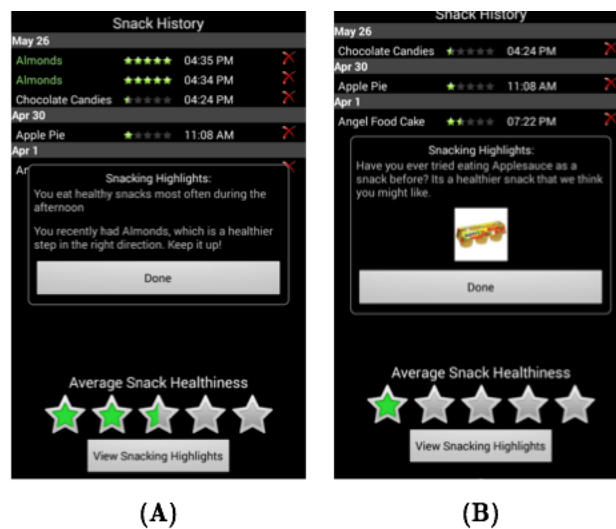


Figure 5.3: Screenshots of the personal snack history. Figure (A) shows healthier snacks highlighted in green and the snacking highlights window when there was sufficient history of healthy snacking to generate highlights. Figure (B) shows the snacking highlights window when a user did not have a history of eating healthier snacks to highlight.

snacks an individual previously entered, organized by day, and highlighted the healthier snacks that they had entered (those with  $\geq 4$  stars) with green text to draw the user’s attention to them (see Figure 5.3.A). In addition, the personal snack history generated a daily list of healthy snacking highlights that popped-up once a day when the user accessed the personal snack history (see Figure 5.3.A). The daily highlight list was generated based on specific healthy snacking behaviors the individual exhibited, such as improving their snacking over time, having their healthiest snacking day, or eating a greater number of fruits and vegetables instead of junk food.

If the user did not have any previous healthy snacking successes to highlight, the application instead provided a targeted recommendation for a healthy snack to try based on their snacking history, if they had any (see Figure 5.3.B). This approach represented “Providing instruction on how to perform the behavior,” which is another route to enhancing an individual’s self-efficacy [154, 153]. It was similar to the healthier snack suggestions that they received after entering a snack, however it leveraged their overall snack history and presented it within the context of the snack history.

#### **5.1.2.2 Daily diary**

The daily diary was designed to improve users’ instrumental attitudes towards healthy snacking by prompting them to reflect on the potential positive outcomes that come from eating healthier snacks. The major challenge in designing to change attitudes is that they are driven by an individual’s values. Often, verbal or written persuasion is effective at shifting an individual’s beliefs about performing a behavior, which can in turn change their attitudes about that behavior. This requires knowing what each user values and tailoring messages for those values. If an individual doesn’t care about participating in sports, then telling them that healthy eating will improve their athletic performance may not be an effective intervention. But if they have a child, it may more likely resonate with the user to inform them that eating healthy will model good behaviors for their children.

We designed the feature to help users think about their own values around healthy snacking. We developed an open prompt where people could reflect on their values. We originally chose the

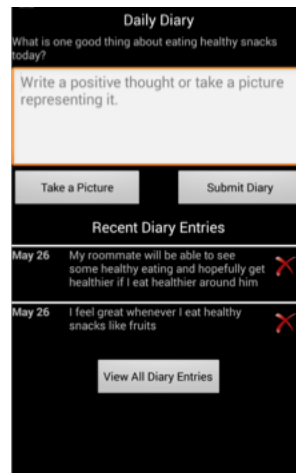


Figure 5.4: Screenshot of the daily diary where users could create diary entries by either typing in a free-text form or by taking a pictures. They could also review their previous diary entries.

broad prompt, **“What is something positive about healthy snacking.”** We aimed to prompt users to focus on the positive aspects of the healthy snacking behavior, which would in turn shift their overall attitudes towards the behavior to be more positive. After conducting a Cognitive Walkthrough of the application, we realized that this prompt was too broad and made it difficult for people to generate ideas. Based on that finding, we focused the prompt to: **“What is one good thing about eating healthy snacks today?”** By including the word “today” in the prompt, we hoped that users would focus on the events of their day in thinking about healthy snacking, which would in turn bring some diversity to their responses since each day is different. We also specifically asked about a “good thing” to focus their reflection on tangible outcomes of the behavior. The IBM proposes that the instrumental dimension of an individual’s attitudes are determined by their beliefs about behavioral outcomes. By focusing on these beliefs about outcomes, we hoped to focus the effect of this feature on instrumental attitudes instead of affective attitudes, which relate to the emotional response an individual has when thinking about a behavior [75].

We used a free-text response block to give people flexibility in how they recorded their thoughts (see Figure 5.4). We wanted users to take a few moments to consider the positive aspects of engaging in healthy snacking, so we felt that having them write a short response would be a



good way to focus their mind on that positive. But, we were worried that for many, having to type out a response on their phone would be too time consuming. This led us to include an option to take a picture of something representing the positive aspect of healthy snacking. For example, they might take a picture of their kids, if they felt that modeling healthy behaviors, for them, was a positive part of healthy snacking.

Lastly, we wanted people to be able to see their previous diary entries, so that they would serve as a reminder of the positive aspects of healthy snacking. Repeated exposure to information can be more effective at creating behavior change than just a single exposure to that information [31, 27]. In the application, we showed the three most recent diary entries on the same screen as the prompt and diary entry field (see Figure 5.4). We also allowed them to review all of their previous entries in a table on a different screen.

### 5.1.2.3 Social stream

People’s perceived social norms around a given behavior are shaped by the social pressures they feel from others, especially those who are close to them or who are similar to them. Descriptive norms, specifically, are formed based on what an individual sees other people doing with respect to a given behavior. Persuasive information demonstrating that key referents engage in a particular behavior can be effective at shifting an individual’s perceived norms about the behavior, which in turn affect their behaviors [100]. Michie and colleagues call this BCT “Providing normative information about others’ behavior” [153]. The effectiveness of this persuasion depends on the extent that the person reading it identifies with the group being described [186]. Previous research has leveraged this in media campaigns intended to change people’s perceived norms about a behavior [195, 184]. Typically these campaigns craft messages that highlight how other people who share a social identity perform a certain behavior.

We leveraged this approach and enhanced it with dynamic content, which could be supported in a sociotechnical intervention. Instead of static messages that would be seen over and over again, we showed different messages with new content several times per day (see Figure 5.5).

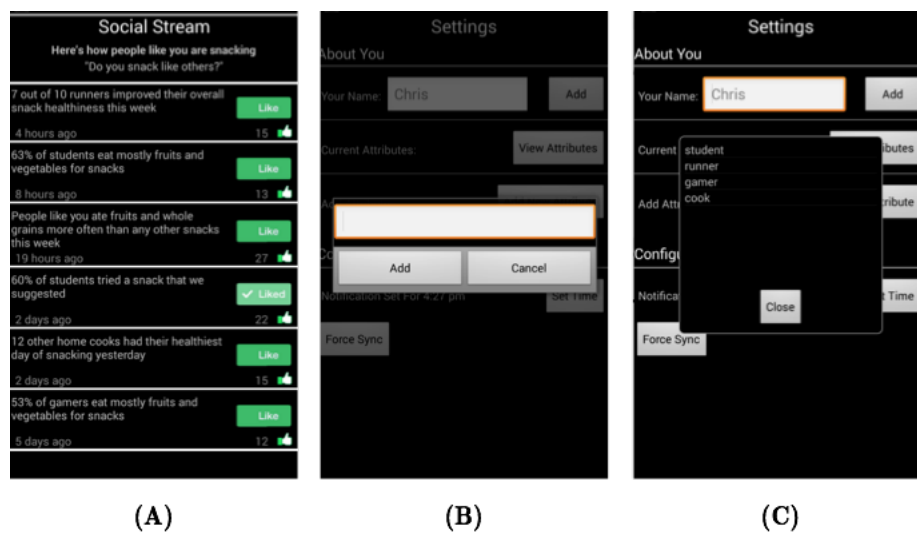


Figure 5.5: Screenshots of the social stream. Figure (A) shows the social stream filled with entries that the user could view and ‘like.’ Figure (B) shows the interface for adding an “attribute”, which was done before using the application through a referent group elicitation exercise with a researcher. Figure (C) shows the interface for viewing the attributes a user had added.

We first identified relevant social groups for each participant, so that we could ensure the messages they were receiving were for social groups that were relevant to them. We asked participants during application set-up about the three social groups that they most identified with (see Figures 5.5.B and 5.5.C). We generated 33 different message templates that were delivered to the social stream feature on participants’ phones over the course of the two week study (see Appendix F). The different referent groups that the participants identified with were substituted into each message. In this way, different participants were exposed to the same content during the course of the study, but tailored to their referent groups.

In considering the IBM, we identified guidelines in designing content for the social stream. It needed to be believable, make participants feel as if a significant proportion of their referent groups were engaging in healthy behaviors, and avoid providing specific details of behaviors in which similar people engaged (e.g., “30% of swimmers ate carrots today”). This last guideline was important in focusing the effects of the feature on perceived descriptive norms and not other constructs. Providing information about the detailed behaviors of referents may act as modeling healthy snacking, which is a strategy that enhances self-efficacy [19]. Exposing participants to messages that modeled specifically how to snack healthy would have undermined our effort to affect only one target construct through each feature.

Simply displaying the simulated social stream might not be a sufficiently engaging experience for users and if they failed to see the messages, then the feature would have no effect on their perceived norms. Thus, we added a “like” button, similar to that in Facebook, along with a simulated count of likes that was displayed under each message. We anticipated that these two small changes would provide a greater level of engagement and make participants feel like they were actively involved in a community of other users with similar experiences.

## 5.2 Methods

We conducted a two week field-trial of Individual Snack Buddy to explore users’ experiences with the application and the ways in which our design decisions affected those experiences (see

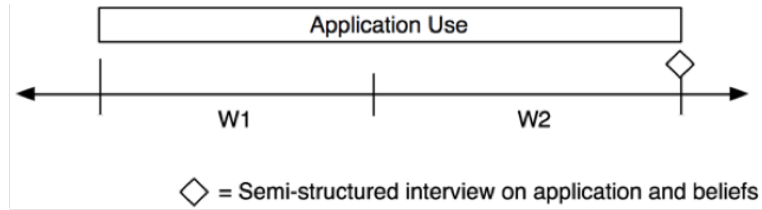


Figure 5.6: Overview of the research activities and study design for Study 2.

Figure 5.6). Furthermore, we used the application as a technology probe [112] to explore the factors that influenced individuals' eating behaviors and elicit beliefs held by participants that aligned with the individual constructs and determinants of the IBM. The practice of eliciting beliefs is common practice in using a reasoned action approach, such as the IBM, to inform intervention design and helps to understand the key factors that are relevant to a given behavior [158].

In this study, participants used Individual Snack Buddy on their own, personal Android phone for two weeks. Before beginning the study, we met with them to complete a background questionnaire (see Appendix D) and install the application on their phone and train them on using it. We asked them to test out all of the aspects of the application to demonstrate their understanding of how to use it.

After using the application for two weeks, we conducted a semi-structured interview at the end of the study to explore participants' experiences using the application and with healthy eating. The semi-structured interviews were video recorded and lasted between 27 minutes and 1 hour and 7 minutes [average = 47:43]. The interviews focused on 1) participants' experiences using the application and its individual features; 2) ways that the application influenced their behaviors, beliefs, and knowledge; 3) their beliefs and attitudes around healthy snacking; and 4) their barriers and facilitators for healthy snacking. To elicit beliefs held related to IBM constructs, we used specific interview questions based on those modeled by Montano and Kasprzyk [158]. These specific questions (see Appendix E), which were asked of all participants, included questions about how participants felt about the idea of healthy snacking and the factors that affected their snack eating behaviors. All videos were transcribed for analysis.

### 5.2.1 Participants

We recruited 26 participants using a maximum variation sampling approach [179] across dimensions that we expected would affect application experience the greatest – socioeconomic status, age, intentions, and experience with mobile applications. Participants received a \$20 Amazon gift card for participating. One participant dropped out of the study in the first week due to phone problems. We analyzed the remaining 25 participants – 15 identified as female, 9 as male, and 1 as genderfluid. Nineteen participants identified as white, 3 as Hispanic, Latin@, or Chican@, 1 as African American, and 2 as Asian. Participants ranged from age 18 to 59 (mean = 31.2), with five individuals over the age of 50. Eight participants had no prior experience using mobile health applications, thirteen had used 1 - 2 applications, and five had used 3 or more applications.

### 5.2.2 Analysis

We used an inductive, qualitative analysis where we open-coded transcribed recordings of the semi-structured interviews to identify emergent categories [190]. The initial coding process was conducted by myself and then the categories that emerged were discussed with the research team and grouped into high-level themes.

## 5.3 Findings

Overall, Individual Snack Buddy garnered a mixed reception from participants. For some, the application was too simplistic to meet their needs. For others, there were too many features to engage with and use on a consistent basis. Many appreciated the application overall and its simplicity, but pointed to small changes that they felt would improve it. In the following sections, I describe participants' experiences using the application and with the specific construct-informed features. Following that, I describe the ways that participants' food environment affected their eating behaviors. Through the belief elicitation process of our semi-structured interviews, environmental factors were discussed more often than other factors affecting their eating behaviors. As

such, I explore this factor and how it affected participants eating behaviors in detail.

### **5.3.1 Tensions around simplicity**

The simplicity of the application made it more approachable for users and made it easier for them to use it regularly because it did not demand much from them with each interaction. However, this simplicity limited the value that some participants derived from the application because it lacked the complexity they were looking for. In fact, the primary reason that participants both praised and criticized the application was its simplicity. There were multiple facets of the application where simplicity was at tension with other needs they expressed. These areas of tension centered around the focus on snacks, the simplified entry without portion sizes, and the feedback system.

#### **5.3.1.1 Focusing on snacks**

The first area where we found tensions around the simplicity of the application was in the overall scope of the application – its focus on snacks. Some participants very much appreciated the focus on snacks, especially those who had tried to track their entire diets before, because it was easier to just enter snacks as opposed to one’s entire diet:

“I think the focus on snacks was probably really good, even though I didn’t really struggle with it, I think that just as an application it just was probably a good direction to go in, as opposed to meals. Cus I’ve done the meals [tracking] and it tends to get really tedious having to mark them every single time I eat, ughhhh.” (P10894)

Not only was it easier to input data regularly, but it also allowed people to focus on a smaller subset of behaviors instead of trying to conquer one’s entire diet. Learning to snack healthier could then be applied more broadly to one’s entire diet:

“I mean I think it was a good start, because I guess it is a good start as a way to track your food and help you eat healthier versus than looking at something as complicated as a meal and you can apply whatever you learn from your snacks to your meals anyway.” (P10922)

However, a number of participants did not like the simplicity of the application in terms of focusing on snacks only. These participants were especially interested in tracking meals in addition to their snacks. For one participant, tracking both snacks and meals would give him a better sense of his whole diet, which would enable him to more effectively identify patterns in his behavior that he could work to improve:

“I actually wish – you know, it’s interesting that this is just for snacks. I think that this would be a great app for all food patterning so that not only [would] I have logged snacks but I [would’ve] logged meals and I’m thinking, ‘Oh my God, I had three meals plus I had six snacks. I really need to do something about this.’ And it’s really easy to sort of compartmentalize that the snacks aren’t so bad even though I’ve already had, you know, maybe I’ve had meals. Or if I’m snacking, you know, how do I determine whether this is actually a meal or a snack when I’m really only snacking all day? And I’m not getting the meal [information].” (P10920)

Some participants also expressed frustration with defining “a snack”. The question of what was a meal versus a snack posed a challenge to using the application, as described by P10915: *“I would say that is kind of difficult a little ... you don’t know if that [should] be counted as a meal or snack. That is one kind of thing that was like a little confusing there.”*

During the initial meeting, we explicitly told participants to use their own personal definition of a snack because we recognized people viewed snacking differently and we wanted the application to fit a broad range of users. However, this was a bit puzzling for some participants. And, of course, the decision to focus on snacks made the application less useful for individuals who primarily ate meals and rarely ever ate snacks:

“I mean there were some days where I actually didn’t snack at all. It was really I just – it was just a meal, a meal because yes you can have eggs and things like but it was like an actual like – it felt like an actual meal, not a snack. So then I personally didn’t consider it a snack” (P10911)

For those that did not snack often, they found themselves entering fewer snacks into the application. There would be entire days or periods of days where they would not enter any snacks and having these periods of time without data made the application less useful for them.

### 5.3.1.2 Simplified entry

Participants also discussed tensions around the simplicity of the snack entry process. Unlike many other applications, in Individual Snack Buddy users simply selected a food that they ate as a snack and then the application added it as a snack that was eaten once. It would then time stamp the entry at the time it was entered. In this process, users could not alter or add any additional information about the snack. Many participants appreciated the simplicity of this approach and stated that this simple snack entry process increased their use of the application. However, participants identified two major challenges with this process – a lack of portion sizes and less meaningful time stamps depending on when a snack was eaten versus when it was entered.

Some participants felt that the portion size of a snack was an important factor in its healthiness. A half of an apple is not necessarily as healthy as eating an entire apple. And as P10914 suggested, there was a significant difference between one piece of an unhealthy food versus having multiple pieces of that food: *“When you say cookie, sometimes I ate five cookies. Five cookies is very unhealthy compared to one cookie. ... So when I say potato chips [in the app], some people eat a whole bag of Lay’s potato chips. Some people just eat a handful.”*

This left users with less information about their snacking behaviors. Furthermore, the information captured by the application may not be a fully accurate picture of their snacking without portion size. Not capturing portion size information also failed to give credit to users for adjusting their behavior by eating less of an unhealthy food or more of a healthy food.

Participants also expressed some frustration around the time stamps of snacks being when they were entered and that they could not edit that value. Again, this decreased the accuracy of the data and potentially its usefulness when trying to make sense of it:

“I think, you know, I’m not so Type A so it didn’t bug me but I know if I was, I would want to be able to be very precise in terms of knowing for a fact, okay I want, I want it to be correct. Like no, I didn’t eat it [inaudible] all at this time. I actually ate – it was actually throughout the entire day that it was eaten.” (P10911)

This was especially problematic given that participants highlighted information about the



time of day of their snacking as some of the most valuable information for understanding their behavior and recognizing patterns. Time of day information was identified as highly actionable information that a person could use to help them better plan their food situation and prepare to handle less healthy snacking periods:

“I know I eat ice-cream really late at night. I just don’t really pay attention. It just kinda happens. So I think it would be good if it said, ‘you eat ice-cream late at night. Try and eat something healthier.’ I think that would be really interesting. I think that would be really interesting and helpful. I think that time of day [information] is really useful. Especially because the time of day is really useful to me. [Depending on] the time of day I can go to [the store] to prepare and grab some fruit or some applesauce or something that’s easier for me cuz if it’s after midnight and it’s late then I’m kinda limited to what is in my room and I don’t always have healthy stuff.” (P10891)

One participant actually decided she wouldn’t enter snacks that were eaten at a different time than they were entered. This meant that any snacks that were not entered as they were eaten (either close to the time before or after they were eaten) were never entered at all:

“That would have been really helpful if I could have gone back and actually entered the time or changed the time somehow. Because then what I feel as I go back through, it’s not exactly how I was eating. So I didn’t log it at all because it was like well that’s not when I ate it.” (P10920)

There are implications for users with this kind of appropriation of the data entry process in that they have a less complete picture of their snacking behaviors. They may be using the information in the application to better understand their behaviors and the data in the application could be incorrect or incomplete based on how they enter it. Furthermore, there are challenges for researchers in trying to make sense of participants’ data when there are gaps in the data driven by the way they use the application.

### **5.3.1.3 Simplistic feedback**

Our original design catered to people with lower health literacy and numeracy by providing a simple star rating, from 0.5 to 5 stars, that indicated, overall, how healthy an item was. There was

no feedback in terms of calories, protein, or other quantified nutritional information. Participants in this study, most of whom were not low SES, had mixed responses to the star rating system being the only feedback provided for each snack. Many appreciated the simplicity and found it quick to interpret, while still conveying useful, actionable information. Furthermore, there was also a built-in motivation around the star system where people got excited about getting more stars:

“And then looking at the stars and seeing how many stars I had, like oh I maybe need to bump that up. I think the star representation was good. So you can clearly and again it’s very simple. You know if you’re at one star for the week, that’s pretty bad. So I think again it’s very simple.” (P10910)

However, this was not enough for many participants. Calorie information was the most commonly requested piece of information to add to the application. Both people who liked and disliked the star rating system felt that the application would benefit from information about the calories. A small subset of participants expressed an interest in even more detailed nutritional information including protein and fiber in addition to calories:

“I’ve used a couple other food apps where I’ll use them exclusively for finding I wonder how much fiber and how much protein is in this and looking to just get the whole nutrition facts of something. So if that information were available, hidden underneath if you click like more details for a food and you could delve into the star rating a little bit more, I think that would make it more valuable from an educational standpoint. How many calories did you eat on this day and how many grams of protein? That – yes that’s the app I need actually to and it’s probably out there and maybe that’s not what this was trying to be but that’s what I would be most interested in.” (P10913)

The participants that had these requests were athletes or people training for specific athletic events. For example, P10913 was training for a long distance bike race and P10908 and P10909, who both also wanted more detailed nutritional information for the application to be useful, were training for marathons.

An alternative to providing more detailed nutritional information about each item, proposed by some participants, was to provide insights into the factors that determined the star rating of a given item:

“So I was kinda curious what the star system actually was. So celery is 5 stars why is this 4 stars. Alright I can actually see that. But what does this actually mean? So seeing actually the [explanation]. I think [the star rating] was useful. Seemed pretty intuitive. Just having that and then maybe having more details or something that you can press like that.” (P10892)

This lack of explanation around why the application presented certain information was also identified as a weakness in the healthier snack suggestions feature, which was another form of feedback participants received. P10918 described how she was unable to fully understand why a healthier snack suggestion was healthier – what specifically about that snack made it healthier: *“I knew enough about the food that if I ate a bad snack, I knew what was better. But also the pop-ups never said why [the suggestion] was better.”*

### **5.3.2 Experience with theory-informed features**

Although much of participants’ feedback about the application focused on the overall design and approach, participants also spent a significant amount of time discussing the specific theory-informed features. In the following three sections, I discuss participants experiences with each of these features and the ways that the different features affected their snacking behaviors and, in some cases, their eating behaviors in general.

#### **5.3.2.1 Personal snack history**

Of the three construct-based features, participants used the personal snack history most often. Participants highlighted how reviewing their prior behavior provided them valuable information about their behaviors. Seeing all of their prior behavior listed in one place made it easier to discover insights into their own behaviors:

“I look at it every day and I notice just throughout the day I tend to eat less but into the weekend or when I have more time, I tend to eat more because of boredom or just sit there watching T.V. and with nothing to do, I just end up eating. Just drink water or something like that but for sure it depend on the day and it help me look at more like, ‘Oh why did I eat 10 snack on Sunday and none for three days, on Monday to Wednesday?’ It’s very helpful.”

However, the text-based list view we provided for participants to review their previous history may not have been as valuable as a graphical visualization. Specifically, P10917 talked about having interactive graphs that she could use to explore her data in more detail: *“but then again, yeah, maybe the visuals. Like a little graph you know? Maybe see low points and high points ... See why you were failing those weeks. Or like you can drill down into the times of day that you snacked the most. If it’s like a text thing, it’s hard to read words and statistics and make sense of them.”* This idea of visualizing snack history over time was mentioned by several participants as a more effective way for them, personally, to be able to make sense of their prior behaviors.

In considering the effects of the application on its targeted construct, self-efficacy, we found that several participants described experiences that suggested an effect of the feature on the construct. In some cases, they described this specifically as tied to the ability to consider their prior successes:

“I really liked seeing the snacking highlights, where it kind of talked about ... you know, I ate clementines a lot and it was like, great job, if you keep eating this that’s keeping your score up ... it was encouraging as far as you’ve improved since you started using this and, this week has been your best ever” (P10893)

In the context of reviewing the personal snack history, participants described different granularities of time for considering their behavioral information. These included considering information at the level of each single day, each week, and across weeks. Comparing different days or weeks and insights into how the time of day affected their behaviors were especially interesting: *“It was interesting to think about if I was snacking in the morning or evening and I don’t eat many snacks in the morning. Part of it is a mental thing at work, like I work as long as I can and then I take a break for lunch and everything”* (P10923).

Although the personal snack history was intended to be a space for users to review and reflect upon their prior behaviors, this reflection also occurred outside of the snack history. Many participants found themselves reflecting on their prior behavior when entering an individual snack or during the process of entering multiple snacks that they had eaten earlier in the day or on the

previous day. When user's entered snacks, they not only reflected on the just-in-time feedback they received relating to that specific snack, but they also reflected on the cognitive history they had created from being more aware of their snacking by consistently tracking their behavior:

“I didn't actually look back at the snack logs, but by entering it and like seeing it in my face. It was easier to remember what I had been eating, so then I could, then I could I guess reflect on whether it was good or bad” (P10922)

In this case, the snack entry process became a site for reflection, not because it provided historical information about snacking, but because it prompted them to think beyond their current snack towards their future snacking behaviors. For others, providing a single measure of overall performance, the average snack healthiness, was the site for reflection on their prior behavior, as opposed to reviewing detailed information about the individual snacks they had eaten.

### 5.3.2.2 Daily Diary

Many participants described how the daily diary provided a valuable opportunity to explore their beliefs about healthy snacking and gave them space to consider what healthy eating meant to them: *“I think the daily diary is a really good idea. I think that if you do this positive thought kind of process that it helps reinforce good habits so I really appreciate that concept”* (P10924). Even those who rarely used the feature praised the concept of providing a space for reflecting on the positives.

Although the feature was generally positively received by participants, many identified challenges with using it. Some people just felt like writing in a diary was just not for them: *“I found that I'm not the type of person to write down my thoughts about anything so it's just a little bit of a mismatch”* (P10892). Other participants identified specific challenges with the daily diary that made it difficult for them to engage. The prompt was overly constrained and did not allow participants to explore the topics and issues that were important to them:

“I'm not a positive person so trying to come up with something positive was like as I said easier in the beginning and then after a while, it was ‘Gosh, this is just

not me.’ It didn’t seem genuine and that’s just why I felt like ... this is becoming a chore” (P10916)

This was echoed by participants who were specifically interested in using the diary to reflect on their specific snacking choices:

“I think what I would have liked to do is almost just like explain, I felt like I need to explain like why I didn’t snack or why I snacked on mint peppermint patties then the diary or journal could be just general like reflections because I think that would have been helpful for me to look back [at my snacks] and say, ‘Oh this is why I didn’t snack,’ or ‘this is why I did.’ You know or why I made choices of candy because I was at a training and it was on the table or why I had, you know, a cookie” (P10912)

For this participant, being able to document these reflections during the process of entering snacks or while looking at their snacking history would have been a major benefit.

The challenge with a constrained prompt was further exemplified in the difficulty that almost every participant faced in constantly developing novel responses to the prompt. In many cases, participants kept repeating themselves in their responses to the prompt or simply gave up on using the feature. P10915 repeatedly created responses involving her kids since that was the major focus of her healthy eating, but there was only so much to say about them: *“I put in trying to eat healthy is good for me and the kids, like the kids are helping you know make something, but then I ran out of ideas.”* This was exacerbated by the fact that the feature was intended to be used every day, which made users run out of new ideas quickly.

Secondly, participants identified the prompt and the open-ended response format as vague and felt unsure how to respond:

“I didn’t really know what to put in it. I took a picture of my cat once. There wasn’t anything in [my diary] and I was like I have to do something. I didn’t know what to say, the prompt like what is good about health snacking or something like that ... And maybe if the questions were more targeted too, but it is really vague” (P10923)

Many suggested that providing a more structured response, something akin to a Likert-type scale or a multiple choice selection, would be useful in helping to address the uncertainty in

responding:

“Just questions like how do you feel today? Activeness? How much energy do you have? Just like short questions that you can just [answer] like from one to five, rather than just sitting there and answer it yourself. I think that would be, at least for me, that would be a lot easier” (P10917)

Much like in the personal snack history, individuals did not want to only focus on the positives and the successes in their snacking, they also wanted to reflect on their unhealthy behaviors and consider the implications of eating less healthy: *“I’d kind of want to put a negative thought. Like I ate a cookie today and I shouldn’t have and I feel like sick right now, or something”* (P10895). Whereas some participants simply suggested this as a useful alternative to the current design of the diary, several participants actively repurposed the diary for their own needs during the study. They ignored the prompt, in some cases, and focused on less positive aspects of their snacking behaviors because they felt it was more useful for them:

“I would like write on reminders like what not to eat next time. If I ate something unhealthy like that day, I’m like, try to avoid this next time or like eat this thing next time as an alternative to that” (P10919)

They viewed reflecting on their less healthy behaviors and the negatives as part of *“the healthy learning process to improve”* (P10916).

### 5.3.2.3 Social Stream

Although participants described using the social stream less frequently than other features, those that did engage with the feature, even for a short amount of time, identified benefits from those interactions:

“I looked a little bit maybe twice or three times, what the runners and walkers were doing and they all eat healthy. I was like okay, they are on my team and care about what they eat – are trying to eat healthy and they are going to make the healthier choice” (P10921)

The social stream diminished some of the feelings of isolation that participants held in the endeavor of enacting behavior change. They felt as if they were “*not alone*” in their effort to adopt healthier snacking behaviors when they saw social stream messages describing people similar to them making congruent efforts to snack healthier:

“I really liked finding that camaraderie with people like oh some percentage amount or this certain percentage of social workers do this or are eating healthy or have similarities and so I really like that kind of camaraderie. I’m like, I’m not alone in this or the sense of like it felt almost like support I was getting from strangers if that makes sense” (P10912)

This was true even though participants did not directly know who the other actors in the stream were, as the research team had generated those messages:

“it was just really nice to have that even though they’re totally strangers, we’re still kind of communal animals so having that recognition and making it seem like everyone around you, even though you don’t know them, is eating healthy was I thought really cool” (P10893)

Although this feeling of “*camaraderie*” was relatively pervasive in our study, participants suggested that providing more transparency into who these people were or providing similar information about people who they knew in their lives would be even more valuable. P10917 felt like she would have developed a greater connection with information in the stream if she knew who the other people were and if they were people she knew: “*I don’t really don’t know them so it doesn’t feel connected to what I know. So the social – like with a Facebook app would be like, oh my friend ate this that day. Just feel more connected and I feel more [attached to] it.*”

Several participants suggested that they would benefit more from seeing information about the specific snacking behaviors and ideas of how others were snacking healthy. They thought this would help to make the social stream content more engaging and also help them figure out new ideas for healthier snacks. We had designed the social stream to explicitly avoid this kind of information, because we wanted to avoid modeling healthier snacking behaviors, which would theoretically increase participants’ self-efficacy instead of exclusively targeting perceived descriptive norms.



Interestingly, participants described several experiences that suggested the social stream actually promoted participants' self-efficacy, counter to our intended design. One participant described how seeing that others were able to eat healthy made her feel more confident in doing so herself:

“like I said I think I identified most with the parent ones, particularly being home alone all day with a two year old – like I eat when I can, it is like oh so someone else is in this boat, is like doing good things and I can [eat] good things” (P10912)

It may also be the case that some of our prompts may have been too specific and drifted into the domain of modeling how to engage in healthy eating, which would be more likely to affect self-efficacy.

In addition to effects on self-efficacy, participants also reported experiences that suggested a positive change in their attitudes toward healthy snacking. Seeing other's snacking healthy, made them think about their own positive successes with healthy snacking, contributing to a shift in their attitudes:

“It kind of again confirmed that I'm doing good things. I'm in the majority of like eating healthy or snacking healthy and for like my professions and my interests so that made me feel better about what I do” (P10912)

Unlike the effects on self-efficacy and attitudes, which were unanticipated, we had expected to hear experiences from participants that indicated a shift in their perceived descriptive norms. These experiences took different forms, the first being a confirmation of positive beliefs or a refutation of the negative beliefs they held about the snacking behaviors of their referent groups. Many groups that participants chose to identify with were groups that they expected to eat fairly healthy because they ultimately wanted to believe that they themselves, through their social identities, were healthy. So it was common to hear how those beliefs were reinforced through the social stream:

“And so with home cooks, I thought well that makes sense. I think I have heard that cooking at home is the healthier thing to do, so I am not surprised that people that identify as a home cook, not just that everyone cooks something at home at some point, but if I identify as a home cook, I must like it or take pride in it. Those are the people that I would expect are probably going to be eating more healthy.

So I guess it gave me some evidence that I took as confirming my own bias or suspicion about home cooks” (P10923)

On the opposite side of that, it was not uncommon for messages in the stream to challenge one’s currently held beliefs. One participant, P10913, described his surprise in seeing that one of his referent groups ate healthier than he expected: *“Apparently engineers as a group eat a lot or snack a lot healthier than I would have expected. Well engineers I think of like Mountain Dew and potato chips but – it made me feel good overall.”*

The social stream also created a sense that *“everyone around you, even though you don’t know them, is eating healthy.”* This feeling influenced participants’ perceived norms. It made participants feel a sense of urgency that they should engage in the behaviors that others are performing to be included in the larger group of individuals that were snacking healthfully: *“especially the ones that related to me, I liked, because I wanted to be part of that ... I wasn’t sure if I was actually a part of that 70% [that ate healthy snacks] but I totally wanted to be”* (P10891).

The social stream also triggered participants to reflect on their social identities and ensure that the groups that they identified with were healthy. This process helped them refine the referent groups they wanted to give their attention to considering, with respect to healthy eating. This did not mean that individuals suddenly decided to develop new social identities and disaffiliate with groups that they felt might be less healthy. However, it did prompt them to critically evaluate how their identities had a role to play on their health behaviors. One participant described the process of reflecting on her social identity, as a swimmer, supports her healthy eating:

*“[I liked] mostly all the ones about swimmers actually. Because I try to be really healthy when swimming. So this one I liked last night actually. Like 19 swimmers ate more than one 5 star snack yesterday, which was like a commitment. I don’t think it would be hard for me because I always have certain things I eat when I’m about to swim. I always eat a banana which I think is 5 stars, I’m not sure. And then when I come back I always have peanut butter and then I try and have something that’s super healthy. And I just can’t swim without bananas cuz like I get foot cramps. But like, I think it would be good. But also I think it helps show me that if I’m swimming it helps me to be healthy in other aspects”* (P10891)

Among the positive experiences that participants reported with the social stream, there were some significant challenges. The first related to the believability or perceived trustworthiness of the data contained within the stream itself. We focused on positive behaviors in the content we created for the stream, so it seems reasonable that participants identified a positive bias in the content. One participant, P10913, described his struggle with wanting to believe the positive information in the social stream, but having difficulty reconciling this new information with his personal experience. He felt that there was a *“slight underlying thing of ‘Do I really believe that?’ ... Where is this data coming from? Do I trust this but I want to believe that. That would make me happy.”* This dissonance made it more difficult for some participants to fully engage with the content of the stream, but also may have forced them to interrogate their inner biases and internalize a different, more positive understanding of that group.

Secondly, some participants were unsure what to do with the feature or what they would gain by looking at information about what other people were eating. Many of these people, like P10892, also identified that they were not social media people or not into social interactions in their technology: *“[the social stream] wasn’t useful to me. I got a Face book account maybe two years ago and have looked at it maybe once per year. So I just don’t use social media that much.”* Another participant, P10917 suggested that having actions in the social stream affect the application in other ways would help improve the usefulness of the feature. For example, ‘liking’ certain content in the stream could help to customize the healthier snack suggestions that were provided in the application.

The resemblance of the social stream to other social media, such as Twitter, prevented some participants from engaging with the feature. Some participants, like P10920, identified themselves as *“not a social media person,”* and quickly dismissed the feature, without interrogating it and better understanding how it worked: *“I didn’t use the social stream at all and wouldn’t because I don’t want to be sharing that I’m eating 15 snacks a day.”* This representation ran counter to how we explained the social stream and did not capture how it worked in practice, but because of negative associations they had with social media, they immediately ascribed a behavior to the

feature based on their prior experience and dismissed it. Several participants jumped to a similar initial perception of the feature – that it was based upon actively sharing your own activities and observing the individual activities of other people within the system – because it was described as a social feature. Although most did not have a similarly strong negative reaction to this association with major social media platforms, such as Facebook and Twitter, there remained a strong linkage of the social feature with these platforms.

### **5.3.3 Effect of the environment on eating behaviors**

Individual Snack Buddy served as a probe by which participants actively engaged with the topic of healthy snacking and healthy eating. Participants discussed these topics through our conversations about their experiences using Individual Snack Buddy and through our direct questions about their eating behaviors and their beliefs about healthy eating. We found that environmental factors were by far the most significant factors that participants described affecting their eating behaviors. Environment factors were those that formed the external context in which their eating behaviors took place. These were factors external to themselves such as the food that was available in their home or at work. In the following sections, I discuss the environmental factors that affected participants behaviors and the different food environments that they encountered in their everyday lives.

Although the application and our questions focused on snacking, participants often broadened their responses by talking about their overall eating behaviors. Therefore, in this section I broaden the reporting to discuss the environmental factors that affected their eating behaviors in general. In cases where a participant talked specifically about snacking, I reflect that explicitly in the reporting of the findings and through their quotes.

#### **5.3.3.1 Availability and accessibility**

In this study, the most commonly cited factors that influenced participants' behaviors were the availability and accessibility of certain foods. Availability and accessibility were related, but

separate factors, at the core of how people interacted with their environment. Availability, as we found, related to the presence of foods within a food environment. This included whether certain foods were present or not and in what quantities. For example, P10913 reported keeping her *“vegetable crisper pretty well full”* at home, meaning that a number of vegetables were regularly available in her home environment. While the *“limited menu of things that are available”* when P10922 went out to eat meant there was less availability of healthy foods in that environment. Accessibility, on the other hand, related to the ease with which participants could select and consume available foods. Leaving foods out on the counter or in an easily visible and reachable location would increase their accessibility, while storing them in a hard to reach cabinet would make them less accessible.

As we found, participants discussed availability and accessibility separately, but also in close relate to each other. In the next two sections, I discuss availability and accessibility separately and how they influenced participants’ eating behaviors.

### **Availability of foods**

Participants described the availability of foods as two different axes – one axis for the availability of healthy foods and another axis for the availability of unhealthy foods (see Figure 5.7). The horizontal axis represents the availability of healthy foods. The increased availability of healthy food acted as a facilitator to healthy eating – when those foods were more available, participants were more likely to eat them:

“My husband, he likes eating healthy and he wants me to eat healthy, but he definitely doesn’t eat as healthy and like has a different idea of what it is and so that was kind of interesting because I think, he started eating a lot more fresh fruits since we’ve been married cus I would always have it around ... and mostly having it available and getting used to buying it” (P10893)

Although the availability of healthy foods was important, having healthy food around did not necessarily mean that a person would avoid eating unhealthy foods. For participants that discussed the effects of having an increased availability of healthy foods, they explicitly mentioned that it would lead to greater consumption of those foods. They did not necessarily say or imply that

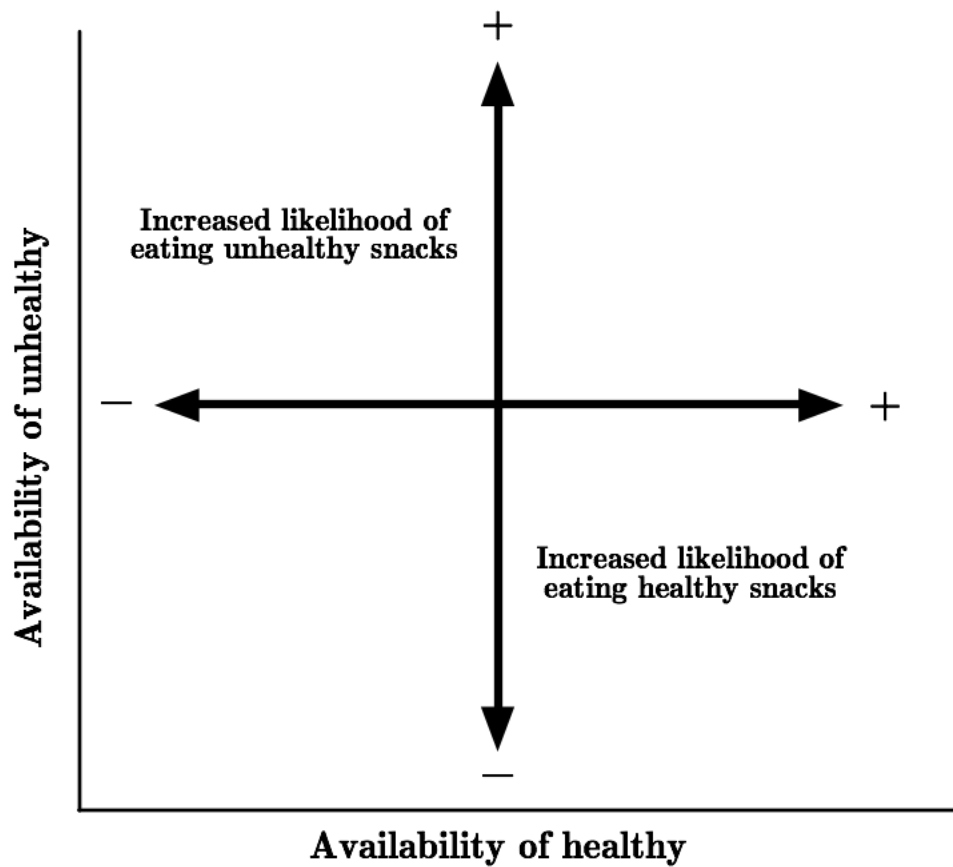


Figure 5.7: Two intersecting axes representing the way participants described the availability of food. Along the horizontal axis is the availability of healthy foods – from less available on the left to more available on the right. Along the vertical axis is the availability of unhealthy foods – from less available towards the bottom to more available towards the top.

they would be eating healthier foods in place of unhealthy foods. However, a few participants did describe experiences to this effect. They discussed how having a greater availability of healthy foods would shift their eating behaviors away from unhealthy foods towards healthy foods. For example, P10924 used the word “just” when describing how an increased availability would increase her consumption of healthy foods: *“Having [healthy foods] available would be the biggest thing. So if we did more careful shopping, it would be much more likely just to eat the healthy stuff.”* Her statement implied that making healthy foods more available would help her eat those foods over other options.

On the opposite side of the axis, when healthy foods were less available, participants described having more difficulty with eating healthy:

“Let’s just make sure that we keep buying those things or making sure that when we go shopping we have enough apples for us to bring an apple every day. Versus only buying two and not having enough for a week.” (P10922)

The other axis, the vertical axis (see Figure 5.7), related to the availability of unhealthy foods. When these foods were more available, participants suggested that they would be more likely to eat them. They described situations in the past where having these unhealthy foods available led them to be eaten:

“I am not going to buy that [unhealthy snack], because then it will be in the house. And once it is in the house, I am definitely going to eat it.” (P10916)

And when unhealthy foods were less available, participants would be less likely to eat unhealthy. In fact, for many, making unhealthy foods less available was a strategy that they employed to try and improve their overall diet:

“I love potato chips. I never eat them. I don’t buy them, because I would eat the whole bag. That is our other healthy eating strategy is we just don’t buy the unhealthy food, even if we like them. If it is not here, I can’t eat it. I don’t like chips so much that I am going to get out and take my lazy ass over to [the grocery store] and buy potato chips.” (P10923)

Although several participants stated that making unhealthy foods less available would help them eat healthier overall, nobody suggested explicitly that they would eat a healthier food in place

of an unhealthy food when one was not available. The specific examples they provided focused on how the unavailability of unhealthy foods allowed them to avoid those foods.

In looking at the axes in Figure 5.7 together, and considering how participants described availability, the lower right quadrant, with an increased availability of healthy foods and a decreased availability of unhealthy foods, would be the case that participants suggested they would eat healthy foods *over* unhealthy foods. On the other hand, our results suggest there would be an increased likelihood that participants would eat unhealthy snacks in the upper left quadrant, where there is less availability of healthy food and more availability of unhealthy foods. In the upper right and lower left quadrants, where both unhealthy and healthy foods have greater or lesser availability, there is less certainty around how that might affect an individual's overall choices and diet, given that both types of food are more or less available. In these quadrant, other factors, such as psychosocial factors, may become more salient. In considering this diagram, based on participants' insights, it appears that the relative availabilities of healthy versus unhealthy foods might be a more important factor than the raw availability of those foods alone.

**Accessibility of foods** Having foods available did not necessarily mean they were accessible. Participants described the importance of being able to “grab” something to eat – “*whatever was there*” and ready to eat. P10910 described how having snacks available at work did not mean they were accessible to her when she was hungry: “*It just depends on what’s handy because I always have healthy stuff in my office but I’m not always in my office.*” In this case, healthy foods were present and available in the work environment as she had brought them into her office. However, she could not easily get them if she was in another area of her work environment outside of her office. In these cases, she described eating whatever was around and easily accessible – unhealthy foods like candy and cookies.

Furthermore, accessibility also depended on the ease with which an individual can turn available food materials into edible foods ready for consumption. More convenient, easy to prepare foods are more accessible and ultimately more likely to be eaten. Those foods that required additional steps to prepare would be less likely to be eaten:



“Even with fruit where it’s like, ‘oh I have to cut it up’ or ‘I have to do something to it or rinse it off, oh no’ as opposed to, I grab a bag of chips and I open it and I eat it” (P10894)

It is also important to differentiate the “accessibility of food” from “food access,” which refers to the process of acquiring food to make it more available.

### 5.3.3.2 Different Food environments

Participants described four different types of food environments that influenced their eating behaviors – the home environment, organizational environments (such as work or school), social environments, and the community food environment. These environments overlapped to some degree, but also operated at different levels. For example, a social event could be taking place at a restaurant, creating a social environment in the space where an individual may share food with others and feel pressure to eat foods that the group approves of. Additionally, it’s also part of the community environment as it took place at a restaurant, a point of food access, and had elements related to the community food environment such as the price of food, environmental cues of smells and sights of food, and a specific set of choices for food.

Although these environments interact in many ways that might affect eating behaviors, participants described distinct attributes of each different environment that made healthy eating both easier and more difficult. Here I consider each environment and the affordances and challenges they provide for supporting healthy eating behaviors.

**Home food environments** The home was discussed more than any other environment, which makes sense given that many people spend a great deal of their time in their homes and eat many of their meals and snacks there. It was clear from the interviews that a healthy food environment in the home acted as a major facilitator of healthy eating. The home food environment was characterized by the foods availability within the home, their relative accessibilities, the cues in that environment, and the tools available to prepare those foods. In the rest of this section, I describe home food environments in more detail and how they affect eating behaviors.

*Availability and accessibility in the home* The availability of healthy foods in the home often varied for participants and depended upon their shopping practices, their ability to get to a store that sold food, and their cohabitators. Purchasing food was the primary way through which participants introduced new food into their home environment. Going grocery shopping on a consistent, regular basis was a practice by which participants kept healthy snacks available in their home.

However, participants were not always able to make it to the grocery store, which interfered with their ability to make healthy foods available in the home. Transportation was discussed as one challenge that people faced in getting to the grocery store more often. Some people didn't have a car, which made it more difficult to get to the store. For one participant, P10914, the distance to get to a grocery store was a challenge, even though he had access to a car.

Furthermore, when people became busier because of other demands on their lives, they had a more difficult time getting to the store to purchase healthy food for the home. Work, school, and the general demands of life all took up participants' time and prevented them from being able to introduce more food into the home environment. P10914 described the challenges of both limitations around transportation for his partner compounded by his busy schedule:

"I have to drive a long ways to a grocery store, other than [the next town over] there's no nearby grocery store ... I want to start eating more vegetables but like my work [is crazy] and my girlfriend can't drive so I have to go to the store. So it's really a pain in the ass to get to the store on the weekday. So I'm kind of stuck with what I have at home." (P10914)

In the home, accessibility of food was typically quite high. It was easy for people to physically access food in their homes by going into the kitchen and opening the fridge or pantry. Therefore, if healthy foods were available in the home, then they were typically accessible. However, the relative accessibility of healthy foods versus unhealthy foods was an important factor in the home. Just because fruits or vegetables were available in their home, did not mean they were the most easy to access. If a less healthy food were the most visible or were to be the first thing that a person noticed, then it may be more likely to get consumed.

Foods were also less accessible if they needed to be prepared. Participants identified unhealthy foods in the home as easier to prepare, often requiring no preparation, making them more convenient and accessible, whereas healthy foods were perceived to require greater preparation. Even if they were well aware of the benefits of eating something healthy, preparation was still a major barrier:

“I have like, say, a big ham sandwich [because] I have run out of time and I don’t have time to make a salad. But if I have time and I do it, I really truly do feel better at the end of the day.” (P10918)

This was especially influential in snacking as compared to meals, in that snacks were something that individuals would often grab quickly and where convenience and accessibility were even more of a factor:

“[I snack] at home, when I have food lying around and I don’t have time for a meal. That’s generally what it ends up being ... Usually it’s about speed and I mean, health in the sense that it’s in my diet in a sort of way. But usually it’s more – what do I want right now and what’s [accessible].” (P10894)

In addition to an individual’s ability to introduce foods into the home environment, participants also described cohabitators as major factors that influenced the availability and accessibility of food in the home. Living with other people, whether they were roommates, friends, family, or a significant other, made a major impact on what food was available and accessible. Cohabitators would introduce different foods into the environment and could positively or negatively influence the home food environment.

In cases where cohabitators introduced unhealthy foods into the home, making them more available there, participants found themselves tempted to eat those foods and ultimately reported eating less healthy when this happened:

“I mean I have a friend who got 7 pounds of chocolate in a couple of weeks ago and has been sharing that with my roommate in front of me. I mean, like, it’s fine. [They were] saving [me] some so next week [I] can have all of it. I mean it’s not like oh my god I hate you. It’s just – I want it.” (P10892)

During the study, P10892 had been sticking to a strict diet in order to make weight for a specific sporting activity. So the presence of a large quantity of chocolate, a favorite snack for her, was a temptation during a difficult time of maintaining a specific diet. Avoiding the chocolate while maintaining a strict diet was made easier by the fact that she would be done with that diet in a week. After which she had every intention to eat the chocolate that was made available in her home environment. This case demonstrates how the timing of when foods are made available or unavailable, and other factors going on in an individual's life, interact with availability to determine whether or not a person ends up eating foods that are available.

Cohabitors didn't always introduce unhealthy food into the home for themselves. Instead, it was common for them to get food that they intended to share with people they were living with. Even though they often had the best intentions, it ultimately made it more difficult to eat healthier:

“I have to say that my wife does enable some of the unhealthy snacking. Well, she likes to get treats because she likes me so. So she'll buy stuff but of course I enjoy but maybe it's a little too much.” (P10924)

In this case, not only was the food more available, but there was a level of expectation set for P10924 to eat the treats because they were bought specifically for him.

When cohabitors contributed to a healthy home food environment, by increasing the availability of healthy foods, participants, like P10891, found it easier to eat healthier: *“[My roommate] came back with a bag of Cuties and was like, eat all of these Cuties. So I had two Cuties, green tea, salad and a bagel.”*

Cohabitors also consumed foods that were in the home, in essence reducing their availability. When they consumed the healthy foods in the home, it made it more difficult for participants to eat healthier. They no longer had the healthier snacks available that they may have been counting on. In some cases, participants would adapt their own practices based on how their cohabitors affected the home environment.

“I actually don't have a lot of snacks in the house right now. When I want to snack, I actually get up, walk to the store and buy it and walk home. ... I don't

buy snacks and keep them at home and eat them two weeks later. My girlfriend will eat it up. She's very – if she sees something, she'll take it.” (P10914)

There was a reciprocal nature in the interaction between P10914 and his girlfriend. When he introduced snacks into the home, his girlfriend would then be affected by that and be likely to eat those snacks. And her behavior of eating those snacks, often before he could, in turn changed the way he purchased snacks and the extent to which he kept them in the home.

In addition to affecting the availability of certain foods, cohabitators also affected the accessibility of foods. By altering the physical environment of the home, cohabitators would make certain foods more or less accessible. Something as simple as moving a healthy snack into a less visible location would create a consistent barrier to healthy eating:

“Apples I generally try to keep around, though I forget they're there. My roommates keep moving my food which is really frustrating. They put all of my food in this fruit bowl that's like raised by and it's not at eye level so I forget its there, its really frustrating.” (P10894)

***Tools for food preparation in the home*** The most significant tool in the home was the kitchen itself. Although other environments can have kitchens, such as the workplace, the home is a place where more freedom is afforded in using the kitchen. The kitchen allowed participants to clean and prepare food – especially fresh fruits and vegetables:

“Like me and my sister. If she's like cutting up a cucumber to like make a cucumber tomato salad. I'm like, let's do this. You know, cut up a whole bunch of vegetables and eat them together. So it's easier when I'm eating it with someone else. It's easier when we [are] at the house too.” (P10895)

In addition to having access to a kitchen in the home, it was also important for the kitchen to be in a usable state when wanting to prepare some food. Having dirty dishes or clutter in the kitchen was a physical and cognitive barrier to being able to prepare food and make it available for eating. P10894 described the challenges she had in using her kitchen consistently when she had roommates who would often leave it dirty or put away cooking utensils she was planning to use:

“It affects me because they don’t seem to have any kind of conception of how the kitchen works in the sense of, ‘oh no the kitchen’s dirty all the time’. It’s like, ‘no I reuse this pan because it’s stainless steel and I can just wipe it out and leave it here’. And it’s like clean, it’s just not clean clean. It’s usable, that sort of thing. It can be kind of frustrating because they have a huge lack of knowledge base like let’s not put wood in the dishwasher guys. Let’s not, let’s wash the pans in the sink and not throw them all in the dishwasher.” (P10894)

Although few participants explicitly highlighted the importance of a kitchen as a tool for supporting healthy eating, the experiences of those who did not have access to a kitchen in their home made its importance abundantly clear. In this study, we found a lack of kitchen access primarily amongst college students living in the dorms or in a housing situation without a full kitchen. P10891 described the feeling shared by several students around making the transition from living without a kitchen to having a kitchen. With a kitchen, she could cook meals and stop relying on microwave meals to increase the availability of healthy food in her home:

“Hopefully it will be a lot less challenging with the availability cus I plan to move off campus and make the majority of my own meals. And I know how to cook healthy cus my mom taught me how to cook healthy which is really great. And yeah, so I’ll have my own kitchen. So excited! Way better than just microwave food.” (P10891)

**Organizational food environments** Although participants spoke most often about the home environment, there were also other environments that participants regularly visited that impacted their eating behaviors. Organizational environments, as participants described them, were shared environments regularly visited by an individual where they have some individual control over limited aspects of the environment. In these environments, broader social and political factors had substantial control over the different aspects of the food environment. Participants described two specific organizational food environments – the workplace and school. There was less control over these food environments compared to the home and these environments also had greater variability in terms of the availability and accessibility of healthy and unhealthy foods. In the next two sections, I discuss the experiences of participants in these two organizational food environments and how the environments influenced their eating behaviors.

**Workplace food environments** For most participants, they described the work environment as a place where they typically ate less healthy. In fact, for most, it was an environment that created some of the greatest challenges in eating healthy. For example, P10909 promptly responded, *“the work environment for sure”* as her first response when asked what makes it harder to eat healthy snacks. This included snacking more often than they would in other environments, eating less healthy foods, and eating greater quantities of foods. P10910 described this dichotomy in her snacking habits as *“erratic”* because they differed so greatly between work and home: *“Like I said, at home, I don’t really snack much and here at work, I do [like] crazy.”*

There were two aspects to the workplace environment that made it harder for them to eat healthy at work – the physical aspect and the social aspect. With the physical aspect, participants identified that, in the work environment, they had less access to healthy food since they had less control over what foods were present, as opposed to their homes, where they could keep their pantries and refrigerators stocked with healthy food.

Individuals were also less likely to have access to tools for storing and preparing food in these environments. If their workplace did have a kitchen, which many did not, it was not a kitchen where individuals could freely use it and prepare any meals they liked. Microwaves were the most common appliance in these kitchens, limiting the types of food that could be prepared. P10896, who worked from home at the time of this study, had previously worked in office environments and described feeling limited by workplace kitchens:

“I’ve worked in offices, and I’ll eat crap [at home], but there I’ll always go out to lunch and if I do bring snacks they won’t be as good. But working at home is lot better because I have access to the whole [kitchen]. And when I inevitably do get an office, I’m building a kitchen in there.” (P10896)

Few participants had significant capability to store food, outside of their own personal desk areas. And depending on the work environment, some didn’t even have the option to store food in a readily accessible location for themselves. As P10917 described, *“You can’t have food in the lab but I would just have like a small snack outside of the door and just eat whenever I can.”*

Having access to a refrigerator was especially important for storing healthy food at work. Some participants worked at a place that provided access to a refrigerator, while other participants lacked access to one. Lacking access created challenges in bringing and storing healthy foods:

“So my snacking at work is influenced by some – is it easy to eat? Can I keep it a work? I don’t have a refrigerator to keep it in so it has to – I’m kind of limited on what I can use.” (P10914)

It was also common for unhealthy foods, especially snacks, to be littered throughout the workplace, readily available and accessible for people:

“Yeah and then there’s thing just laying around because in my job, there’s just food everywhere. All day. And it’s free. Free! I mean I have access to cookies, brownies, candy - anything you can think of all day long.” (P10910)

This was extra challenging because participants felt they were unable to alter the environment by making foods less accessible or available, because it wasn’t their own environment, but a shared environment:

“Well because I know I eat crap at work. If it’s available, it’s available the whole time. I can’t do anything but just [have] the willpower. It’s all willpower, right?” (P10910)

In addition to the physical aspects of work environments, participants also reported the social aspects of these environments presented significant challenges to eating healthy. Although the people at work were often not participants’ strongest social connections, social influences in the workplace were still significant. They were exposed to the unhealthy behaviors of their co-workers, both establishing norms around what to eat at work and also cueing them to desire certain, sometimes unhealthy, foods.

It was often a common, well accepted practice for employees to bring in food to share with their co-workers. More often than not, people would bring in unhealthy foods to share. P10919 described one reason why she suspected it was more common to bring unhealthy food to share than healthy food:



“Everybody at work. They bring in like the cake. They are horrible. They are horrible, so I have given up. ... There are too many people at work who won’t eat vegetables and who don’t like vegetables at all. And it is sad because you see them passing it on to their kids too. So it is going to be multi-generations before that is broken. ... Every once and awhile I will make a stew or a soup and I will bring it in. You know like celebrating something or we have had a couple of crazy weeks or something like that. Every once and awhile, not all the time, because the people that I work with in addition to not liking vegetables are very picky. Only like this, not this. So it is hard to bring [healthy] stuff in that everybody would eat.” (P10919)

When trying to bring healthy foods to share with her co-workers, she found people were less likely to eat it. Eventually, this discouraged her from wanting to even try to bring healthier foods. Ideally, when bringing food to share with others, you want to maximize the number of people who can enjoy that, which was more often the case with unhealthy foods like cakes or donuts, which were crowd-pleasers:

“At work actually, I work at home depot and it gives me more of a glimpse of what the real world is like because its, its in [another town] so its outside of Boulder and the age range is high schoolers to retired veterans who are bored and want to get out of the house. So there’s this huge amount of diversity there and there’s this huge diversity in diet. And also whenever they buy food they’re always like, ‘oh we got donuts for everyone’ or ‘we got cake’.” (P10894)

This wasn’t just co-workers, but also managers who would bring food to treat their employees, which effectively contributed to a work culture that facilitated unhealthy eating and contributed to norms around bring and eating unhealthy foods. P10910 described that as especially prevalent in her office: *“Some of the managers that I work with [make it harder] just because some of them – most of them don’t eat very well. [They] bring in all sorts of stuff to share and it’s never anything I [should] eat.”*

Not all participants described their work environment as unhealthy. Although this was less common amongst the participants, some suggested they ate healthier at work or believed their work environment was supportive. When we asked P10911 about social groups that would help him eat healthier, he described a culture of overall healthy eating at his workplace and identified his co-workers as people that would help him eat healthier:

“Maybe some co-workers as well because I know a lot of people – some of them are real health nuts more than others ... That’s actually a really good point I mean especially, for example, I mean our office, a lot of people naturally kind of eat healthier. ... I mean something like that, like being able, if you wanted to, connect with specific people in your office or like where your employment is – I think that would be pretty cool. I mean because then you are – like you are being accountable for each other and working to be able to support each other.” (P10911)

In addition to having a healthy-oriented culture in the workplace, the relative busyness that an individual had at work made it less likely for them to eat unhealthy snacks. This was something that P10912 often found: *“When I’m at work ... well, I didn’t snack at all yesterday because I was super crazy. It was busy and I wasn’t hungry.”* Because she did not snack as much, she believed this was a healthy effect of being busy. However, snacking can be very healthy depending on what you eat and can be a good strategy to support energy levels throughout the day. So busyness at work can be protective against unhealthy snacking as well as a barrier to engaging in healthy snacking behaviors.

On the opposite side of that, when an individual was at their desk for extended periods of time or bored at work, they indicated they would be more likely to snack:

“Work was probably more likely [to eat something bad], because that is where I snack more regularly and I’m right there at the desk and it is easier to do versus [home].” (P10923)

Some types of work environments might inherently facilitate unhealthy eating practices more than other environments. P10910 worked in the food services business, which inherently meant she was constantly exposed to food, often unhealthy food, and that there was leftover food available on a consistent basis. She also viewed it as part of her job to eat the food to maintain quality standards and to communicate details of the food to clients:

“And part of it is we have to – we should taste the food too, right? We don’t want to serve you something that – what if it doesn’t taste good? We want to make sure you’re having good food so we have to taste it too. Yeah or when we try a new product, it’s like we’re all going to sample it and I don’t really – I try to not eat gluten. But it’s like well, it’s there. I better just try it because I need to be able to tell customers what it tastes like.” (P10910)

In essence, the demands of her job put her in conflict with her own intentions to avoid certain foods or try to maintain a specific aspect of her diet, which involved avoiding gluten.

Several participants also worked in childcare or teaching settings and described them as especially challenging. In this environment, snacks of all kinds were regularly available and accessible. When combined with an extremely busy, fast-paced teaching profession with long hours, made for an environment that facilitated snacking on the most convenient, often unhealthy things available:

“I’m just guessing that I snack more late afternoon early evening when I’m here because I usually have my dinner after work, you know, nine or ten o’clock at night. If I don’t have any healthy options here am I snacking on like a candy for the kids or am I going to the vending machine ... I grab a candy bar from the classroom or whatever the kids have around – something that is not so healthy.” (P10912)

Surprisingly, one participant who worked in a healthcare setting, a setting which one might expect a greater awareness and practice of healthy eating, reported that her co-workers ate very poorly and that there were often unhealthy foods available there:

“Everybody at work. They bring in like the cake. They are horrible. They are horrible ... somebody brought in a whole bag of [breakfast burritos] yesterday and left them in the kitchen. Yeah, I didn’t have one, because I had my own stuff, my own egg burrito. But yeah they will do stuff like that” (P10918)

Although this environment may not be more unhealthy than the average work environment, it also challenges the notion that healthcare work settings are more likely to be healthy environments.

Only one participant described working from home consistently. He suggested that by doing so, he was able to take advantage of the advantages of the home environment. One would expect, however, that the healthiness of the home work environment would ultimately depend on the healthiness of the home environment. However, there are several factors, such as having full access to a kitchen, greater access to one’s chosen foods, and consistency and predictability of the food environment, that give the home work environment an inherent advantage in its healthiness:

“I think working from home is a lot better you know. I’ve worked in offices and I’ll eat crap here [referring to home] but there I’ll always go out to lunch and if I

do bring snacks they won't be as good. But working at home is lot better because I have access to the whole thing. ... I think [I eat healthier] more so the days that I'm really at home and working is when I'm eating more consistently." (P10896)

Additionally, one other participant worked from home on one or two days in the week and compared it favorably to the environment when she went into work. This participant, P10909, echoed his sentiments about it being easier to eat healthy when working at home: *"I work from home on Mondays and it's a lot easier [to eat healthy]."*

***School food environments*** The school food environment also challenged participants' ability to eat healthy. Because this study only included people over the age of 18, the experiences we heard primarily focused around the school environment in a higher education setting. However, one participant was a senior in high school, and was 18 years old, so his perspectives help enrich our findings on school food environments.

Much like work food environments, participants were faced with physical limitations around being able to keep healthy foods available and accessible for themselves. Participants believed that it was more difficult for them to keep healthier snacks with them throughout the day because they were less portable:

"I go to school and I carry like my backpack and have [unhealthy snacks] all day and they'll be fine. But if I carry like a fruit or vegetable, I have to eat it by a certain time or else it will start to go bad." (P10919)

In addition to it being difficult to make healthy foods available for themselves at school, participants also described the high availability of convenient, unhealthy foods at school, especially from vending machines:

"Like if people are [at school] late and they're snacking it's probably from one of the vending machines. Like those vending machines are full of unhealthy food. Um, so I see that everywhere." (P10891)

This was a major frustration for participants who wanted healthier options at school. It made some feel a reduced sense of control over their eating in those environments:

“But just looking at the option that is offered, it’s not very much healthy snacks that you can buy in a vending machine. Even the vending machine doesn’t have that much with – why would they have one option for water and maybe five options for other sodas? And it’s just frustrating for one and kind of disappointing to see like we try to eat healthy but we don’t really have that much choice or control of it and how inconvenient it is to try to eat healthy.” (P10917)

Much like the work environment, participants described their exposure to the eating behaviors of other people in the school environment. In many cases, they observed people eating fairly unhealthy, which would in turn affect their own beliefs and behaviors:

“[You see] people lugging around a bag of Wendie’s while you’re in class. Yeah, you smell it and you’re like, ‘You’re not helping anyone.’ ... Or when you smell it, like a pizza box, [when you’re at school] and you are like, ‘guys we’re gonna order pizza.’” (P10471)

One participant described how observing the behaviors of others in her school environment normed these less healthy behaviors in the school context:

“But if I see them, really what do I see? A bag of Cheetos, Nachos, something that they get from their cafeteria. I feel better if someone is eating as bad as me but at the same time, we know what we’re eating – we know what we’re putting in our bodies but we can’t – we don’t have that much choice to change it because of our circumstances.” (P10917)

Being surrounded by others also increased the likelihood that they would share food with those people. Because the eating behaviors of others were often not that healthy, this led to participants also eating less healthy foods. In these cases, the eating behaviors of others in the school environment directly affected their behaviors.

**Social environments** In addition to home and organizational environments, participants also identified social environments as a distinct type of environment that had an influence on their eating behaviors. Social environments were those where individuals had practically no control over the availability and accessibility of food and where they encountered and were influenced by other people and their behaviors. Participants described social environments that included other people’s

homes, specifically the homes of friends and family, and events, which could be hosted at a number of places including parks and restaurants.

In a social setting, participants described how they had little control over what foods would be available to them. It was especially important to eat the foods that they were offered to be respectful of their host:

“You want to be appreciative of the party, because you don’t want to stand out as somebody who is snobby about what food is like [available], because everybody has their own thing.” (P10918)

In cases where healthy food was provided, this could facilitate healthy eating and some participants described social environments where there was healthy foods available. However, most participants identified social environments as typically less healthy food environments:

“You know, you go to your friends house and they’re like, ‘what do you want?’ That’s mainly what people have, are just the bad stuff. Mostly, I mean, you know some people have good decent snacks, but mostly bad.” (P10895)

Social environments were composed of more than the physical location, the physical presence of different foods, and the people present. They were also composed of the specific activities that are going on in that environment. For example, P10919 described how he attended a series of graduation parties and had wanted to eat the foods that were easiest to grab, so that he could “[try] to socialize and [do] all that stuff.” However, while playing sports on a “*hotter day, [he’d] try to eat something that’s a lot more cooler or refreshing*” like mangos or strawberry jello. Both of these events took place at parks, however the different activities created different food environments. P10895 also described how she would eat different foods in social environments depending on the activities they would be doing, even in the same physical space, in this case a friend’s home:

“Yeah I mean like what [we’re] doing [influences food choice], like if we’re going to watch a movie we’re going to eat popcorn. Or, if I’m, I don’t know. I’ll eat like potato chips if we’re just like hanging out or like chips and salsa if we’re just like hanging out with my friends or whatever. Cus, you know, you just like, ‘oh we’re going to go to your house, let’s just like run by 7-11 and grab something.’ It’s

like, you're going to grab chips for everybody, not, you know, a bunch of bananas.”  
(P10895)

The perceived norms around what kinds of food should be eaten in a social environment were a major aspect of the social influence in these environments. For many, social environments were perceived as a space where one could justifiably eat less healthy since it was a special event. P10471 felt that at a social event, people should just eat whatever they want and take advantage of the setting, *“Yeah, at special events? Eat what you want.”*

In fact, multiple participants, suggested that they felt comfortable eating less healthy in a social environment since it wasn't very common and they typically ate healthy. In essence, the rarity of engaging in social environments was used as a justification to not worry about the healthiness of food during those experiences:

“I am not so obsessed with calories and healthy eating that I wouldn't go to parties and have potato chips or have a soda or not have birthday cake. I am not that extreme, but I can do that because I eat healthy the rest of the time. Or [my friends and I] will go out to a restaurant and have something that has cream sauce all over it and it is absolutely delicious, but I don't feel bad about that because I usually eat pretty well the rest of the time.” (P10918)

P10913 described how she perceived the norms around food in social environments and how they affected her:

“Just again going into the social situations in our culture, tend to revolve around unhealthy food and drink. Get a beer after work and eat salty whatever they have ... Friends can make it harder just going to a friend's house for dinner and it's going to be amazing and probably not very healthy. And then same with family. ... I like being around my friends and family, even co-workers in some settings. But I just don't think it's a positive thing from a health standpoint, from a dietary health standpoint. ... If it's a potluck sort of thing, then it's on me to decide what I'm contributing to dinner and it can be something healthy or not so I think that's a way that I myself can influence others. I think about it a lot but it's – I tend to think – over think it a little bit too much and people aren't going to want to eat raw kale leaves like I do. They're going to want to cookies. So I end up getting cookies.” (P10913)

Even though she wanted to bring healthier options to events and try to affect the environment in a positive way, the norms around what kinds of food people want at a social gathering prevented

her from acting in a way that was protective of her health. Ultimately, she recognized the pervading norms around activities and conceded to them when engaging in social environments by bringing less healthy foods to the event instead of something healthier she would prefer. P10910 also described giving in to the norms around having unhealthy food in social environments:

“People bring in all sorts of stuff to share and it’s never anything [healthy]. Oh one person always brings fruit so that’s good and you know when the bowl of tangerines shows up or something like that, you know who brought it. But there’s only that one person who does that. ... Oh I even bring all bakery stuff. But I don’t eat it. I put it out for everybody else. I do. I do, contribute to [the unhealthy environment] for sure.” (P10910)

In both of these cases, the participants recognized that they were acting counter to their own values and intentions around healthy eating. They accepted the pervading norms for the environment and also wanted to make sure they were bringing food that other people would want to eat. In contributing food in a social environment, both these participants wanted to feel like they were contributing something that others would like and assumed that meant unhealthy food. There was an implicit assumption that more people like unhealthy foods than healthy foods and that unhealthy food would be a better fit for a social environment.

**Community food environment** The community food environment encompasses all of the avenues through which an individual can acquire food. In our work, we found that the community food environment primarily manifests itself, physically, through different food outlets, their types, prevalence, and densities. By food outlets, we mean physical places where food could be bought such as grocery stores, convenience stores, and restaurants. Participants were affected by the specific attributes of food outlets, such as the ease of access to different outlets or types of outlets (in the form of hours of operation and physical accessibility and proximity) and the different methods for accessing those outlets – such as drive-throughs or delivery services. However, participants also discussed other aspects of the community food environment that included the prevalence of local foods and community gardens, the growing season for the community, and the foods that grew natively throughout the community that people could forage for or glean.



***Grocery stores and shopping*** Grocery stores were an important resource for helping participants eating healthier. Across almost all participants, grocery stores were viewed as major facilitators for healthy eating. Going to the grocery store on a consistent basis allowed participants to keep fresh fruits and vegetables and other healthy foods around:

“Yeah, we try to go [grocery shopping] like once a week, cus, we try to like get stuff like for a week – just cus produce goes bad and stuff and we don’t want to bulk up on a whole bunch of stuff and like stuff expires or whatever. So we go like once a week or like once every couple weeks. Depending on what we get.” (P10895)

Participants who did not grocery shop often or on a regular basis suggested that grocery shopping more often or even more consistently would help them eat healthier. One participant highlighted the importance of grocery shopping more in her response to a question about what would help her eat healthier:

“Basically if we made an effort to go grocery shopping and get healthy things, um, maybe go get more blueberries.” (P10891)

Even some who already went to a grocery store consistently felt like they could better utilize grocery stores to eat healthier by going shopping more often, planning meals and shopping ahead of time, or preparing a grocery list in advance:

“Planning might make it easier to eat healthy snacks. And I’m not a very good planner. Making the grocery list and sticking to the grocery list and not picking up things that aren’t on there. You know? Okay, I’m not going to put – well I might put M & Ms on the grocery list but a lot of times [getting those] happens just as a spur of the moment thing. So if I just made and stuck to the grocery list. ... I don’t [plan meals ahead] like for a whole week or anything. It’s really hard – I find it really hard to do meals as a single person. So I think that that might be a good thing to focus on.” (P10920)

For most participants, accessing the grocery store was relatively easy. Few participants reported physical barriers to getting to the store. The most common barriers to going to the grocery store that participants cited were a lack of motivation and a lack of time. Having easy access to grocery shopping is likely due, in part, to the context our research project. The community

where most participants lived had a high density of grocery stores with relatively easy access from most areas of the city.

Participants who lived in more rural areas or in a larger city reported challenges in accessing grocery stores. For example, P10914 lived in a rural area and described his greatest barrier to eating healthy foods as *“getting them”*:

“I have to drive a long ways to a grocery store, other than [the next town over] there’s no nearby grocery store. There’s a Safeway [grocery store] there, but I don’t like Safeway. I’d rather go to Burger King three cities away. There is a discount store which is – the Amish run it and they have discounted food and they buy like second class vegetables ... I know what like that watermelon – that’s why it tastes [off] – it was only 79 cents. And you get your nutrition and everything from it but it doesn’t taste as good as like a good fresh one that you get at King Soopers [grocery store].” (P10914)

As P10914 described, he didn’t just have challenges with the variety or quantity of healthy foods that were available. He also had issues with the quality of foods available in a rural area. He wanted to have access to stores that carried higher quality foods and not having that was a deterrent in wanting to eat healthier. He also had a negative perception of a major grocery store chain, which he did not use, even though it was the closest. He illustrates how not all stores that sell fresh produce are perceived equally in terms of the quality of the food and of the store itself. Even within the same type of grocery store - the chain supermarket - there was perceived difference and preference.

One participant who lived physically distant from grocery stores would link her shopping trips with other trips as a strategy to try and overcome the challenges she had with being physically distant from grocery stores:

“It’s usually dependent on one of those three things – if I’m running low and I’m within a day or two of being out of vegetables, fruits or milk, then I’ll be making a run to the store when I can and try to link my trips. If I’m going into town and I need something, I’ll be sure to stop at the grocery store before I go home. I kind of make a point to make sure [fresh fruits and vegetables are] always there. And the quality of produce doesn’t change that much with our amazing agricultural technology.” (P10913)

Again, P10913 made a point of referencing the quality of the produce as an important factor in the context of discussing food access from grocery stores.

In the city, transportation created a challenge for one participant in going to the grocery store as often as she liked, which led her to grab quick, convenient food from the vending machine when she needed a snack:

“I do try to go to Safeway and Whole Food a lot more and just sometime just picking up one or two banana or one apple is so inconvenient that I can just like oh I’ll just buy this from the vending machine is a lot easier. But when I do go out, I do think about oh I should probably buy a bag so I can just pace myself throughout the week and eat this instead of that. And it do save a lot more money too if you just buy it in bulk. ... But it is just inconvenient. ... and just parking is hard.” (P10917)

In this case, the challenge she faced was finding parking if she were to go to the grocery store. This was a bigger challenge than the actual physical distance to a grocery store, which was a greater problem in the rural community that P10913 lived.

***Restaurants and eating out*** Restaurants were another commonly discussed food outlet that contributed to the community food environment. Participants often described eating out in the context of environments that make it more difficult to eat healthy. For example, P10894 had traveled out of town for a short time during the study and found that she was eating less healthy specifically because she “was eating out a lot more.”

Participants provided a number of different reasons why they would eat out. Often eating out happened as part of a social activity or interaction. It was common for participants to describe getting together with friends over a meal at a restaurant. People would also eat out for a quick meal if they were out or didn’t have time to prepare something. For example, during lunch at work or when driving between activities.

In addition to these common reasons why participants described eating out, P10914 described a unique reason why he would eat out for lunch while at work:

“I do [eat out most days at work] but that’s the thing – because I don’t like what I’m doing. It’s very tedious so I like to get out and come back in. It would be

much better if I brought a sandwich in and ate it at work. I know that would save money but I just want to kind of get out and stretch my legs.” (P10914)

In this case, eating out for lunch gave him a reason to get away from work and a specific place to go. Even though he acknowledged in our conversation that he could take his own sandwich and go outside to eat, he still felt strongly that there was something different about going to get something to eat at a nearby restaurant.

When eating out, participants described two choices that needed to be made that ultimately affected their ability to eat healthy – 1) where to eat and 2) what to order. Both of these choices were limited by the availability of options provided in the environment.

The first choice was influenced by multiple factors that included what options were available in the community, the preferences of others if it was a social activity, the foods preferences of the individual, their desire to eat healthy, and their time availability. The available options were a facet of the community food environment itself, while the others factors were ways in which psychosocial factors interacted with the community food environment. P10919 described the complex intersection of these factors in his experience picking a place to eat with friends:

“Friends can guilt me into eating foods that I shouldn’t eat. Like my friends are like, ‘Let’s go to Five Guys and get large fries,’ and I’m like, ‘No, I really want to but it’s unhealthy foods.’ I try to avoid it but I’m really, really hungry so I’ll succumb to their taunting.” (P10919)

In this case, Five Guys was present in the community food environment and he had an inherent preference for the food. However, he had a cognitive and affective concern about eating something unhealthy. With the social influence of his friends and because of his high level of hunger, he eventually supported the decision to go there to eat.

In the absence of the social influences, making a healthier choice about where to eat might be a bit easier. P10919 described trying to eat at healthier places for lunch, a context where he did not have the strong social influences of his friends:

“Well, when I was in school and I would go out to lunch, I would try to avoid like the fast food places and go to Whole Foods and get a healthier snack for lunch

rather than getting like a burger from Wendy's or something. It was neat. I liked it. ... I wanted to like eat all healthier so that when I go to college I would be in better shape." (P10919)

His positive attitudes towards healthy eating and his intentions to do so manifested themselves in the places he chose to eat when the social influence was removed. And having a Whole Foods available nearby to get lunch helped facilitate this decision.

P10914 also described the factors that influenced his decision to eat at healthier restaurants for his lunches:

"But I have been going to healthier places to eat. Like I said – don't ask me why they serve chips but they do have nice sandwiches and they've got nice breakfasts. I get a bowl of fruit. Sometimes I'll get a bowl of fruit and a bowl of green chili. I have for a long time because for a while there I got into a habit of eating McDonald's for breakfast but it's not even real food. It's too beyond processed. I can taste it. So when I eat a can of something – a can of soup – even the good brand stuff, I can tell it's canned. You make it yourself, I can tell it's not processed. Well, even a McDonald hamburger kind of tastes squishy. It doesn't have a good taste. It doesn't taste like beef anymore. But I learned that from eating better foods. I can't – I don't want to let myself get into that habit of eating out too much at the fast foods." (P10914)

When he was with his girlfriend, he suggested he would often have a much harder time making the healthier choice about where or what to eat. But he personally valued eating healthy and appreciated the better taste of healthier food. When outside of the social influences and in a context where he had easy access to a restaurant that served healthy food nearby his work, he found himself making healthier choices.

Once a restaurant was selected, participants highlighted that there was another choice to be made – what to order. Some participants described significant difficulty in selecting a healthy option when eating out. There were often limited healthy options to choose at a given restaurant. One participant described how she would usually go with a salad whenever she ate out because there were rarely other healthy options on the menu.

There was an interaction between the first choice, of where to eat in the first place, and the choice of what to order. Choosing a place that had more healthy options supported making

healthier decisions about what to order, while selecting a restaurant with fewer healthy option would make that harder:

“I guess maybe sometimes there were compromises in terms of like what we were eating with the meal, like if we were going out, it was kind of hard. So we just had to adapt and find the healthiest option that was available you know with where we were. ... when you are out there is a limited menu of things that are available. So you kind of have to decide, but I guess that is compromise too, like we didn’t plan to make dinner, so we had to go out. Then it makes it harder to find a place to go that you know offers the healthy things we are looking for.” (P10922)

In this case, P10922 identified how finding a place that had healthy options would ultimately make it more likely for them to eat healthier. Those places that had limited menus of healthy options were much more difficult to do that. Selecting a restaurant with healthier options in the first place, presented a valuable strategy for supporting healthier decisions when eating out.

***Non-traditional food sources*** Participants identified other food sources outside of traditional food outlets like the grocery stores and restaurants. These included local foods, such as community markets, farms, and community gardens, and foods growing naturally in the community that could be foraged or gleaned. P10894 was lactose intolerant, however she found that she could drink goat’s milk and sheep’s milk. Because these milks were less common in stores, she turned to a local farm that had a farm share program where should could pay a certain amount up front and receive fresh goat and sheep milk on a regular basis.

P10893 was in the process of starting her own farm, so she both grew her own food and contributed food she grew as part of a community garden program. As part of that, she was directly involved with local food programs and with other growers, which were a major source of fresh fruits and vegetables for her:

“It’s going to be summer and there’s going to be a lot of food that I grow, but it’s something where I get really excited about the idea of eating cherry tomatoes right off the vine and my mouth starts watering just thinking about it. And so, that’s something where you know, I really look forward to kind of the seasonal things where everyone kind of looks forward to the local organic peaches that come up. And I love getting ready for the caprese salad that’s going to happen and the basil and tomatoes that are going to happen.” (P10893)

She also had previously participated in a program that supported gleaning – the practice of recovering foods that were growing naturally throughout the community, but that weren’t necessarily part of a farm:

“Somebody started it because in Arizona – Phoenix used to be orchards of citrus, so in their backyards people have commercial grade lemons and grapefruits and oranges. And people don’t realize what good quality it is, because they just bought it with the house and everyone has it. But we, like on college campus you’d have the lemon rows and so around, its just, took it for granted. And so around the time they get ripe a bunch of clubs would go around and collect the extra fruit and they would donate it to food banks. And so, the idea was to kind of connect people to the excess. And I signed up for it ... So it was, it was something where I posted like, hey I have some extra basil. And I got so much responses, so I was like I think I’m going to tell my neighbors about it” (P10893)

She was able to contribute to the community food environment by making available food that grew around her home. At the same time, she also was able to access food through the community environment that either grew in public spaces or that others made available from their own homes and nearby areas.

#### **5.3.4 Food environment restructuring**

The food environment had profound impacts on participants’ eating behaviors. However, participants also influenced their food environments. They described different ways in which they altered their environment in order to promote healthier eating behaviors. These practices, which we refer to as environmental restructuring [155], were implemented across a number of environments – from the home food environment to organizational and social food environments. Some participants described practices they had been implementing for years, while others discussed newer strategies they had tried more recently. In this section, I discuss the various ways that participants restructured their food environments or envisioned restructuring their food environments to support healthy eating. Furthermore, I describe the barriers and facilitators to those practice that participants encountered or envisioned encountering.

#### 5.3.4.1 Restructuring to change availability

One way participants restructured their food environments was to increase the availability of healthy foods in their environments. As described earlier, having a greater availability of healthy foods made it easier and more likely for participants to eat healthy.

The primary practice through which participants increased the availability of healthy foods was by purchasing them at the grocery store or another store:

“Yeah I should probably go to the store – go and get fruit or something so I can have a healthier option. Like, I try to stock up on healthy stuff when I go [to the store] ... and then I usually just eat whatever is around.” (P10891)

However, just simply going to the grocery store did not ensure participants would bring home healthy foods. Participants needed to call upon their knowledge of healthy eating and go to the store with an intentionality around purchasing healthy snacks. One way that this intentionality manifested itself was in the form of grocery lists. Participants described them as invaluable tools in helping ensure they brought healthier foods home from the store:

“Having [healthy snacks] on hand at all times [makes it easier for me to eat healthy]. I always make sure my vegetable crisper is pretty well full. So just having a consistent shopping list where I know I’m always going to be well stocked with healthy snacks makes it infinitely easier.” (P10913)

In addition to having intentionality around shopping for healthy foods, it was necessary to have knowledge around how to shop healthy – something our participants suggested was different than just knowing about healthy eating. Participants described grocery shopping, in and of itself, as a practice, that one could have varying levels of skill at and could be improved with training and education:

“Yeah I think [shopping healthy] is something that I kind of, I sort of already, it might just be, what is it, hindsight bias, but something I already knew. But just like getting another reminder again of how to shop, how to get those better items and get those in [my home]. To just be reminded of it.” (P10908)



Participants shared specific topics that they felt were important in effectively shopping for food. These included knowing how long certain foods would last, what foods might be convenient to prepare or to take with them, what sections of the store you should spend most of the time and in what order, when to go to the grocery store to keep a constant supply of healthy foods, healthier alternatives to the foods people in the family liked, avoiding grocery shopping on an empty stomach, comparing similar food items (nutritionally and with cost), understanding unit prices and price per quantity, scheduling grocery shopping at a consistent time or figuring out ways to fit it into other trips or daily activities. P10916 described how she put several of these pieces of knowledge into practice in her shopping and planning:

“Like I said, I think I do a good job of shopping for you know fruits and vegetables and having them in the house and you know we always have nuts and dried fruits and things [that last]. So I think my own active decision of this is what I am going to eat and then always, always, always this is how much of X thing I am going to eat is always tricky. ... For me when I do make those sort of rules [of what I can and can't purchase], I am pretty good at making them black and white, but I have to actually make them, you know. So I am not going to buy, like I can walk past the candy aisle at Sprouts no problem and not like fill those bulk bins, but that is grocery shopping. Then once it is at home, if I did buy a bag of chips with the intention of like oh this will go with sandwiches for the week, but oh at 3 o'clock and there is chips. I am going to eat the chips. So for me that is the biggest barrier and the biggest help is that planning ahead step.” (P10916)

As P10916 referenced, effective grocery shopping also benefited from consistent planning and awareness of one's food environments. For example, being aware that certain foods were running low in the fridge or pantry or at the office enabled participants to act before they ran out. Meal planning and thinking ahead about what could be prepared over a certain period of time was also an important aspect of effective shopping:

“Um, so yeah our grocery shopping is, we normally plan for just a few large meals that we would make during the week and we would kind of eat on those throughout the day and over a couple days.” (P10908)

P10893 had a unique approach to increasing the availability of healthy foods for herself and her family – she grew them. She had her own garden, as part of a community garden program,

that allowed her, especially during the summer months, to be able to have greater access to healthy foods:

“I grow carrots and things like that. That helps a lot. And I get to choose exactly what seed, oh I want to do purple carrots which are – well actually, if something is purple it actually is higher nutritional value, but it actually tastes better because it has more, humans naturally know and can kind of tell. Yeah, like purple peppers and purple carrots are actually and like darker lettuce are technically healthier. So, like extra bonus when you eat those. So yeah, that’s another fun fact for people. But yeah, so that’s something where you know, you start growing your own food and you get really excited about like, I like lettuce, I want to try something new and, oh bonus, it’s actually healthier. So, I’ve got, I don’t really have any hurdles that make it hard to eat healthy.” (P10893)

Shopping most immediately affected the home environment as participants described bringing food home after shopping. However, shopping for healthy foods also allowed people to then restructure other environments – namely the organizational environments of work and school. Participants described the practice of bringing healthy snacks or meals with them to work and school. By doing this, they were able to have healthier options available, increasing the likelihood of eating those foods instead of less healthy ones from vending machines or that had been brought by other co-workers or students:

“Yeah because I intentionally bring healthy things with me because I know I can get a lot of crap anywhere I look so that’s why I bring healthy things with me. Yeah. Like I have hummus in the refrigerator all times at work. I have rice crackers sitting there. Rice crackers are better than potato chips.” (P10910)

P10918 brought her lunch to work as a way to ensure she had healthy food available during the day at work. In fact, she highlighted forgetting to bring her lunch to work as one of the major barriers she faced to eating healthy food. In addition to packing her lunch, she also suggested that it would be helpful for her to think ahead about what she would have for snack and pack that in advance and bring it to work:

“You know, when I pack my lunch, I have to think more about not only what is in my lunch, but what is in my snack.” (P10918)

Although less common, participants described restructuring social environments by bringing their own, healthier foods. In some cases, this was to ensure that they had something healthier for themselves to eat in the face of expectations that unhealthy foods that would be dominant. However, it was also a way for that individual to help create a healthier social environment for everyone including themselves, like during a potluck:

“Kind of if it’s a potluck sort of thing, then it’s on me to decide what I’m contributing to dinner and it can be something healthy or not – so I think that’s a way that I myself can influence others.” (P10913)

P10918 also tried to introduce healthier options into social environments when there were events:

“Yeah every once and awhile, I will make a stew or a soup and I will bring it. You know like celebrating something or we have had a couple of crazy weeks or something like that. Every once and awhile, not all the time.” (P10918)

Practices like pickling and preserving vegetables and fruits allowed them to last longer and made them available during times of the year when fresh fruits and vegetables were not in season or as readily available. Essentially, P10893 invested extra effort at one point to introduce new food that would ensure the long-term availability of healthy foods:

“And, you know, that’s something where it is hard because we opened our last pickle jar, I think, last week. And it’s like, oh gosh, we’re out. And we finished it and, we, I guess to go backtrack, we, I found it in the very back of my cabinet when something spilled and I had to clean it out. And I thought that I was all out of pickles, so for the month previous we were just saddddd. And we didn’t really have an alternative, so definitely, went more for like the ranch dressings that ,you know, are really high in fat and are probably not as good as fresh pickles, but ... canned pickles. But it was something that is definitely a barrier is the winter cus I get so used to eating things fresh that I may not leave enough to ... carry through. And our culture doesn’t do that.” (P10893)

In addition to restructuring to increase the availability of healthy foods, participants described practices they used to decrease the availability of unhealthy snacks. Some of these strategies overlapped with those used to increase availability such as using a grocery list. In this case, they would be focusing on keeping unhealthy items off of the grocery list:

“Yeah one of those silly rules in my brain is I can’t buy it if it is not on my grocery list. And when I am at home with like full with like a cookbook in front of me, I am not going to put like gummy worms on the list, right? And so when I get to the store it is easy for me in that moment to walk by the gummy worms. Exactly and that is something that has been a habit for a long time for me as an adult making my own food purchases. And then the impulse purchases are much more likely to be junky, but then if I don’t let myself make an impulse purchase. I am not going to get that junk food.” (P10916)

P10920 created a danger list of products that she would not allow herself to buy. This served as a central location for her to think about what to avoid when shopping and to increase her awareness of foods to avoid:

“I need[ed] a list where those things I don’t – I shouldn’t be eating are on there and can’t be added to my [shopping list]. ... I definitely know some danger products. Like I really shouldn’t have no business buying M & Ms to begin with. I found this new product called, I don’t remember what it’s called but basically it’s brownie bark, you know, it’s brownies but it’s like a cracker. And I can sit and eat a whole bag of those things and so I have no business buying those either.” (P10920)

As she found new unhealthy foods that she was worried she would eat too much, she would add them to the list. So the list evolved over time with her needs, but at the same time required constant vigilance.

P10471 described an interesting practice by which he passively restructured his food environment to avoid unhealthy snacks – laziness:

“I have these weird compulsions for hot Cheetos or funyuns that are insatiable. But, usually I don’t [get them] ... because I’m too lazy to go out and buy them. So I just, yeah it’s laziness ... I have what I have at my house and I’m not going to go and get it.” (P10471)

This strategy may have worked well for him because the food that he normally bought “*errs on the side of healthy*.” So when he had specific cravings for less healthy foods, he usually didn’t have them around already and had a strong motivation not to act and go get those foods. However, for others, laziness could equally prevent them from getting healthy foods. Especially since several participants highlighted the effort required to go and get healthy food and prepare it as a barrier.

#### 5.3.4.2 Restructuring to change accessibility

Participants described ways that they restructured their environment to make it easier for themselves to eat healthy foods that were available. One of the most common practices used was pre-preparing healthy foods so that they would be easy to choose and consume. This could range from cooking a healthy meal that could be taken with to work or school to cutting up vegetables ahead of time to make them more convenient snacks:

“I’m going to try to prepare them before hand, so you know, if the option is to grab the chips out of the pantry or the little Tupperware of vegetables I have, it’s just easier to have it there already. So probably like when I get groceries like chop everything up and have it all ready. Just so it’s more convenient.” (P10895)

As P10895 alluded to, this was especially important given that less healthy snacks like candies and chips were often viewed as more convenient because they were already prepared and ready to be eaten. That meant that quick preparations were an especially valuable type of restructuring. For example refrigerator pickling required little preparation and could make a healthy food easier to choose because it would have a different, often better, taste and could stand-alone as a snack. This wasn’t introducing new food into the environment, but was instead transforming it into a form that would be more appetizing and easy to eat:

“Like fresh pickles that are like a day old. They call them refrigerator pickles, so you get your cucumber and you slice it up and then, you put it in the refrigerator for 24 hours, you don’t even have to boil it, it’s just like refrigerated the whole time. Those are like the best pickles you’re ever going to have. And they’re just, they’re just as good, probably even better because there’s no chance that they’re going to get soft.” (P10893)

In addition to pre-preparing foods, participants also described the simple practice of making healthy foods more visible or just more physically accessible. For example, P10894 described how she bought a fruit bowl, so that she could keep fruit out, on the counter, so that it would be visible and easily accessible for whenever she wanted a snack. Other practices that people discussed included moving healthier options to the front of the refrigerator or taking something healthy out of the freezer to defrost it and make it readily available to eat.

On the flip side of that, participants also described practices of “hiding” unhealthy foods or moving them to places that made it more difficult for them to get:

“Um, when I go to my boy friend’s house, well his mom eats real healthy, so there’s like that half of the cabinet, and then his like really bad half of the cabinet. So him and his dad. So I try to like, eat her side of the cabinet when I’m there ... Like me and his sister put all the bad stuff at the bottom, so like, ‘if you want the bad food, you work for it. You get down on the ground and you pull that door out.’” (P10895)

Participants recognize that adding just a little bit extra effort may be enough to make the choice between a healthy and unhealthy snack just a little bit easier. However, it’s still close enough and visible enough that it may not always have the desired effect. Some participants developed more extreme systems to increase the effort substantially and put unhealthy foods completely out of sight:

“I have one room mate yeah. I mean, [her snack] can [influence me]. But we have a system where we will share food a lot of the time. So we’ll put that in the middle of the room. And the stuff she doesn’t want me to have she has hidden under her bed so she’s hidden away a lot of the unhealthy stuff as a courtesy [to me].” (P10892)

#### **5.3.4.3 Recruiting others in restructuring**

The examples of P10895 and P10892 hiding away unhealthy snacks in less accessible places also showcased the importance of involving others in the process of restructuring environments. Most every environment an individual encountered, whether home, social, or organizational, had other stakeholders – people who have some responsibility for the food environment and who were affected by it as well. For example, in the home people often have cohabitators like roommates and family. In organizational settings they have co-workers or fellow students. It was very rare for participants to have full control over any food environments. And, in fact, others were already actively affecting the food environment, sometimes in healthy ways, sometimes in unhealthy ways.

It makes sense, then, that participants would try to recruit others in trying to restructure the environment in a healthy way. Both P10895 and P10892 worked together with people living in

the same home environment to make unhealthy foods less accessible. For others, shopping together and discussing food purchases and plans was a way to work together towards improving their food environment:

“Having too many of the unhealthy snacks around [is a problem]. It’s probably a shopping thing so just the fact that my wife does most of the shopping and we’re not making those decisions together yet. Just the awareness and just kind of talk about it and make the decision. I think I do have a natural plan to try and involve my wife more and get her on board so that we do a better job of shopping. It’s something I’ve been intending. I’ve even talked to her a little bit about it.” (P10924)

P10924 identified that these conversations cannot just happen once and hope that things will improve. He recognized that he needs to have on-going conversations with his partner and that it may take some time to start to develop plans for action and for her to get on-board with the plan. Recruiting others to the cause of creating a healthy food environment might take time as they have to develop their own intentions and beliefs around wanting to change. During our conversation, he went on to describe one approach that could be effective in recruiting his wife towards creating a healthier environment – speaking from his own fears and beliefs. When asking him about how he could discuss his hope to shop healthier with his wife, he at first highlighted that they did not discuss these issues often, but quickly turned to highlight he had his own fears as motivators for why he wanted to change:

“My wife will bring home a treat and I’ll say, ‘Hun, you really shouldn’t buy as many treats.’ Yeah, but I’ll eat it now. But other than that, I don’t know that I have a whole lot of conversations about snacking. I guess my big concern I haven’t mentioned is to lose a little weight in the near term to avoid being overweight in the longer term because that does seem to be a very definitive pattern culturally and specifically within my family. So I’m concerned about what I look like in 20 years and how active I can be. So, it’s been around at some level for a long time because it’s just an obvious thing. Definitely [in the front of my mind] as we get [older].” (P10924)

Sometimes an individual may not have had direct influence over a food environment. In this case, they could advocate for a healthier food environment by persuading those with control that

it was important and valuable to restructure the environment. P10893, for example, spent quite a bit of time at her parent's home, however it was not her home, so she didn't feel like she was in charge of the food environment there. Instead, she suggested some healthier foods and drinks to her mother, who could in turn introduce them into the environment:

“Things like San Pellegrino's were actually a lot healthier than we thought. And so, my mother totally stocked up at Costco and just like, it was just cool to see how the whole family liked having an extra excuse to eat a little healthier.” (P10893)

#### 5.3.4.4 Challenges to restructuring

Restructuring was not a simple activity for participants. Creating change within an environment was, in effect, a process of behavior change in itself. Participants would need to develop intentions and motivation and then take action to change something in the environment. Therefore, restructuring a food environment required the input of energy, or effort, to create change within an environment that had likely developed to some level of equilibrium. Although pre-preparing foods would make it easier to select and eat healthy foods at the time of decision making, there was still extra effort that needed to go into preparing them in advance:

“Pantry food is just easier to prepare than anything in the fridge, unless it's like – even with fruit where it's like, ‘oh I have to cut it up’ or ‘I have to do something to it or rinse it off, oh no’ as opposed to, I grab a bag of chips and I open it and I eat it” (P10894)

In this case, not having sufficient time or energy were major barriers in terms of conducting the activities of restructuring, such as making a grocery list, pre-preparing food, going shopping regularly.

Of the challenges participants described to creating healthy foods environments, other stakeholders of the environment, such as roommates or co-workers, were often the greatest:

“I have a roommate who if I told I wanted to eat healthy she would probably laugh at me. Well she's not necessarily against me. She would just laugh at me. So she [has some] food around the house that was tempting. So there go you! If I wanted



to just get rid of the cheese it wouldn't be a big deal, well the cheese would be a big deal because she does love cheese and she does have cheese in the house." (P10472)

P10472's roommate had unhealthy food around, which she found tempting, but that she felt she would be unable to remove from the environment. Her roommate loved that food and would likely not part with it, nor did she have to. In this case, as a cohabitor, P10472's roommate had every right to have her own food. Sharing grocery shopping with roommates made this even more difficult as the food was directly shared and multiple parties had input as to the food they would purchase:

"The way I'm shopping, I'm living with – the program I'm in, I'm living with, there's six of us in the house and we [share groceries] and kind of come up with a grocery list as a house. So, I don't really have complete control over the individual things that we get, I do a lot of the grocery shopping and I do most of the cooking for the house too. So I make sure that there's usually at least the fresh fruits and vegetables are pretty easy because we get some of those each week and usually the roommates don't eat those so I can. And some of the prepared stuff I always will cook some like, cooked vegetables and those are usually again for meals and again they don't eat many so there's usually a lot left for me. So, it makes it a little harder at some points because obviously the food that they eat is around and available so like the cereal, the other things like that. The frozen pizza is around, things like that. But, so yeah. It does affect it, it's not like it doesn't stop me from doing anything." (P10908)

In addition to the explicit challenges participants described, the interviews revealed a potential implicit challenge consisting of a lack of knowledge around how to restructure an environment in a healthy way. Even more fundamental, may be a lack of awareness among people around the idea of environmental restructuring – making changes to their environments to facilitate healthy eating. Almost every participant identified their food environment as a major factor influencing their eating behaviors and that increasing availability of healthy foods would help them eat healthier. However, fewer participants described changing their environment as a practice they engaged in regularly. Nor did many identify specific ways to increase availability or alter their environments to support healthy eating – suggesting an opportunity to increase awareness of environmental restructuring as a strategy to improve eating behaviors.

## 5.4 Discussion

In taking Snack Buddy out of its original design context, a low SES community in Denver, the application received a mixed reception – one that was, overall, less positive. The simplicity of the application, in terms of its overall focus, input process, and feedback, were aspects tailored to the lower health literacy and numeracy of the low SES community. However, these design decisions were not fully appreciated in a more purposefully varied sample of participants. Simplicity is often touted as a keystone of design, especially for mobile applications [168, 44]. But simplicity can be at tension with other aspects of an application. Specifically, we found simplicity was at tension with users’ desire for a more holistic consideration of their behavior as opposed to focusing on a subset of their behavior, such as snacking in our case. Simplicity was also at tension with providing detailed data that users could capture and reflect upon; exemplified by the lack of portion size information in our application.

This trade-off between the simplicity of data entry and the richness of data has been exemplified in two major approaches to dietary self-monitoring in sociotechnical interventions. On one hand, some interventions allow users to enter each food they eat along with details about each of those items [12, 51]. On the other hand, interventions have started to adopt photo-based logging where the focus is on reflecting and engaging during the entry process, but details of the food are lost since only a picture exists of that food [185, 74]. Individual Snack Buddy tries to situate itself somewhere in the middle by aiming to reduce the burden of entering details about each item, while still trying to capture some specifics about the foods that were eaten. Of course, another approach – automatically sensing the food people eat – has tried to bridge this tension by removing the burden of entry all together while still retaining details about the foods users eat [227, 178, 38]. However, these automated approaches disengage users from the data entry process – a key time that people reflect and learn [40]. Our research suggests that, ultimately, there is no one-size fits all solution for self-monitoring diet and that it is important to design for the intended context of use.

In this section, I first discuss the implications for this research on our understanding of the environment as factor that affects eating behaviors. In doing so, I relate our findings to other models of the food environment. Next, I discuss ideas for how we can design to address environmental factors. Specifically, I discuss the ways in which participants engaged in environmental restructuring and consider how we can design systems to support environmental restructuring. Lastly, I discuss implications for our research related to theory-based design of sociotechnical interventions in the form of design guidelines.

#### **5.4.1 Environmental factors: An underspecified determinant**

Our results suggest that eating behaviors are heavily influenced by environmental factors, potentially more so than other factors. Participants readily suggested that environmental factors, such as availability, accessibility, and their ability to shop and access healthy foods, were often the primary or most apparent reason for their eating behaviors. Some models, including the IBM, which informed the design of Individual Snack Buddy, give less consideration to these environmental factors than other factors. The IBM acknowledges that environmental constraints and facilitators are factors that can affect the performance of a behavior, but research using the theory often gives greater attention to the psychosocial factors that are more clearly specified [158]. Other models, such as socioecological models of health behavior put the environment at the forefront. However, environmental factors, as a determinant of behavior, are often underspecified, even in socioecological models.

One reason for this underspecification is that defining the “environment” and “environmental factors” can be very difficult [17]. Furthermore, environmental factors tend to be behavior specific. This current study aims to help address this shortcoming, with respect to eating behaviors, by exploring people’s conceptualization and interactions with the food environment in greater detail. Our work suggests that, within the context of eating behavior, the Community Nutrition Model proposed by Glanz and colleagues [90] presents a model that could help more clearly and completely describe the environmental factors that influence eating behaviors. The model (see Fig-

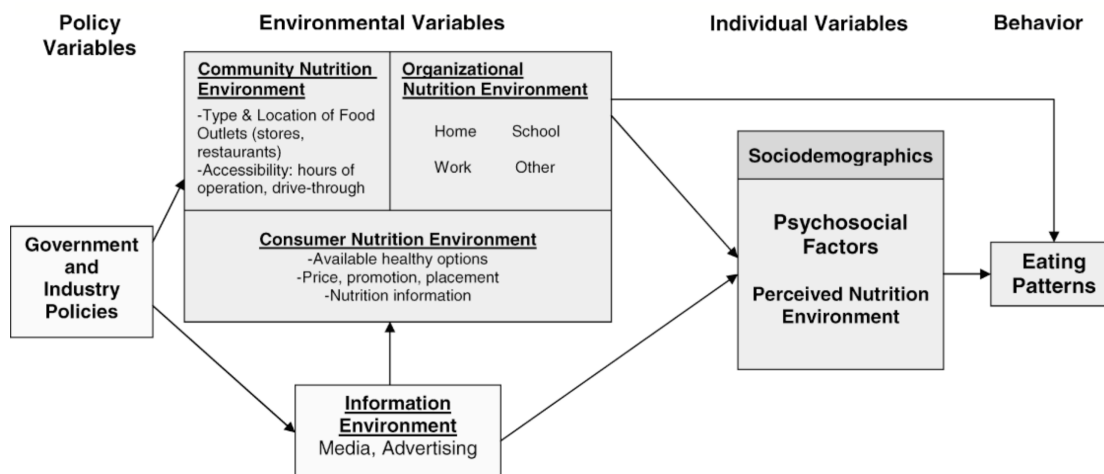


Figure 5.8: Path model describing the Community Nutrition Model proposed by Glanz and colleagues [90]

ure 5.8) closely aligns with our findings around the different food environments that affect eating behaviors and the salient aspects of those environments. The model suggests that different environments both directly affect eating patterns and indirectly affect them through psychosocial factors, sociodemographics, and by informing the perceived nutrition environment. It specifies three different nutrition environments – the organizational nutrition environment, the community nutrition environment, and the consumer nutrition environment – that exert influence on people’s behaviors.

There are several changes to the Community Nutrition Model that would align it more closely with our results. The first of which would be to separate home food environments from organizational environments. Our findings suggest that home environments and other organizational environments share very little in common and that people conceptualize these environments very differently. These findings are consistent with an extensive body of research suggesting home environments are unique and especially important and influential on eating behaviors [103, 132]. Other research, specifically involving the Community Nutrition Model, has similarly suggested that the home environment be considered its own, separate component of the model [170].

Our results also suggest a need to expand our conceptualization of the community food environment. In the Community Nutrition Model, and in much of the body of research considering

the community food environment, there is a focus on retail food outlets – places where food can be purchased (e.g, grocery and convenience stores, small markets, restaurants) [28]. However, local food programs, community gardens, and the natural environment, which we refer to collectively as non-traditional food sources, enrich the community food environment. Although we found that these resources were only used by a small portion of our participants, for those that did, they were very important. These understudied food sources could hold significant potential in helping connect people with healthy foods, as suggested by previous research [60].

Additionally, our work suggests an additional type of food environment not originally specified in the Community Nutrition Model – social food environments. These social food environments differ from organizational environments as people have less control over the foods available, there are unique social norms and pressures within these environments, and they are not environments that people consistently encounter. They also differ from the community food environment as these social environments can exist both inside and outside of the community food environment. Social activities can take place at a restaurant, where the decision about where to go would be affected by the community environment, however they can also take place a person’s home. Additionally, the community environment does not imply the presence of the social environment. One can go to a fast food restaurant to pick up food for themselves on the way home from work, which requires considering the community food environment, but there is no social environment involved.

Lastly, the the Consumer Nutrition Model does not specify any mechanisms by which these environments may affect eating behavior. Our research suggests that different food environments appear to work primarily through affecting the availability and accessibility of different foods. Previous research has defined availability and accessibility similarly to our findings and suggested a similar relationship between the two [56, 56, 115]. This finding, that these concepts are core to the way environments affect people, is consistent with prior work looking at the effects of microscale environments on food choice [218] and microenvironments on eating behaviors [115]. In this previous work, the accessibility, convenience, and availability, including the availability of a diversity of foods, are aspects of the environment that actively affect food choices and that can be manipulated to

support healthier choices [215].

Our work also aligns with prior research suggesting that people interact with their environments in a bidirectional way [215, 33, 149] – the environment exerts influence on their behaviors and they, in turn, exert influence on their environment. In this study, we found it was primarily through environmental restructuring of their home, work, and social food environments. Specifically, our research suggests that it is through availability and accessibility that people can exert influence over different microenvironments.

#### **5.4.1.1 Environmental control**

In considering environmental factors, our research suggests a novel construct that plays a role in how people interact with their environments – environmental control. The level of control that an individual had over an environment was one of the key differentiators between the different environments. Participants had the greatest control over their home environments, with less control over organizational environments, and even less control over social environments. However, the level of control participants had over a given environment varied. In some cases, participants who lived alone had full control over their home environments, while those who cohabited had less control.

Participants discussed significant frustration in cases where they did not have more control over the food available in a given environment. For example, P10894 found it extremely frustrating when her roommates moved her fruit bowl with healthy food into an inaccessible position or when they left the kitchen in an unusable state. In cases where they did not have full control, participants sometimes tried to influence environments outside of their direct control. For example, some brought healthy food into social or works environments. However, they often found that doing so required significantly more effort and forced them to challenge the accepted norms of the environment.

The level of control an individual has over their food environment can affect their ability to create a healthy environment. However, it can also influence the psychosocial constructs that affect eating behavior. For example, we saw that when participants were unable to control the environ-

ment their intentions to eat healthy also decreased. For example, in social environments where they identified having limited control over the food environment, we commonly found participants accepted that they would just eat less healthy than they wanted during that event. They were also more susceptible to social norms in that context, as opposed to, say, their work environment, where they had more control over the foods available and accessible to them.

There are certainly aspects of the food environment that an individual may have significant difficulty in exercising control over – if they are at a friends house, they have very little control over the food available to them and social pressures to eat the food they are served. It may be more important to identify the realistic ways that an individual could influence their environments, given their resources and their situation, and to help them address perceptions of limited control.

Because our research relied on the verbalized beliefs of participants around the factors that influence their behaviors, more work must be done to explore the concept of environmental control and understand the extent to which it is grounded in reality versus perception.

#### **5.4.1.2 Expanding the Community Nutrition Model**

Considering the Community Nutrition Model proposed by Glanz and colleagues, there are several differences between the findings of our research and the model, along with new concepts that expand upon it. Figure 5.9 illustrates these through a visual representation that builds directly upon the Community Nutrition Model to help clearly situate the ideas within and relative to the model. We integrate availability, accessibility, and environmental control as key concepts through which people interact with their environments. We also replace the word “nutrition” with “food” to broaden its domain. This diagram also includes concepts introduced later by Glanz and colleagues that refer to environments that are closer to the individual and accessible to limited groups of people as microenvironments [191] – environments King and colleagues would consider the “me” domain.

This visual representation is intended to help summarize and illustrate the findings of this study and relate them to the previous literature. As such, it is descriptive and does not aim to

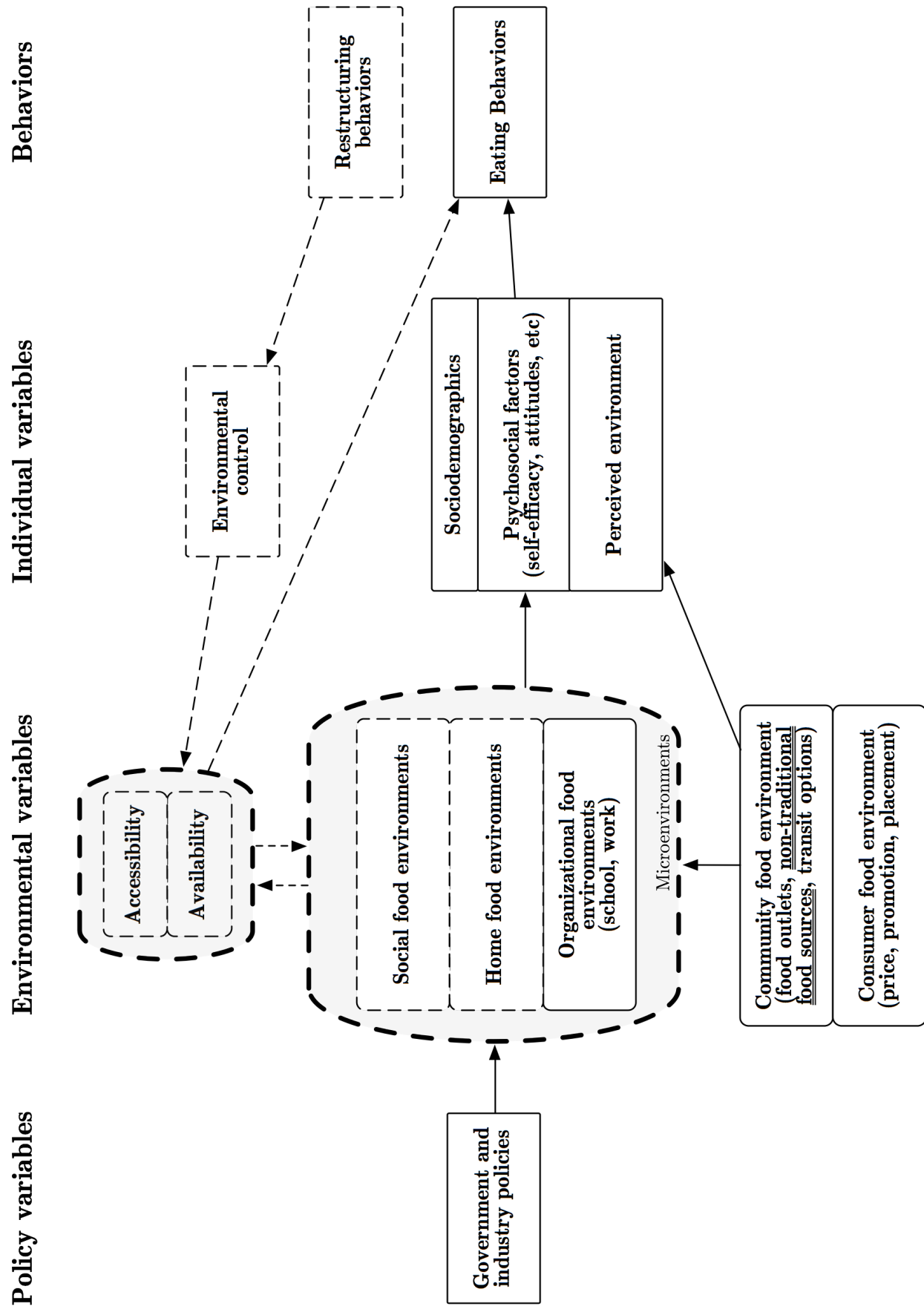


Figure 5.9: A visual representation to help situate our findings within the Community Nutrition Model [90]. Components that use dashed lines or text that is doubly underlined represent where our findings differ or where we introduced new concepts.



be predictive. It is conceptual in nature as it is based on exploratory, qualitative research around people’s experiences with their food environments. Further work would need to be done exploring these different concepts and relationships before a model could emerge.

#### **5.4.2 Designing to address environmental factors**

Most sociotechnical interventions to promote healthy eating, or to change health behaviors more broadly, have focused on psychosocial determinants of behavior, such as knowledge, self-efficacy, awareness, and social support. However, few have addressed or even considered the broader environmental factors that can support or obstruct change (see Section 2.2). In Study 1, I suggested considering these factors in tailoring the information and feedback provided to users. The idea would be to push people towards healthier foods they may already have or consider the availability of foods in their community and nearby their location when presenting information.

In addition to those approaches, this second study suggests that supporting environmental restructuring may be a way for sociotechnical interventions to help users improve their food environments. Although the concept of changing one’s environment has been discussed in the literature for many years [19, 33], Michie and colleagues formalized the term Environmental Restructuring to describe the practice in the context of health behavior change [155]. In their work, they define environmental restructuring as “alter[ing] the environment in ways so that it is more supportive of the target behaviour” [153]. This term gives a name to strategies and practices that have been explored in strands of research across different fields. For example, within the public health literature previous research has explored using home visits to help people create healthy food environments in their homes [101] and interventions to support parents in creating healthy food environments for their children [82].

Most of the previous research that has explored changing people’s environments to support healthier behaviors has not described the specific changes that people use or that can be effective. These studies refer broadly to supporting environmental change without providing the details as to what that means. Furthermore, most of the prior work has focused on children and childhood

obesity in the context of supporting environmental restructuring. The present study is one of the first to explore, in detail, the specific practices individuals engage in to restructure the food environment. Specifically we explored practices that individuals used to restructure the microenvironments they encounter [191] or the “me” domain of the food environment [129].

I propose that sociotechnical interventions can play a role in addressing environmental determinants of health behaviors through supporting environmental restructuring. Researchers can consider four specific practices of environmental restructuring in considering the design of systems – 1) increasing the availability of healthy foods, 2) increasing the accessibility of healthy foods, 3) decreasing the availability of unhealthy foods, and 4) decreasing the accessibility of unhealthy foods. These four high-level practices can be used as the foundation of systems that support environmental restructuring. Similarly, Wansink suggests three broad strategies to consider in manipulating the environment to make it healthier – *convenience, attractiveness, and normality (CAN)* [215]. Our approach of manipulating availability and accessibility to create a healthy environment aligns with the *convenience* attribute in Wansink’s CAN Framework. This makes sense given *convenience* is most susceptible to intervention by an individual – the focus of our work. Individuals have less control over the *attractiveness* of the appearance or price of food, nor do they, individually, have much control over *norming* the purchase or eating of certain foods. Instead these rely more so on business owners, policy-makers, and organizations to enact change.

Our results suggest that the idea of creating a healthier environment and setting oneself up for success is a concept people are already familiar with, so engaging with it may come intuitively to people. Participants were already aware and conscious that their environment affected their eating behaviors, especially the availability and accessibility of food. However, they were not necessarily aware of how specific details of their environment affected them. Nor were they aware that there were specific ways that they could alter their environment to support healthier eating. Instead, they naturally developed emergent practices of environmental restructuring. Technology can be a tool for raising people’s awareness of their surroundings [24, 2, 110] and so there is an opportunity to use sociotechnical interventions to help people become more aware of the ways their environment

affects them and to be vigilant about opportunities for environmental restructuring.

Even with a greater awareness of how their environment affects them, there are specific ways that people can restructure their food environments to support healthy eating (e.g., putting less healthy food in hard to reach places, pre-cutting fruits and vegetables so they are easier to grab). There is a need to impart this knowledge and support people in practicing these skills on a regular basis. Technology has been effective in teaching and supporting skill-based practices ranging from cooking [193, 66] to programming [157] and teaching children how to brush their teeth [39]. As environments can naturally shift over time, it's important to keep people engaged in constantly practicing restructuring, something that sociotechnical interventions are well positioned to do [83, 26, 123]. Technologies can use reminder systems and pervasive elements to consistently keep people actively engaged.

It's important to acknowledge that, previously, researchers have developed sociotechnical interventions to support one specific type of environmental restructuring – grocery shopping [199]. As we found, the practice of grocery shopping is a major way that participants currently engaged in environmental restructuring. These previous studies have suggested that technology-based systems can be effective at supporting grocery shopping and increasing the healthiness of the choices made at the store [183, 219]. By building upon interventions that already seek to support healthier grocery shopping, we can support more holistic practices of environmental restructuring.

One specific study used augmented reality on mobile phones to guide users through healthy grocery shopping while in the store [5]. Our work suggests that a similar approach could be used to help visually guide people through other practices of environmental restructuring. For example, one could imagine taking pictures of a home environment or using augmented reality to suggest specific ways to physically restructure the environment to support healthy eating. Pictures or videos that users took of their home environments could be rendered with annotations that instructed specific changes that could be made. An application could identify specific areas where healthy foods could be stored that would better facilitate someone in eating them. It could suggest color coding certain cabinets in the home – red, yellow, green – to provide a quick way to shift their attention

towards the cabinets with the healthier foods [202, 208]. Such a system could be implemented using nutritionists who annotate images remotely and send them back to users or using automated, vision recognition systems that could be trained to suggest specific opportunities to make changes in environments.

#### **5.4.2.1 Environmental restructuring and choice architectures**

Environmental restructuring overlaps, to some extent, with the research on choice architectures and behavioral economics, an increasingly popular topic in the fields of public health [109], psychology [9], and more recently computing [139, 29, 3]. Choice architecture interventions have demonstrated effectiveness across a number of health behaviors, especially in healthy eating [209, 109]. However they have a major limitation in that they are setting-specific interventions. Every setting where food is available needs to implement its own choice architecture. For example, a student may go to a school where the administration has carefully architected the school environment to support healthy choices. They may have put healthy snacks in the vending machines, have a salad bar as the first station in the cafeteria, and implemented other strategies. However, if the student transferred to a new school, where none of these efforts had been made, then they will no longer have a supportive school food environment. Choice architectures are not portable.

Furthermore, the choice architecture approach is disempowering in nature because those with power make decisions about how things should be. Our research suggests re-envisioning people as their own choice architects by providing them tools and skills by which they can restructure their own environments. Instead of using stealth interventions that purposefully rely on individuals' unknowingness, as many choice architectures do, we could facilitate environmental restructuring by making explicit the biases that people hold, how they can affect them, and strategies to address them.

### 5.4.3 Principles to support theory-based design

One of the key motivating questions behind this study was around how we could more explicitly and effectively use health behavior theory in the design of sociotechnical interventions. Although most theories of human behavior provide valuable frameworks that explain and predict behavior in a systematic manner [88], few provide guidance on how to implement interventions. In this study, we used one approach to operationalizing behavior theory into technology-based interventions – Construct-to-Feature (C2F) design. In our process, we selected the IBM as our theoretical framework and, from it, three constructs – self-efficacy, descriptive norms, and instrumental attitudes. Each construct then informed the design of a feature that would induce change within its target construct, based on considering the current theoretical understandings of the construct and effective interventions [158, 154, 153].

We reflected on our experiences using a C2F approach in designing Individual Snack Buddy and how our design decisions affected participants’ experiences using the application. In doing so, we identified several principles that could help guide theory-based design of sociotechnical interventions that aim to change human behavior. In designing interactive systems using behavior theory, our research suggests that researchers be transparent, provide a coherent experience for users, be iterative and reflexive in their process, use a modular approach, and leverage the most salient aspects of their target theories.

#### 5.4.3.1 Transparency

Transparency in theory-based design means that it is easy for both the designer and community to understand how the behavior theory informed the application design. This is accomplished through both the process used to design an application and through effectively reporting this information.

In the design process, researchers should first consider the theories that best fit their needs. From this, they can consider what aspects of that theory they want to consider before beginning

their design process. This allows designers to be intentional about how theory is informing their work, instead of developing a theoretical basis for their design after it has already progressed. The constructs, relationships, and underlying propositions of that theory should drive forward a design. For a target construct or proposition posited by a theory, researchers can consider strategies that are theoretically or empirically supported in affecting change and then identify sociotechnical designs that would facilitate that strategy. Designing in this forward, theory-first process can help researchers understand the theoretical basis for their own design.

#### **5.4.3.2 Coherent experience**

One of the greatest weaknesses of our approach in developing Individual Snack Buddy was that we overly compartmentalized the different theory-informed features. Participants described the features feeling separate from the core focus of the application on tracking their snacks and that the features felt like just one more thing to do. It was difficult, in some cases, for participants to see how these different features tied into their process of improving their snacking behaviors. Features in a theory-based application need to clearly inform users why they can be beneficial. This could be done through their design and integration into the application as a whole or through providing information about how a certain aspect can support their overall goals.

We also missed opportunities to tie the features into the core self-monitoring aspect of the application. We identified two specific ways that theory-driven applications can create more coherent experiences for users by better integrating individual features. The first is through having features, or parts of features, co-located within the application. Robinson and colleagues successfully embedded reflection within the data entry process of their application [185]. This reduced the number of distinct interactions that participants need to have with the application to engage with its different features. Our research suggests that this could be a beneficial strategy for creating cohesion and making it easier for participants to engage with different facets of theory-based applications. In our study, specifically, several participants identified that they would have preferred entering diary entries right after they entered a snack or when they were reviewing their snack history to have

something to seed their reflection.

Second, designers can leverage the information collected through one aspect of their application across other features. In our case, there were opportunities for information user’s input in one feature to be leveraged in another aspect of the application. For example, one participant suggested using their interactions in the social stream to customize the snack suggestions they were receiving.

#### **5.4.3.3 Iterative process for theory-based design**

Using behavior theory to design an application must be an on-going iterative process. As Hekler and colleagues argue, the design decisions made using theory are “design hypotheses” about how certain aspects of an application will affect theoretical components [106]. We had design hypotheses that each feature would affect its target construct. Embedded in each of these are more generalizable hypotheses around how strategies like reflecting on prior behavior and demonstrating group norms, when implemented in a sociotechnical intervention, can be effective at changing specific constructs and behaviors.

Based on the participants’ experiences, we identified ways in which our features supported changes in their target constructs. Our results identify where our design hypotheses were supported and where they were challenged. We can use this evidence to iterate on the application to test new design hypotheses. Researchers using theory-based design should use an iterative process where they are constantly evaluating the extent to which their design decisions are leading to the desired effects on theoretical constructs and behaviors. This can be done using both qualitative inquiry of users’ experiences and quantitative, experimental study designs and analyses.

#### **5.4.3.4 Modular and component based**

By designing a modular, component-based approach, it becomes easier to conduct studies and analyses that identify the “active ingredients” in applications [155]. The “active ingredients” are those components in an application that actually affect changes in target outcomes. Identifying the “active ingredients” of an application requires empirical research studying the effectiveness

and level of engagement with each component. If components are too tightly coupled, such that researchers cannot create multiple experimental conditions that separate different features, then it becomes difficult to use study designs, such as factorial studies or A/B testing, to identify these ingredients. Furthermore, a more modular design supports qualitative inquiry into users' experiences with individual aspects of the application. We found that it was easy for users to describe their experiences with specific features because they were modular. By discussing different individual features, participants could easily assess their value. Based on these findings, user experience and engagement should be considered as aspects of what makes a feature an “active ingredient” in an interactive system.

The modular nature of the design process then provides researchers with the ability to eliminate components that are ineffective or create negative experiences. If a feature is rarely used or users find it frustrating, even if there is evidence of an effect on a target outcome, then it would not be an “active ingredient” and can be removed. If a feature is only used by some users or under some conditions, it may be considered an “active ingredient” under those conditions and the application can be tailored. Interventions that contain more components are more likely to be cognitively taxing and difficult to use [206, 122], so it is important to retain only those features that demonstrate efficacy and improve user experience.

#### **5.4.3.5 Leverage the most salient aspects of theories**

We agree with Hekler and colleagues that it is important to consider the nuances of theories and understand the complexities of how constructs interact and to what extent they work independently or in tandem [106]. If a theory stipulates that researchers must activate one construct before being able to influence another, then an intervention must operationalize this to effectively use that theory. Our findings, however, challenge the idea that “picking only some constructs from a theory” [106] should be considered a pitfall of theory-based design. Instead, we argue that researchers should identify and use the most salient aspects of a given theory, as long as this is a conscious and iteratively informed decision.



Trying to create multiple features to address all of the components in a theory may require a level of engagement that is infeasible for most people in their daily lives, meaning they may end up rarely using most of the features. The issue of complexity may end up being extra problematic with applications that are not brief, lab-based interventions but that are intended for on-going use in everyday life [45]. We found that people had difficulty making time to use the additional features outside of the core system of self-monitoring their snacks.

## Chapter 6

### Study 3: Exploring experiences of food insecurity

The idea of supporting people in creating healthy food environments for themselves relies on a person having consistent access to healthy foods and a significant level of actual environmental control over at least some food environments. For those who experience food insecurity and face significant barriers to accessing healthy food, there is a “cart before the horse issue.” Creating a healthy food environment requires first having a certain level of access to healthy foods. Food access, different from the accessibility of foods, refers to the ability to acquire food through various means such as purchasing it at the grocery store or getting it from a food bank. How, then, can we support greater access to healthy food for people experiencing food insecurity? What role can technology play, if any?

As a first step towards answering these questions, we explored the diversity of experiences that people face with food insecurity. The goal was to understand the challenges faced in accessing food, the tools used to support food access, and the current ways people who experience food insecurity use technology to help themselves access food. Understanding the current tools, the problems they aim to solve, and the extent to which they address those issues can illuminate opportunities for technology to help. We can also learn from the current adoption of technology to build upon those already being used to support food access.

To explore this issue in greater detail, we used a community-based participatory research approach to engage people who experience food insecurity actively in studying the issue. We conducted a participatory, qualitative inquiry into the lived experiences of people facing food insecurity.

People captured their daily experiences accessing food, so that we could see, through their eyes, the challenges they face in accessing healthy foods.

## 6.1 Study approach: Community-based participatory research

Community-based participatory research (CBPR), sometimes referred to as Participatory Action Research [221], is a collaborative, action-oriented research approach that involves the development of long-term, equitable research partnerships between academic researchers and communities to study and address issues of sociostructural inequity [213]. In these partnerships, the findings from research activities are leveraged to bring social change to communities. This approach has been used to study and develop interventions to address health issues ranging from diabetes [34] to healthy eating [140, 176]. Recently, HCI researchers working across other domains have also begun using CBPR approaches to develop equity-oriented research efforts to explore technology practices and design opportunities [59]. In these studies, research teams attend to issues of both academic rigor and community impact by building trust, fostering authentic relationships between research partners, and engaging in iterative cycles of research and action. Often times, the process of relationship and partnership building can take months to years to ensure that it is done in a way that creates a strong foundation on which to conduct the research project.

Israel and colleagues identify eight key principles of CBPR work related to improving the health of individuals and communities [114]. For example, integrating knowledge and action for mutual benefit of all partners and building upon the current strengths already within the community. These principles are the foundation of high quality CBPR work. Although the approach shares commonalities with common HCI practices such as Participatory Design (PD) and User-Centered Design (UCD), it differs in the level of involvement of the community, research partners, and participants. CBPR involves the community at *all* levels of the research process – from defining the problem and research questions to developing the study design, conducting data collection and analysis, and through dissemination [213] – whereas other design-oriented participatory methodologies only involve the community or target users at certain phases of a research project, such as

during design. There is also an emphasis on equity and social justice in CBPR that is not commonly present in other participatory methodologies.

Unertl and colleagues identified unique aspects of using CBPR in the design of technologies to improve health [213]. In doing so, they elaborated on the eight principles first enumerated by Israel and colleagues. These elaborations include creating shared ownership of technological products of the research, support for capacity building around the use of technology and research methods, and leveraging specific participatory design methodologies (such as UCD and PD) for the implementation of technology-based solutions. We adopted these revised principles as the framework to guide our project – from its formation and through subsequent stages.

## 6.2 Partnership development

This study was conducted in partnership with Boulder Food Rescue (BFR), a non-profit organization in Boulder that works to rescue and redistribute healthy food, especially fresh produce, to low-income people in the community. “Rescuing food” means that they work with local grocery stores and other food outlets to collect food that would otherwise go to waste. They do this work through a participatory approach by developing relationships with residents at low-income housing sites and working to integrate the voices of food recipients back into their programs.

In developing the partnership, we worked together to identify research questions using both BFR’s expertise around the community’s needs and a review of the research literature. We also spent time early in the development of our research project to set expectations, identify our separate and shared research interests, discuss the CBPR process, and discuss potential research methodologies. In addition, we reached out to other community organizations interested in the issue of food security to identify research questions they were interested in exploring through our project. These organizations included food pantries, public housing organizations, Latin@ advocacy organizations, after-school programs, and organizations supporting and advocating for people experiencing homelessness. This partnership development and community engagement process started in May 2015 and took around 5 months.

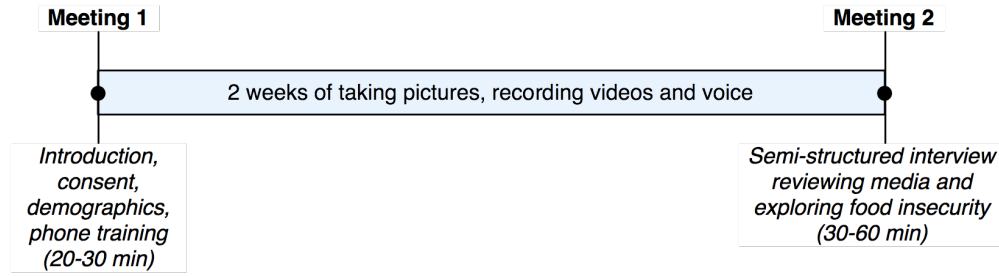


Figure 6.1: Timeline-based overview of the design for Study 3

When we first began the partnership, no member of our research team member could speak Spanish. This meant that we could not include Spanish speakers as research participants in our project. This was problematic since many of the people experiencing food insecurity in Boulder speak Spanish. To build the capacity of our research team to effectively enable Spanish speakers to participate, we worked with several community organizations to find someone who was bilingual that would be interested in joining our team. Through these efforts, a community member, who lived in one of the public housing communities in Boulder, joined our team. She has served as a community researcher and liaison as well as the lead interpreter and translator for our project. As a community researcher, she has been actively involved in designing and conducting the research project from an early stage.

### 6.3 Methods

Through the development of our partnership, and based on our findings from Studies 1 and 2, we decided to conduct a qualitative exploration into the issue of food insecurity with people who are experiencing food insecurity in Boulder. We used a multimedia elicitation interview (MEI) approach, which is a participatory, semi-structured interview method where participants record media (i.e., photos, videos, and audio recordings) related to a topic of interest using a multimedia recording device, such as a camera phone [128, 35]. Those pieces of media are reviewed during a subsequent semi-structured interview and used to guide the conversation. They serve as prompts for conversation on the broader topic of interest and are captured as research artifacts for analysis.

Figure 6.1 illustrates the design and research activities for Study 3. In total, we met with participants twice – a first meeting to discuss the study, conduct informed consent activities, collect demographic information, and explore each participant’s comfort with using a mobile phone to record multimedia – and a second meeting, two weeks later, to conduct an individual, semi-structured interview exploring their experiences with food insecurity through the media they captured. In order to be inclusive of people who were uncomfortable with using a camera phone, we offered alternative methods for capturing their experiences. These included using either a written diary or a voice recorder, both of which we provided. To thank participants for giving up their valuable time to be a part of the study, we offered a \$25 gift card to King Soopers, a chain supermarket with multiple locations in the community.

In our study, we developed specific prompts to guide participants in capturing media that were inspired by prompts used in a previous research study exploring the perceptions of technology of people experiencing homelessness [58]. The four prompts we used were – 1) record moments when you are in the process of getting food, 2) record things that make it more difficult to get, prepare, or eat food, 3) record tools you use to help you get food, and 4) record positive experiences you have with food. The prompts were provided to participants on a note card for reference during the study. We asked participants to think broadly about any tools they used to help them get food, which would include any objects that they felt made it easier for them to get food. We provided several examples that ranged from simple tools such as shoes or bags to more complex tools such as their mobile phone or car.

At the first meeting, we administered a brief demographic survey as well as the 6-item food security screener developed by the USDA [1] (see Appendices G and H). We also explored participants’ comfort in using a camera phone to take pictures and record videos of their experiences getting food. For those who were comfortable, they could either use their own camera phone, if they knew how to record media using their own phone, or they could borrow a camera phone from us. We conducted a brief training on how to take pictures and record videos for those who borrowed a camera phone. In addition to providing them the prompts for what to record on a note card,

we also provided them with a script by which they could confirm with family members and close friends that it was alright for them to be recorded (see Appendix I). Along with that, we provided a script that they could use to explain to people why they were taking pictures, in case anyone asked (see Appendix I). All surveys and documents that were given to participants were translated into Spanish, so they were available in both languages.

During the second meeting, we conducted a semi-structured interview around participants' experiences with food insecurity and the challenges they faced in accessing food. This interview was primarily guided by the media each participant collected during the two week period between meetings. We reviewed each piece of media they collected and asked questions to gather additional context and insight about their experiences (see Appendix J). We also asked questions, in a semi-structured fashion, about their broader experiences getting food that were informed by the research questions of the project. Appendix J lists sample questions that were used during some interviews, however we let participants primarily guide the interviews.

### **6.3.1 Recruitment**

A key goal of our research project was to capture a diversity of experiences with food insecurity from people across a wide variety of backgrounds. This called for a broad outreach approach for recruitment to ensure we were inclusive of as many different voices as possible. That meant we could not just focus on one place or organization for recruitment, but instead needed to pursue every avenue – especially outreaching to spaces where we could connect with people who were not already accessing food resources.

Based on the experiences of BFR, there were a few specific sub-communities in Boulder who they interacted with in their work – older adults, Latin@s, people who are houseless or who have uncertain or changing housing situations, and people with families. We wanted to ensure there was representation from individuals across all of these communities and outside of these communities. Thusly, part of our work involved outreaching to organizations and individuals who worked with these communities and to places where people from these communities might be visiting on a regular

basis.

Our recruitment materials included flyers and small handouts that could be given to clients of different programs. In addition, we also visited community organizations and events to speak to people about the study and inquire about their interest in participating. Our outreach efforts began in spaces where people experiencing food insecurity might visit on a regular basis. This primarily consisted of food pantries in the Boulder community who posted our flyers, gave out the small handouts we created, and referred specific clients to us. In total, we worked with 26 different organizations, which included churches, advocacy organizations, public housing neighborhoods, shelters, poverty education programs, schools and after-school programs, and government agencies (e.g., county public health, city offices, and SNAP/WIC offices). We also posted recruitment materials at an additional 4 public locations (e.g., libraries, grocery stores).

We also used snowball sampling where we asked participants, at the end of the study, about anyone they knew who might be interested in participating in the study. Our goal was to connect with people who were not already using services or who were not engaged with programs we were already working with for recruitment. We recruited three participants using this method.

In total, we conducted outreach and recruitment activities for five months to enroll 26 participants.

### **6.3.2 Participants**

In total, 26 individuals completed the research study. All participants who enrolled in the study completed it. Table 6.1 describes the demographics of participants in our research study. Everyone who participated self-identified as having challenges with food access. The USDA screener questionnaire identified all participants as experiencing some level of food insecurity.

In considering the subgroups we aimed to have participation from, we had 4 participants who described having non-conforming housing situations (e.g., living in transitional housing, having a campsite, or being houseless), 8 participants who identified with the Latin@ community, 7 older adults (people either age 65 and older or living in housing designated for older adults), and 11



participants with families (having children or others who lived with them that they cared for).

		N	(%)
Gender	Male	3	(11.5%)
	Female	23	(88.5%)
	Gender non-conforming	0	(0%)
Age	20–29	0	(0%)
	30–39	7	(27%)
	40–49	8	(30.7%)
	50–59	5	(19.2%)
	60+	6	(23.1%)
Race/ethnicity	White/Caucasian	15	(57.6%)
	Latin@/Chican@/Hispanic	8	(30.7%)
	Asian	1	(3.9%)
	Multiracial/multiethnic	1	(3.9%)
	Disagrees with racial/ethnic classification	1	(3.9%)
Years lived in the community	<1 yr	3	(11.5%)
	1 – 2 yrs	5	(19.2%)
	3 – 10 yrs	5	(19.2%)
	11 – 20 yrs	6	(23.1%)
	>20 yrs	7	(27%)
Household size	Single person	15	(57.6%)
	Multi-person (2 or more)	11	(42.4%)
Highest level of education attained	Elementary school or lower	3	(11.5%)
	Middle school	0	(0%)
	Some high school	1	(3.9%)
	High school	4	(15.3%)
	Some college	7	(27%)
	College	7	(27%)
	Advanced degree (e.g., MD, PhD)	4	(15.3%)

Table 6.1: Study 3 participant demographics

### 6.3.3 Data collected

In this study, we collected the following data: 1) basic demographics, 2) participants' responses to the 6-item USDA food security screener, and 3) video recorded interviews with each participant.

In total, 19 interviews were conducted in English and 7 interviews were conducted in Spanish.

Of the interviews conducted in Spanish, 3 were led by an English speaker and interpreted and 4 were conducted completely in Spanish and led by the community researcher. All the video recordings were transcribed in their native language – either English or Spanish – and then those in Spanish were translated by the community researcher into English for analysis. The interviews lasted between 35 minutes and 1 hour and 49 minutes [average = 75.3 minutes].

21 participants used a camera phone to capture videos and photos, 3 participants documented their experiences in a written diary, and 2 participants were unable to record any media during the two weeks because they were too busy. Participants recorded a total of 767 photos (36.52 average per participant) and 228 videos (10.86 average per participant) using camera phones.

#### **6.3.4 Analysis**

We conducted a thematic analysis of the transcribed video interviews using an inductive analytical process. The interviews conducted in Spanish were translated into English before being analyzed. We began by open coding the data to allow important categories to emerge from the data, which were iteratively aggregated into key themes. We then used member checking to discuss the themes we identified with our research team as a whole [142]. Through the member checking process, we refined the themes we identified with the research team as a whole.

### **6.4 Findings**

As we had anticipated, the experiences participants described with food insecurity were extremely diverse. Some participants reported situations where they would be unable to eat for several days at a time because they were unable to get food. Others discussed how they would have to eat foods that affected their bodies negatively (e.g., eating yogurt for someone who was lactose intolerant) or had to cut out other expenses like Internet access in order to get food. A few described that, with the support they received from public and private food assistance programs, they were able to put food, even preferred foods, on the table without much challenge. More often than not though, people reported ups and downs in their ability to access food. One month might be great

with plenty of food, while the next may require skipping meals regularly. This inconsistency and uncertainty was one of the defining experiences of food insecurity that we found.

In this section, I discuss the key themes that emerged from our analysis of the semi-structured interviews we held after participants recorded media for two weeks. I first discuss a series of themes related to the experiences of food insecurity. Following that, I discuss the challenges faced by people that made food access more difficult. I then describe the tools that participants used to support their food access and to try to overcome barriers. Lastly, I discuss the ways that participants used technology to support food access.

### **6.4.1 Experiences of food insecurity**

#### **6.4.1.1 The meaning of food security**

For those experiencing food insecurity, it was often possible to get food, but it was not always food that they would prefer to eat or would support their health. Food security did not mean just having food, but it meant having access to the foods that fit their dietary restrictions, was culturally-appropriate, and healthy.

The main food people were most often unable to get access to was fresh, healthy foods – primarily fresh fruits and vegetables. For those that relied on the food pantries, fresh fruits and vegetables were hard to get with regularity and in the quantities they wanted. Eating a healthy diet, especially a diet with significant portion of fresh fruits and vegetables, was a major value held by every person we interviewed. In fact, fruits and vegetables were the foods most requested by participants from food pantries and would be the first thing that they spent their own money on:

“[The pantries] don’t have a lot of like, the fresh vegetables are all like, just on the verge of going bad, so if they have fresh vegetables, you have to like, process these vegetables that day. ... So, more produce and vegetables, I mean, that’s what, I mean, if I go to the grocery story, I’ll buy vegetables” (P525264)

Cultural foods were also very important and something that was difficult to afford and get at food pantries. This was primarily something discussed by participants from the Latin@ community.

Not only were there issues with accessing cultural foods, but many of the foods they had access to through pantries were not culturally appropriate and unfamiliar to participants:

“I think papaya is one of those fruits that enjoy eating a lot and it’s really, really rare that they bring it. ... One of the things that I never bring – one is eggplant, uhmm, I mean I have an idea on how to cook it but not really, and I never have tried to cook it. I have never brought home like one or two to maybe play with it and experiment but its not familiar.” (P881183)

#### 6.4.1.2 Where people get food

The two most prevalent ways that people accessed food was through food pantries<sup>1</sup> – private assistance programs where people could go and get food for free on an emergency or regular basis – and through grocery shopping. Almost every participant had used or was consistently using a food pantry to get food. Many supplemented the food they received from pantries with grocery shopping or relied primarily on grocery shopping, which involved either using one’s own money or government benefits to buy food at a store. Government benefits programs included SNAP (Supplemental Nutrition Assistance Program), formerly known as food stamps, and WIC (the Women, Infants, and Children program). The participants who got a significant portion of their food through grocery shopping were typically those that received a greater amount of financial support from SNAP and WIC. Ultimately, most participants relied *heavily* upon the food pantries and government assistance programs.

In addition to these two primary sources, some participants received recovered food that was delivered directly to their housing communities by Boulder Food Rescue (BFR). These participants lived in public housing neighborhoods or used services where BFR would deliver food, which occurred at least weekly. The food they delivered consisted of primarily fresh fruits and vegetables, pastries, and packaged foods. Some viewed these food deliveries as supplemental to other food they had, while others relied on it as a primary source of food:

“There’s a problem taking the bus and shopping and carrying groceries so I don’t

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<sup>1</sup> We use the terms food pantry and food bank interchangeably as they are synonymous and participants used both terms.

drive. The Food Rescue man on bike delivers cartons of eggs, veggies, kale, pie, 5 containers of yogurt. I [grabbed] a dozen eggs, 2 pastries, and a bunch of kale with a bottle of skim milk.” (P542338)

A few participants also got food from hot, prepared meals that were provided by various organizations in the community. These included shelters, churches, and a community table program where anyone could come to get a meal. These meals were especially important for people who did not have access to a kitchen. One participant highlighted the importance of being able to get a meal and then also get some food to take with since it was already prepared:

“Now there’s my Tupperware bowl. Now see what that is that’s umm French toast, some fried egg and umm I’m not sure what else. Oh yeah there’s some meat and some scrambled eggs in there too. That’s the egg guy, he does a great job cooking at the shelter. That’s the seconds at the shelter you know, you can go through when there just about ready to close down and if they have a lot of extra food which some days they usually do that’s already cooked, they give you extra food and then – I couldn’t put that directly in the bowl though I have to get a tray and then they put it on the tray and then I transfer it to the bowl. Just for sanitary reasons. You get the one [first] pass. They have the times up there now and see they quit serving at like 7:15 in the morning. At 7:10 you’re allowed to go in for seconds again if you want more to eat. A lot extra sometimes yeah.” (P195733)

A few participants also mentioned how they would sometimes receive food from friends or family who had something to share. This food had originally come from a grocery store, farm, or food pantry, but participants received it through an intermediary. Sometimes this was because the person already had too much of a certain item or because the participant may not have been able to make it to the pantry or store, so their friend kept them in mind when they went to get food:

“One of my friends that goes sometime to the pantry sometimes they take some extra milk and then she lives on my way to work so she’ll be like, ‘okay I got some things for you.’ Um, so yeah, once a month, once every six weeks – something like that. She calls me. She calls me to tell me that she would have something for me, so I can stop by on my way home.” (P404382)

One participant described gleaning or foraging – the practice of collecting foods that grew naturally throughout the community – as a source of food for herself. She had learned, from her father and by spending time in the community and talking with others, about specific areas where

plants with edible fruits grew. During the summer and fall, she would visit these areas and collect food that she could either eat freshly picked or cook up:

“And I found what I thought was blueberries growing all over town last year and lo-and-behold they’re service berries. They’re in the blueberry family and they have a little more seed in it, the seed is more prominent, but they’re still highly edible and they’re just like blueberries and you can pick them in bunches like that. They grow on trees, they’re all over town. [I picked] ‘em and I took them to [my church] fellowship. [I picked them] probably three or four times. I love to forage. I’m very delighted to see that the blossoms are on the suckle pear in front of Flatirons Hyundai. And when I was there picking up the ground pears, the landscapers were there and they said, ‘you can’t have those we sprayed the ground with poison.’ I was broken hearted because they’re little golden globes of sunshine and you have no idea how sweet and juicy they are. Oh I love to forage. There are cherry trees and nearly every one of them is dead where I live, but there’s half of it alive in my apartment complex ... And then we have wild plums, but they’ve really cut a lot back from the fence on the other side of the fence where the train tracks are. Wild plums grow all along the roads near El Dorado, out toward Estes. Daddy used to call them Galilean Plums or Potawatame Plums. And they’re just mostly seed, but they have a lot of pectin and they’re really good. And you can even, right about now you can, say in another month, the first fruit that comes in are the chokecherries, which is nuts because its all seed and there’s no way to separate the seed from the flesh because the seeds are soft and they crush. So that’s a hard one to deal with. But my neighbor has the most heavenly crabapples and he had me try to smell the blossoms next to his house. All he does is stick them in a pan with water and simmer them and they turn to candy.” (P797855)

#### **6.4.1.3 Learning and navigating the system**

We heard two different experiences from participants in getting food – one where it was very challenging and confusing and one where it was a regular, habitual practice with little issue. The differentiating factor was the time the individual had spent interacting with the food resources in the community – the time they had spent learning “the system.” Those who were newly interacting with food resources like food pantries and government assistance reported having great difficulties in trying to get food and access services. There was so much to learn and so many potential resources to consider, especially given that food insecurity was coupled with other challenges such as finding housing and paying medical bills, which had different resources available. It was overwhelming for some and prevented them from being able to get all the support they needed. For example,

P930181's husband had recently died, so she was left with overwhelming debt and had developed significant depression that prevented her from being able to stay on top of everything in her life. She had lived out of her car for several weeks and had just recently been admitted into a respite house that provided temporary shelter. She described an overwhelming number of programs she had learned about that may be able to help her out across a number of domains – food, housing, medical bills and health insurance, cell phone bills, car insurance, among others. Some of these she had already applied to or was already using, however many of them she did not even have a chance to research yet or connect with. However, it had taken her a few months to find out about most of these, during which time her situation had become worse and worse.

On the other side, those who had been using the resources in the community for a significant time, at least the better part of a year, had developed patterns and practices around accessing the different food resources they needed to use. They had identified the food pantries and government programs that they had access to and preferred to use. They had created schedules around the hours of operation for different programs and planned their lives around submitting on-going paperwork required for certain programs. As P130001 put it, “Once you have found out about the system and get started with it, its fine. It’s the initial finding out about it [that’s hard].”

#### **6.4.1.4 No backup: A lack of redundant systems**

The issue of creating redundant systems, “having a backup”, was paradoxical in nature. Participants described the importance of having a backup – whether it was a stockpile of food in case they lost access to a food program or a second, redundant tool for accessing food in case the first broke. Yet very few could do so due to limited resources. Within the same interview, participants would describe situations where they ran out of food and had no back-up, but would also say that they tried to store away extra food when they had a chance. Based on their actual experiences it appeared that this was more aspirational than realistic.

P525264 described multiple situations where she tried to go grocery shopping, only to find out she did not have enough money in her account when she went to check out:

“And I totally ran out of money and I went to the grocery store like, oh, I got a hundred bucks maybe in my bank account and I tried to check out and my card wouldn’t work and I’m like oh my credit card is also maxed out. How do I pay for this? It was the most demoralizing awful experience ever and that’s actually happened to me before. I mean how is it that I don’t have a backup? I mean what would happen if there was like some kind of emergency?” (P525264)

Even though this happened multiple times, and she found herself without a backup, she still seemed hopeful about stockpiling some backup food. After pantry visits she intended to store up some of the food she got, but in reality it seemed that food rarely was used in that fashion. Instead, she had to use it to meet the bare minimum for feeding everyone in the family. Either that or another incident would happen that would deplete any food she had stored:

“Sometimes they, usually at the food bank<sup>2</sup>, they say ‘Please take one or please take 2’ and sometimes it says ‘No limit’ and if you have room to store food, which I have a little space in my garage where I keep cans and nonperishable things – for those weeks that I like, can’t make it to the food bank or we don’t have money, it’s so nice to have that in the pantry. Although, I was keeping noodles and stuff in there and we had a mouse or vole or something that moved in like thinking, ‘Wow! There’s a smorgasbord here.’ some of the stuff that I had stored out there got ruined. Yup. um, one of the things that got wrecked was a whole bunch of Ramen ... I also have a chest freezer, so I put bread, they give away a lot of bread. Lots and lots of bread at the food bank, so if you can take a couple loaves of bread and put it in the freezer than that will stay.” (P525264)

At the time of getting food, P525264 seemed confident that she would get enough to have a back-up, but her reality and previous experiences differed from that. It may be that, for people who experience food insecurity, the lack of redundancy in their lives further enforced the value and importance of having a backup. It is unfortunate, then, that participants had such difficulty in doing so:

“[It was] hard [not having food]. Stressful. Really stressful. Yeah. There is no storage in my life ... I mean, I was in my apartment for a few days with absolutely no food. So, um, there’s no back-up, there’s never any extra money for back-up. There’s not even enough money for normal days.” (P797855)

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<sup>2</sup> Food bank is synonymous with food pantry.



#### 6.4.1.5 Socialization and community

Participants highlighted the social interactions around food and food access, or the lack thereof, as core to their experience with food insecurity. These social interactions allowed people to provide companionship and instrumental and informational support for others who were going through similar experiences. Socializing around getting food, whether it was going to the food pantry together or waiting for a transportation service, made the experience of getting food more pleasant and enjoyable. It also gave people a good excuse to get together or see people they otherwise wouldn't. For P633777, one of the only times she got to see her good friend was when they visited the pantry together:

“Occasionally I will meet a friend there, you know. Just to make it more fun. One in particular friend I'll meet there. ... We do try and coordinate [going to the pantry] and then we'll try to go out for tea afterwards, look at cookbooks, share recipes, things of that nature. If I'm lucky, [I see her] once a week. Sometimes its every other week, sometimes its every two weeks. ... I mean I do get to see her around other times, but not always, so that's kind of why we use the pantry as our connection.” (P633777)

There were examples of instrumental support that people provided and received from other people who were experiencing similar challenges with food access. Giving or receiving rides to the pantry or another resource was the most common way people provided instrumental support to each other:

“I help other people. Yeah I was driving my Vietnamese neighbor to [one pantry], but she used her sisters address in Louisville and [that pantry] said I couldn't get anymore food there since I live in Boulder. Just one time. I drove three other times and just had to wait. Now I used to drive them over here [to another pantry], but they've made other arrangements. Now there's another neighbor who has a blind son. And she's Cambodian I think and she asked me to take her up to EFAA<sup>3</sup> for 5 dollars. And that's when the lady [at EFAA] was like, ‘Well you can get food this one time, but then we need to see all your paperwork.’ So I didn't take her there anymore, but I took her over to the Harvest of Hope<sup>4</sup> one time and now she has another arrangement. They just know me and they know the place and they know that I drive and then they ride with me” (P797855)

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<sup>3</sup> Emergency Family Assistance Association (EFAA) is a food pantry in the community this research took place.

<sup>4</sup> Harvest of Hope is a food pantry in the community this research took place.

There was also a great deal of informational support that people provided each other in terms of spreading awareness about food resources. Given the challenges that people faced in learning about resources and programs that could help them get food, this type of social interaction was especially valuable:

“Most people, most of the homeless find it through word of mouth. There are brochures that go out and we – I say we. The homeless will take handfuls of them and distribute them to everyone we meet. So the word of mouth here among the homeless is very strong and very good. In fact, I survived a year of homelessness because of the homeless. They showed me where to go and how to survive.” (P130001)

While people developed community and banded together, in some cases to try to overcome their challenges, food insecurity also served to create barriers to socializing and creating community. Not having money or access to food made it more difficult to participate in social activities like potlucks and eating out:

“Not as often as I used to. Not very many [social activities], cus I can’t afford it. I really can’t afford to go out too much. I mean, since I stopped eating Chinese food. I liked it, once and a while, I don’t have too many experiences with friends, but when I am I just, its wonderful. I just love it. You know, whats a good – the Walnut Street cafe – you can get a decent wonderful meal at a reasonable price and the one on Table Mesa, we went there and a gang of us and it was just wonderful. We sat outside. So that’s a place I can go to. Not often maybe, but I can go to there to eat because its very good stuff and their prices is fair. ... I was asked to go out to join some people at [a pasta restaurant] ... but, I, I said no. But I really wanted to go because it was for a special occasion. So I talked with a friend and said, well the thing to do, you always look up in advance if you can, what the restaurant serves or just go and see what they have. Or say, ‘let me join you for dessert,’ go home and eat and then go to the restaurant and join them for dessert. They don’t care if I’m eating it or not. So I’m going to do that from now on because I miss out on a lot of things. I miss out on a lot of things.” (P398427)

Food insecurity can be very isolating from both friends and the general community. P525264 talked about how food insecurity made her feel isolated because she felt like other people could not relate to her struggles with poverty:

“It’s interesting living [here] where so many privileged people have not idea that people around them are struggling. Like people I work with have no idea I go to the

food bank, and I guess there's a certain amount of shame with it but I've learned not to let that get to me ... It's very isolating because like I'll have friends who will like complain whatever stupid thing that they're worried about and I just keep my mouth shut because you don't want to be like, 'You have no idea how vain and stupid you're being' because this is what I'm doing because everyone is capable of the same, I don't know, stress levels, you know? Mine just come from a different set of stressors from other people. I don't think my experience is that much more stressful, you just create your own level of stress related to your own experience. Like, the upholstery in my new car is not the one that I want and it's just like, whatever." (P525264)

#### **6.4.1.6 Shame and internalized negativity**

The experience described by P525264 with isolation from her friends highlights another experience of food insecurity – shame. Interestingly, participants used a variety of words and phrases to describe these feelings, which they had developed and held internally. They all related to the same core concept of feeling shameful and humiliated about their situation and what they needed to do to get food. These words and phrases included: “shame”, “demoralizing”, “embarrassed”, “dignity”, “self-conscious”, “freaks me out”, “uncomfortable”, “bad connotation”, “negativity that comes with it”, “humiliating”, “failed to overcome life's challenges”, “beating yourself up”, “upsetting”, “painful”, “judge myself harshly.”

Participants described feelings of shame both around their situation, the fact that they experienced food insecurity, and also in using resources like food pantries and food stamps. It was often using resources that was the greatest source of shame:

“I mean going to the pantries has such a bad connotation or something like that. Um, and I always felt like it was like, I can do it, what's wrong with it?’ And watching that documentary helped me get some of that – well its shameful, its – I mean I have a college degree, I should be able to pay my bills without having to think, ‘okay, is it going to food or is it going to my bill?’” (P404382)

These feelings were especially prevalent when people first tried to use a food resource like the food pantries. P394586 described his experience during the first time he had to visit the pantry. During the time of our interview, he had only gone to the pantry a handful of times and was still feeling shameful about his using it and adamant that he wanted to stop using it as soon as possible:

“I want the food, I take real good care of it. I eat it. I prepare it really special, I’m grateful. I’m embarrassed I had to access this frankly. Its the first time and I hope I never have to do it again. ... I appreciate the food I get from [the pantry]. And hopefully I uhh, my job is good and I won’t have to go back. Not because they aren’t nice people, but because for me it is dignity. This sucks, its not worth that.” (P394586)

This experience was contrasted with P195733 who had been using the food pantries for a little over two years and had developed a consistent pattern of going to get food from the pantry and ultimately felt positive about his experience. He tried to bring positivity to each day and hoped his positive vibes would rub off on others. He felt comfortable with his own situation and only reported feeling badly when others were negative around him:

“I just heard something this morning as a matter of fact when I was over at the meadows library. I heard some people, I heard a man talking to a woman while we were waiting to get in about some homeless people who had been saying something bad to them or something like that and I just felt bad because I felt like all the homeless people get clumped together, stereotyped. And I wanted to say, well you know, we’re not all like that or something like that you know, but I just kind of sucked it up. It’s sad, but it’s pretty much everywhere you know? It’s something about homelessness and positivity or whatever don’t kind of go together, they don’t go hand in hand you know? It’s usually like homeless, negative you know. That’s why I try to work against it. I’ll tell you what, since I moved [here] like two years ago I’ve been like the happiest because I’m camping out. I used to sit out in Wyoming and used to dream about living outdoors to be honest with you for the last couple of years so it’s all kind of fallen together. But yeah, Boulder just has so many goods, but it has so many bads too you know? Like so many homeless and umm you know, you can’t camp and you can’t do a lot of this stuff because of the city’s rules. I would say there’s more pluses than minuses.” (P394586)

#### **6.4.1.7 Lack of voice**

In our interviews, we asked participants if they felt they had a voice in their food access experience or if they had any input into the services they used. The answer was almost universally, “no”:

“Oh absolutely not. No. There’s nothing you can suggest at any of them. It is the way it is and if you don’t like it, don’t come.” (P130001)

Participants often followed this response by explaining that having a voice and having input is something they greatly desired. Most commonly people described wanting to have more voice in the types of food that were available at food programs or in the general operations (e.g., the hours of operation, the check-in process for each visit). P468868 was interested, generally, in having a voice in any way that she could. When we asked if she would like to have a voice in the programs she used, she was extremely enthusiastic about the idea:

“Yes, yes! Yes, opportunities of course to express our voice, yes. ... That’s what I’m really interested to do. That’s why I’m going to do that 10 weeks [leadership] class and maybe if I can find something that – I can talk with people being together. I’m interested to do that. I’m really not good at public speaking, but I’m trying to learn.” (P468868)

Not everyone felt that they had the skills or capacity to be a part of a committee or present and discuss with a group of people. However, they still felt like their knowledge and experience was valuable and that they had something to contribute. They appreciated the idea that they could use their experiences of facing food insecurity to contribute back and improve the system for others.

These experiences where participants reported not having a route for participation did not necessarily mean that there were not opportunities to have input. It may be the case that participants may not have been aware of opportunities to have a voice or may not have considered the idea of providing input. One participant reflected on her experience having noticed some food that had spoiled, but not saying anything. In reflecting, she recognized she could have said something and felt like she would have been listened to, but just had not thought of it:

“I’m pretty sure I can say anything I need to to them. They’re good people too. They’re really good people. They have a mission and they’re fulfilling it as best they can. ... Like when I saw, I don’t know why I didn’t say anything at the time, but when I saw all that spoiled food in there, the gray sushi, you know, I didn’t say anything and I could have. So, like to help.” (P398427)

The idea of having a voice in the programs they used was very exciting for participants and suggested an opportunity for programs to be more proactive in engaging the people using their services.

### **6.4.2 Challenges encountered in food access**

Part of the core experience of food insecurity was encountering constant challenges to getting food. As highlighted in the previous section, this meant challenges getting healthy, culturally-appropriate foods that fit within any dietary restrictions one might have. During the study, participants revealed specific challenges they faced in getting food, which included a lack of financial resources, transportation barriers, disability and mobility issues, problematic hours of operation and other time demands, difficulty finding information about programs, the low quality of available food, limited social support, paperwork and red tape, and a lack of respect. I describe each of these challenges in more detail here.

#### **6.4.2.1 Lack of financial resources**

Given the market-based, capitalist system in which this research is situated, financial resources are the main tool by which people are expected to acquire food. Because of this, for most people, the most central challenge to accessing food was not having enough money. The lack of money prevented participants from purchasing the food they preferred and led them to purchase less healthy foods that they viewed as cheaper. They also aggressively pursued money saving strategies like coupons and haggling and relied more heavily on other sources of foods, primarily the food pantries in the community.

Many participants suggested that they would prefer having their own money to spend on food as opposed to getting food from other sources. It provided them with a greater sense of control over the food they had available to them and, more broadly, over their lives. Money was equated with freedom and control, two things that people experiencing food insecurity struggled to secure:

“Well I know when I just go to the store and just pay money and buy anything I want – I feel free. I have control. But when I go to the food bank and some well-intentioned person is escorting me around and looking at everything I choose and directing me, you know, to things that are there and making comments about what I’m choosing and you know, questioning things and you know, even though the person is trying to be friendly, it doesn’t feel like freedom. It feels like someone’s trying to control me. Ya know? I like the feeling of having money and having

power to just choose and no comments, no judgment, no opinions from anyone.”  
(P414698)

The SNAP program was intended to provide additional financial resources to purchase food for people who had, what the government deemed to be, “insufficient income.” This program was important to those who received it and for a few it made a major impact on their ability to access food. For example, one participant, a single mother of two, received \$400 each month in food stamps and combined with visiting the food pantry, she often had more food than she needed. However, this situation was not common. In many cases, the dollar value of the support participants received was not sufficient to support regular access to food. Several participants discussed the amount they received, or had previously received, as not even worth the effort of applying:

“And by the time you do, supposing you go through the whole hellacious nonsense. You’re sitting there going, for 50 bucks a month? I’m doing this for 50, maybe 75 bucks a month? Uh, fuck it is the attitude that people take.” (P223336)

Some participants described getting much less than the amount that P223336 referred to. One participant only received \$16 each month in food stamps, while another received only \$15 per month:

“That’s a weekly occurrence (referring to running out of food). That’s the norm, yeah it is. I get 15 dollars a month in food stamps. I dare anyone in charge to live off of that. Anyone.” (P130001)

#### **6.4.2.2 Transportation barriers**

Transportation to and from food resources was a challenge faced by many participants. For those with cars and who were able to drive, the two major issues were the costs of gas and the time and distance they needed to travel to some resources. The cost of gas ultimately had to be factored into the cost of getting food. Because of this, even getting free food from the pantry cost them money. And when there was no money for gas, then even the free food from the food pantry was not within access:

“Yeah, there are times that I just don’t have gas. Yeah, having enough gas money to get through the month on my low income budget is like huge. Pretty much [I wouldn’t go]. Pretty much. I’m having to get creative with whatever is left in the cupboards or in the fridge that hasn’t perished.” (P633777)

Those without a car or who were unable to drive had a much more difficult time dealing with transportation. The bus system in the community this research was conducted had good coverage and several participants even acknowledged this. However, almost no participants used the bus system to get food. The bus system was not well-suited for the task of getting food. This was primarily because of the physical risk that participants took in trying to transport bags of groceries, typically quite heavy, by bus. There was significant effort required in carrying groceries from the store to the bus stop and from the bus stop to their home. And there was also the issue of having heavy bags of groceries on the bus:

“I’ve rode buses in the past – whether its going to the food bank or going to the grocery store. With my physical limitations and healing from the injuries I’ve had, it wasn’t always the best experience for me. I show my disability card, but because I’m not in a wheelchair or don’t have a cane they just assume I’m a mental case and they take off before I can sit down and next thing we know my equilibrium is thrown off and I’m thrown to the floor with my groceries on a bus.” (P633777)

Using buses also limited the control that participants had over their transportation. They had to work around the bus schedules and were at their mercy around when they would be able to come and go for getting food:

“Public transportation is a bear. It’s a completely changes your life if you can’t ride a bicycle or whatever, you’re dependent on others and public transportation and it slows you wayyyyy down, way down. Its not very convenient The schedules. No flexibility. And the effort goes up and more of your time and more of your energy if you’re waiting for public transportation.” (P150149)

For P130001, it wasn’t necessarily the bus system itself that was a problem. It was the drivers who often showed her little respect, would some times not allow her on the bus because of her service animal, and would not always accommodate her disability:



“Only [have problems] if I’m having to lift [my grocery cart] up on the bus because the driver won’t kneel the bus or use the ramp. But that’s RTD. And they seem to encourage their drivers to think of their bus as theirs. So their little tin gods. I have been kicked off the bus more times than I care to count because I dared to bring my service dog with me. I put [my dog’s] badge with the ID in front of the driver, the driver won’t look at it. ‘He has to be in a cage, he has to be on the floor, he has to be this, he has to be that.’ He doesn’t have to be any of those things. ... Oh yeah. I take the 205 (a specific bus) that takes me both to Harvest of Hope and to the YMCA. And I have been left at the stop more times than I can count because the driver wouldn’t allow me on the bus with my dog.” (P150149)

Some participants also used community ride services designed specifically for older adults, people with disabilities, and people with low income. These services provided direct transportation to and from locations throughout the community on a sliding scale. They were an invaluable resource for those who qualified and reduced the burden in getting to and from food resources in the community.

These programs were not without their challenges, however. For some, they cost more money than the bus system, so they could not afford it. And much like with the bus system, participants had to relinquish significant control to use these services. They had to call ahead, sometimes weeks in advance, in order to schedule a ride. The availability offered by the service was completely out of their control. And if the program had to cancel or delay service for some reason, then there was nothing that they could do. And these changes in service could have serious implications for people experiencing food insecurity:

“[My ride] canceled – they had a snow day that first snow. They closed, they were closed. They called in and said, We’re sorry, we’re canceling at the last minute.’ They didn’t really say it that way, they sent an automated message that went out that said, We have a snow day, we’re closed. All rides are canceled. I was [relying on that to get food]. I was. I couldn’t go, I couldn’t get food that day.” (P150149)

P150149 found this situation somewhat ironic given that these services were not nearly as flexible when it was the user who needed to cancel or adjust their ride:

“There’s a black mark that goes on your account each time you cancel. And you lose service for two weeks. They can knock my service down, in other words, I’m

not eligible for service for two weeks. It depends on the type of black mark it is. If you cancel – each trip is one trip. There one trip, back one trip. If you cancel that day, that’s two days, that’s two marks. Um, it is tricky. If you get sick at the last minute, I think, I don’t think that you can, I think that you get a mark, so you don’t want to get sick too often. I’m not sure, but I would definitely, if I wasn’t feeling well, I would still tend to go, unless I just couldn’t do it or I was infectious or something. Then I’d say, ‘Look, I’m gonna pass this on to your guys, so I’m going to stay home.’” (P150149)

He often found himself going out even if he was not feeling well or facing issues with his disability. This lack of flexibility was a major problem and gave participants very little ability to advocate for their own needs within the context of transportation. There were situations where participants absolutely needed to cancel, but they were forced to make a decision between their current needs and the future needs they would have for transportation. Without their primary form of transportation, they may further exacerbate their food insecurity and potentially miss essential care they needed.

Several participants described situations where their primary form of transportation became unavailable, which led to major interruptions in food access. Most commonly, their car or bike would need repair, making it unavailable for some period of time. These repairs took both time and money, so they not only negatively impacted their ability to get to the store, but also affected any financial resources they may have had available for food. In cases where primary transportation became unavailable, one could either find alternative transportation or not get food:

“My car is 29 years old and thank god its still running, but any day it could be something goes wrong and I don’t have the money to fix it and it will just be parked until I do. Yeah, so I mean, its more – I mean, you know that’s something, but its not something that bothered me this month. You know, it did bother me in the past few months when my battery died. I accidentally left my lights on when I went into Harvest of Hope and by the time I got out the battery was dead and I couldn’t afford a new battery for several weeks, so I couldn’t go to the food bank for several weeks and um, I wasn’t able, because of my physical condition it was snowing, so I wasn’t able to really go out there and walk somewhere to a store or something.” (P414698)

Previously, P414698 had discussed not having any back-up in her life and, in the context of this situation where her battery died, she went days without eating and described the situation as:

“Hard. Stressful. Really stressful.”

#### **6.4.2.3 Problematic hours of operation and other time demands**

Often times, resources that participants used to access food had limited hours that they were open or serving food. Food pantry hours were particularly problematic and often created a challenge for people in using those services. P414698 had some responsibilities to the church she visited and those responsibilities would sometimes interfere with the hours the pantry was open:

“And if there’s anything else to do before that – if the church needs me to do something, like lets say it snows and I have to help shovel and its Wednesday. Well maybe I can’t get there between 1pm and 3pm, which are the hours that the thing is open. So you know, it’s a choice. I am obligated to clean those sidewalks and if that, if its, if the snow starts at noon and I’ve got to clear those and it dumps and I can’t, I’m out there shoveling. You know? Or it starts at 10 and I’m still shoveling by two thirty. I really can’t get a gallon of milk. So I have no, I have no alternative really” (P223336)

Hot meals were also only served at certain times and on certain days. For example, in the community of this research there was a weekly meal on Sundays that rotated between various churches and there was a community table lunch and dinner that was available each day during certain hours. If you were unable to attend the times of those meals, then you may not be able to eat that meal or even eat at all that day.

Ironically, one of the most common activities that got in the way of people using services was work. Its ironic because people were working to try to have money that they could spend on food, but that ultimately could mean they had less access to food because they were unable to use those food resources:

“Because where I work I have [certain] hours, its hard to find a place where I can go after work or on the weekends. So I know some of the pantry here, they have some great stuff sometimes when I have the opportunity to go when I don’t work a full day. But its not very often so yeah. Outside of office hours its hard to find a place where I can do it. [I go], ooof. Once every two months. I wish I could go more often because I know that they do have and it will save me a lot of money. It will definitely save me a lot of money, but uh – its just not always possible.” (P404382)

#### **6.4.2.4 Awareness of programs**

It was hard for someone to be able to use a program that they were unaware of. It was often not very easy for people to figure out what programs existed and how they can start using that program:

“At first I would call and there are offices in Longmont, Boulder, Adams and they were telling me all this information, like, ‘Oh, your case is in Adams County’ and then they say ‘No its in Boulder,’ Longmont sent me back to Adams and then they sent me back to Boulder. So its kind of hard at first you just have to make sure you call the right number for your food stamps and always there is an 800 number on the back of the food stamps card that you can call and they will tell you your balance and everything.” (P301092)

In many cases it took people weeks or month to learn about programs that might be beneficial to them. During our interviews, we would ask participants about whether they used certain programs and in some cases they were unaware of programs that were within a few blocks of their home. P651480 was surprised to hear that she could be getting food, for free, every week from one of the pantries in Boulder that was actually closer than another pantry she visited that was miles outside of town.

Once someone learned about a program that might potentially help them, they still had to assess their level of eligibility for that program. This required gathering additional information on their services either by calling them, looking them up online, or by talking with others.

#### **6.4.2.5 Paperwork and red tape**

The issue of eligibility and qualifying for benefits was a major challenge that participants faced. In some cases, participants clearly described experiencing food insecurity, but according to the application process they completed, they did not qualify to receive benefits. Even in cases where they had a good sense that they would not qualify, they still applied in the hopes that by some chance it would work out for them:

“I went to Louisville, the Community Food Share<sup>5</sup>, because someone told me that I should look into Elder Share<sup>6</sup>, so when I was researching Elder Share, it linked me to the Community Food Share website and on their site they had like this table, like income guidelines, like for a single person the maximum you can make, and I’m just above, meaning I don’t qualify financially, but I read a lot of the information on the site and that’s what they said on their site. Like, ‘we’ll give food to anyone who shows up at our warehouse.’ And so I was thinking, I don’t have any food, couldn’t make it to Harvest of Hope this morning, okay, today’s the day, drive there. Well – like what happened was, like ... when I went to Community Food Share, I didn’t know, when they said they allow anyone that walks in their door to have food, I didn’t know if that was a once in a lifetime thing or, you know, can I come through your door everyday? Yeah and I knew I didn’t qualify for Elder Share, so what the woman who interviewed me said was, ‘okay you don’t qualify for Elder Share’” (P414698)

Even those who did qualify found the application process frustrating and overwhelming. It could be exhausting to gather all of the information required and it required a significant investment of time – not just hours, but sometimes days of effort. P301092 described her experience and frustration with applying for food stamps. She described it as an inquisition into all aspects of her life, even aspects of her life that she felt weren’t relevant to the issue of getting food:

“Kind of frustrating, I mean, I think if you need help, you shouldn’t have to prove so much, you know? Like I have to give them my bank statement, I have to give them my car registration, I have to give them everything. It is like they need to know your life. I mean, I understand the income part, but why do they need your cars? Like, what does that have to do with food shopping? You know, so, I mean, especially because I know a lot of homeless people apply for it, what do they do? They don’t have all of that information. So I mean I think they should change their system a little bit. ... I feel bad for single moms that have to apply, and they are like, ‘oh no you make too much,’ or ‘you can’t have it,’ but then again it’s kind of frustrating for people that do work that need them.” (P301092)

As P301092’s quote suggests, these application processes often required participants to go through a rigorous process of *proving their poverty*. Doing so required people to directly confront their situation – their poverty, the events and circumstances that got them to that point, all of it:

“It just felt really, really bad being at that place and the whole application process and um, its like, it feels very humiliating. But its not really the other person’s

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<sup>5</sup> Community Food Share is a food pantry in the community this research took place.

<sup>6</sup> Elder Share is a program offered by Community Food Share where older adults could get free food on a regular basis.

fault. They didn't put me in this situation, so I think – do you know what I mean? Its like, no one can make you feel bad about yourself. I feel bad [about myself] and that person just happens to be not very friendly. So are they really doing something to me or is it just how bad I feel being in this situation, in this position of asking another person for help and the other person doesn't really want to help me, its just their job and they're kind of letting me know through the way they're talking to me and stuff, that they don't really want to be there, they don't really want to help. ... Did she intentionally do that to me? I don't think so. But it just, my feeling like I already had to ask for food, now I have to ask again. And its like, 'How much money do you make?' and 'Where do you live?'. and – its kind of like – I don't know. It's just like humiliating. The whole process was humiliating. Yeah and its kind of like, again, she didn't do anything to me, she didn't say anything to me. ... Its like, its extremely painful, its like, its like I failed, like I failed to overcome my life challenges to the point where I can't even provide myself with food. And that's like a really painful thing to admit to myself and other people. And like, I don't like thinking about it all the time because it is so upsetting to me that it, you know, it prevents me from doing the things I can do as far as getting myself out of this situation. You keep beating yourself up and its just hard to function. I don't like thinking about it. I try not to focus on it every minute of every waking hour. But every time I show up at a food bank, I'm forced to think about it." (P414698)

It wasn't necessarily that the staff that P414698 interacted with were being disrespectful or purposefully trying to hurt her. However, the process of applying for benefits and having to prove her situation triggered a great deal of trauma. This process of asking people to *prove their poverty* appeared ubiquitous across all the programs we heard about, except for one. Obviously programs have limited resources and so it seems intuitive that they would establish cut-offs and develop processes for determining whether people were within those established qualifications. However it does not diminish the problematic effects of the practice and the often horrendous experiences that people had enduring them.

For some, the online application systems used by some programs further complicated their effort to apply to get assistance:

" I just gone through applying for food stamps and that took a week online to answer all their financial questions. A week! ... there's all kinds of – its mind boggling everything – you're applying for medical assistance and I forget what else. But their application is so confusing. They need a really good computer programmer to redo it. You really should help them out. Its like the craziest, most disorganized application that I've ever used. I've, you know, I usually do really well

at filling out applications, but this one was just not logical at all. And its kind of like, okay, when they ask you for all your medical bills, you know, usually you just write in chronological order all the people you owe money to and the amounts and you get a total, but the way they asked for it was – they're not really interested that I had three thousand dollars worth of medical bills that I had to pay within three months. ... It was – its too hard to explain all the details to you right now, but that's what made the online application take so long. Cus I had to gather all that information in a crazy way, like a monthly category way instead of the way that people usually report their bills.” (P414698)

Even though P414698 felt like she had developed some efficacy around filling out applications for assistance, this online system created great difficulties for her. The way that they asked for information, in a very specific way, made her feel like she was not able to fully explain her situation. The online application, by being overly constrained in the way it wanted information, robbed her of her own story.

Even the prospect of filling out paperwork to apply for programs was a barrier for many people – both an instrumental and emotional barrier. They decided not to apply to programs, even though they knew they would help them, because the application processes were extremely time consuming and emotionally upsetting:

“I used to go there for many years and then they changed their, there didn't used to be this big long process, and now you have to prove that you're poor and you can't, you have to like show up between certain hours and then you have to sit there and wait for an appointment and so now in order to get this approval you have to sit there and wait in line. Depending on how many people are there you might not even get in and one time I sat there for 3 hours and I'm like, I have to go to work. I sat there for three hours. I have to leave. So after that I'm like, I'm not going back there. I don't have 3 hours to not get anything done. The waiting process is just insane and the whole time feeling like I really need help. I mean, I'm struggling, I mean not just financially but emotionally, I mean it's hard just always barely making it and that was a huge blow and if you do finally make it in, they do this whole audit of your life. 'OK let's write down your bills.' It's very patronizing. Like how much money do you spend each month on clothes or something? Dude, I don't spend any money on clothes, but they have to take you through this whole financial account thing like you're an idiot. If you're poor you must be mismanaging your money somehow.” (P525264)

#### **6.4.2.6 Lack of respect**

As we discussed participants' experiences with food insecurity, one of the most resounding and eye-opening themes was around the importance of respect and dignity. We learned the importance of this most clearly through the experiences participants described where they did not receive respect and where they were treated in an undignified, de-humanizing manner. These experiences were caused by external forces, often other people they encountered in their experiences trying to get food. Participants factored these experiences into their decisions about where and whether to get food. They also highlighted how these experiences diminished their overall emotional health and level of resilience.

As discussed earlier, asking for and going to get help with accessing food was inherently triggering for many participants and generated feelings of shame and humiliation. Adding to those feelings were negative experiences they had engaging with different programs where the decisions of programs and their staff members directly caused participants to feel disrespected and robbed of their dignity. The application processes were often the worst experiences people faced. As P414698 described in the previous section, the person who was conducting her in-take process did not do anything intentionally disrespectful, but the process itself inherently robbed her of her dignity. Furthermore, the lack of attention with which the staff member gave her and her attitude implied a lack of respect, which P414698 readily perceived and was negatively affected by.

Not all of the negative experiences people faced were inadvertent acts of disrespect. P651480 described an experience where she experienced overt, intentional harassment at one food pantry. She explained how there was a staff member who would constantly rush people through the food pantry and yell at them for any reason she could find, for example, not correctly filling out forms. After over a month of these experiences and feeling fearful and traumatized, she decided to stop going to that pantry for food and instead dealt with the reality of having less food for herself and her family. She explicitly stated that she did not go elsewhere and instead described ways they adapted to the reduced access to food. They cut back in other areas and she and her husband ate



less to ensure their children could continue eating well.

Disrespect could be either intentional, as it was in P651480's case, or inadvertent, however the effect was the same – it created a barrier to access. Participants gave significant weight to those experiences in making decisions about where to get food. When participants felt disrespected or felt they were treated in an undignified way, they would be less likely to use that resource. Often these negative experiences occurred early on and prevented them from even completing the application process for services that they desperately needed:

“I don't go to EFAA because of that. Um, first time I went, I was the second one at the door, I was given a number and told I'm number four. Four hours later, the person who was supposed to interviewing me to see if I would qualify for basic food, um, leaned over me with a tray with a freshly cooked pizza from a microwave and said, 'I'll be with you as soon as I'm done with my lunch.' I stood up and walked out and never went back.” (P130001)

Not only did these experiences lessen their opportunities for food access, but they also contributed to the on-going emotional trauma faced in dealing with food insecurity. P414698's experience applying to receive benefits at a food pantry captured the exhausting nature of the experience of the emotional trauma caused by receiving a lack of respect:

“Its like, its extremely painful, its like, its like I failed, like I failed to overcome my life challenges to the point where I can't even provide myself with food. And that's like a really painful thing to admit to myself and other people. And like, I don't like thinking about it all the time because it is so upsetting to me that it, you know, it prevents me from doing the things I can do as far as getting myself out of this situation. You keep beating yourself up and its just hard to function. I don't like thinking about it. I try not to focus on it every minute of every waking hour.” (P414698)

She explicitly described how these kinds of experiences caused emotional trauma, which in turn prevented her from being able to engage with her situation. Without engaging with her reality of food insecurity, she would not be able to work towards overcoming her challenges. Instead she found herself stuck in a cycle of negative feelings and beating herself up.

### 6.4.3 Tools to support food access

In our conversations, participants described a number of tools that they used to access food. These tools helped them to overcome some of the challenges they faced in getting food and played roles both big and small in their process of accessing food. The tools that participants described ranged from free bus passes and modes of transportation to mobility aids, like canes, and bags. Here I highlight a few of the tools that participants identified as supporting their efforts to access food and some key attributes of tools that helped make them more useful.

#### 6.4.3.1 Transportation as a tool

Modes of transportation were, in themselves, important tools that supported food access. Cars were among the most important tools for participants to have because they allowed participants to travel further distances to get food, opening up new options for food access, and made it much easier to transport food, especially when they received heavy foods from the food pantry. This was often the case given that pantries had a significant amount of canned foods. Having a car also allowed participants to combine visits to the grocery store or to a food resource as part of other trips and activities, which saved them time and money, two precious resources:

“This particular one is at Baseline, which I don’t ordinarily go to. I usually go to the old Sunflower in the Village, its now Sprouts. But this particular visit I was at the one on Baseline. It just happened to be on the way home, without having to drive back across town. ... Everything is a round trip plan ordeal. I try to include as much as I can on my roundtrips. Like today when I come to meet you, my food stamps kicked in over the weekend so my first goal was to get to the Asian market to get myself some things there that are more affordable there than the average grocery stores.” (P525264)

Although there were limitations with the community ride services available to some participants, these programs were still valuable for those without cars and who had mobility issues. Mobility issues made it challenging, and often risky, for people to walk to food resources. Community ride services opened up opportunities for those with mobility issues to get food:

“Well its risky. I could fracture if I fall and I’m walking around. So it’s a hazard for me so I have to be very careful ... So it’s a hazard, number one, for [travel by] foot. For buses, you have to wait outside [for a long time]. So if I’m taking Via or Total Transit (ride sharing services), its good.” (P150149)

Although riding the bus came with significant challenges, its important to acknowledge it as a tool that enabled people to get food when they otherwise would not be able to do so. P468868 would often ride the bus to work because her husband needed to use their car because he worked further away. Fortunately, her place of work was nearby a grocery store, so she could head to work early, grab groceries, store them at work, and then carry them home afterwards. This was not necessarily an easy process, but she would otherwise not be able to get to the store because it would be too far to walk. Certainly she preferred driving the car when it was available or having her husband pick up groceries because it enabled them to purchase heavier items like milk, but having the bus there was important for smaller grocery trips:

“I have to get the bus at least half an hour early in order to make it. But like, before work I get my time one hour early. If I’m working from 2, I put my time at 1, so that I have to be, I have to contribute that one hour anyway for shopping, grocery shopping. And what I do, I just, I just do like the light groceries like, I mean, fruits and veggies and then I try to do some bread because [my daughter] likes bread. And I try to do breads, those kind of things by myself. But like with all lentil, like very heavy things – my husband does once a week all purchase.” (P468868)

#### **6.4.3.2 Tools for carrying food**

One of the greatest challenges participants faced, especially those with reduced mobility and without cars, was carrying groceries. Carrying groceries, for some meant carrying them from a food source all the way to where they would store or eat the food, often times their home if they had one. In other cases, it meant carrying food from a food source to a bus stop or pick up location for a ride they were receiving, and then from where the transportation dropped them off to their final destination. These journeys could be of varying distances. For some, the journey could be measured in feet, but for others, the distance was miles:

“These people are, are dealing with – my little walk is nothing compared to a lot of these folks who walk 6, there’s one fellow who walks 6 miles. And I’ve talked, he’s got a 6 mile walk in and a 6 mile walk back with the food. With two percent milk ... of course, your average middle class person who walks 10 steps to his car, puts his butt in his seat, walks 10 steps to his desk, puts his butt in the seat, yeah okay. ... But when you’ve got somebody who’s walking 6 miles to get food, that’s a whole ‘nother story.” (P223336)

No matter the distance, big or small, having something to help carry heavy groceries was important. The most commonly cited tool participants described were their own bags or baskets for carrying groceries (see Figure 6.2). It was especially important to have sturdy bags that could endure significant walking and long distance travel. P223336 discussed the wicker basket she used to haul food, which she found to be much sturdier than canvas grocery bags and also gave the food a little more room, so things like fresh fruits wouldn’t be as likely to get squished. This was an important tool to support the way she would get food:

“I have baskets usually. And uh, fortunately if you do need them, the food pantry does usually have, but, those thin little plastic bags again, you know? And when you’re walking, that food is in their longer and if it’s a little trot from, you know, the door to the car and there’s no pressure on the bag and you’re toodling along. But when you’re walking, you’re holding the, the – all that weight is in the bottom of the bag. And so if you are using those little plastic bags, um, you have to double or even triple them because if you walk any length with them, they just split. ... The baskets, I have a, I have one straw basket. I acquired it many, many years ago and that’s usually what I use. I don’t get that much food at a time myself, because right now I’m only me. ... I tried the canvas bag thing, it um, didn’t really do me much. I wasn’t real impressed with those. Um, I do have, I use them for the church, I can say that those little 99 cent bag things at the supermarket, I use a lot of those um, I got them about two, three years ago and they’re starting – I’ve had to throw away, they worked for a while. But that’s – they’re abused. They’re not, we don’t put two things in them and decorate with them. Its, you know, they carry twenty pounds of food at a go ... and eventually it may take a basket, a basket may take five years, even ten years to totally disintegrate and if you have the skill, you can probably weave it back in, I don’t have that skill, but um, if you did, you could probably keep a basket going for twenty years before it really kind of just, you know, there was nothing left to sew. Its just all straw. And so, uhm, but the canvas bags, the little oil cloth bags, all of those, they are going to wear out um, yes they last a lot longer than plastic bags, but not by that much. And I’m wondering if they’re really worth, worth the time and energy it takes.” (P223336)



Figure 6.2: One participant lays out the different bags she uses to help her carry food that she picks up from the store. The different sizes allow her to keep produce, moist, and easily damaged goods insulated from others.

An especially valuable kind of bag that some participants used was an insulated bag that could keep foods colder for longer. This allowed participants to combine more activities into a single trip, which saved time and gas, and it allowed them to access foods that they otherwise may have not been able to get because of concerns that they would go bad in the car:

“I usually bring multiple bags. Two dry ones for produce and canned goods and one cold bag for anything frozen that I might get. ... Yeah my mom gave me my current frozen bag that I’m using, so – some healthcare provider gave it to her and she has no use for it so she just passed it on to me. It helps keep food frozen until I get home, so I can be out and spend time with my friends for a little bit in the day after we meet there or something. ... [previously] if I thought something was gonna perish before I got home, I just didn’t take it, yeah.” (P633777)

Bringing one’s own bags was also important in this community to avoid the bag tax that had been implemented recently where people would be charged for using the plastic or paper grocery bags provided by the store. For people who experience food insecurity, even a small additional cost can have a significant impact on their ability to get food because the fee would be taking money away from food or other expenses.

In addition to standard grocery bags, those who biked relied on saddlebags, or other bags that were attached to their bike, in order to haul food (see Figure 6.3). These kinds of bags made biking to get food an option when it otherwise may not have been. Without these bags, they would have to risk putting bags on their handlebars or carrying them in some way that was potentially dangerous, or they would have to take less food.

In addition to bags, several participants had carts that they used to help them in carrying groceries. These small carts took various forms, but they were containers that had wheels and a long handle so that a person could drag the food along. Having a cart helped to save time, energy, and enabled people to get more food than they would otherwise be able to access:

“Yeah [carrying the weight] is why I needed transportation and why I got that [rolly cart] and I got another one. So if I have to do any walking with stuff that’s heavy, that makes a big difference, that kind of thing. I got that from Ares – that was like \$3.99. I got another one that was broken and I fixed it because the thing wouldn’t come up – there was something inside broke and I epoxied the little press



Figure 6.3: The saddlebags on the side of P195733's bike help him to carry more groceries, thereby allowing him to take more from the food bank.



Figure 6.4: P904730 reappropriates the stroller she previously used with her children (who have now grown up) to help her carry groceries back from the food pantry.

thingy that presses on the spring load thing and it will work now and I got that for like \$2.99. And that's an Eddie Bauer, I think its got more pockets. Oh yeah. I just took that today and put cans in there and once you get it out and get it on the ground, that's it, so it saves energy and it saves my muscles. Because I'm telling you when I was doing the bus, god, it was like a workout. And in fact some days I did workout, I was like walking around and I was doing this (lifting his arm up and down) when it wasn't icy and stuff, I was using my muscles to try to train. But it was probably not a very good idea. So that saves some energy and time. Well not time so much, but energy." (P150149)

Some participants were unable to afford a cart as the ones they had seen at the store cost upwards of \$50. However, P904730 developed an alternative to one of these carts by reappropriating her old stroller as a grocery cart to help her transport heavy groceries from the food pantry to her home (see Figure 6.4). Because of her health issues, being able to load the groceries onto this cart was the only way she was able to bring home everything she needed to feed her family.

#### **6.4.3.3 Tools to prepare food**

Originally, we had expected participants to focus solely on the actual process of getting food from different food sources and bringing it into their personal food environment, such as their home. However, the tools they used to support the preparation and consumption of food were featured prominently in our conversations about food access. Having access to food that they did not have the tools to prepare was equivalent to not having access to that food.

Simple tools for preparing food, that many might take for granted, were considered important and essential. Can openers, for example, were very important because much of the food participants received was canned. P195733 discussed his simple can opener, a type of can opener that had been developed during World War 2 (see Figure 6.5). He had been able to get these can openers from one of the food pantries he visited regularly:

"Okay now we got a can of tuna. And there's the can opener. ... Actually it was invented in the military. It was invented through the soldiers during World War 2. But you see that groove right there? That locks in the lip of the top of the can and then that blade. It cuts real nice, now see that one – this is my old one, its





Figure 6.5: P195733 shows how he uses a can opener to open a can of tuna.

broken in. That's a new one right there and it was a little stiff running. But yeah that from World War 2 and umm, they're called P38s ... They have a whole little bag of them made up for people that ask for them at Harvest of Hope. ... That one I just showed you, I can make some time with it. This one here. The new one is a little stiff yeah. I'm not gonna bother trying to find it because I have so much crap in there. Not really, see that piece that I was showing you were the blade flips out." (P195733)

Participants made use of whatever tools they had available to them in order to get food prepared. Sometimes they weren't the most perfect tool for the job, but they figured out how to get the job done. Appropriating tools for different jobs was a common experience with food insecurity:

"Now look at that cantaloupe, you see I cut that open with that plastic knife I was showing you. You see how it's kind of rough. That's all I had that day was that plastic knife and if you notice I only took a little part of it off the top. Because it was so hard to cut it with, it wouldn't cut straight. ... Oh yeah, well actually I think if I remember correctly, I had two of them together and made that, yeah." (P195733, see Figure 6.6)

More complex tools, like food processors and blenders, were also important and allowed participants to eat healthier and create more variety with the ingredients they received from food pantries. As participants described, eating healthy was an important value, so they appreciated tools that supported doing so and found it challenging when those important tools did not work:

"My blender crapped out and my food processor is on the way out and my – I have this mixer thing my mom gave me like a bullet or something and sometimes it works and sometimes it doesn't. And its frustrating when that doesn't work. It's an important one because I make smoothies. Or like if I want to make a really fresh green soup with Spinach, I want to take that spinach down to a liquid form and you can't and so that plan – you've got to think of another plan then." (P633777)

The importance of these tools for preparing food became most apparent when participants discussed lacking certain tools and how that made it more difficult for them to actually use food that they accessed:

"You know and then the other thing is that some of this stuff you have and it depends on what you have where you live. Its not like it's a stocked kitchen, so –



Figure 6.6: P195733 took a picture of the cantaloupe he cut open using his plastic knife, which he used for eating meals and cutting open packages.

and one of the pictures in there I made like, like Italian sauce – I made some kind of sauce stuff. Well I didn’t have a knife and I didn’t have a strainer and I didn’t have, so I managed to make dinner, but the thing is, a lot of people, if you’re broke you don’t have a strainer. I mean you have all kinds of pasta, you have to figure out how to drain the pasta if you’ve got a pot to do it in. And I know pasta’s cheap, but if you don’t have the utensils to make it, you can’t.” (P930181)

Dry pasta was one of the most prevalent foods available at the food pantries, yet its preparation would require several tools. As P930181 alluded to, it required a strainer to separate the pasta from the water after it’d been boiled. That also implies the need for a heat source to boil the pasta in water to cook it – a stove top or a microwave. Many foods required heating, so having access to these tools, as P930181 suggested, was important in supporting food access

Microwaves were considered especially important because of their versatility and time-efficiency. It was easy to quickly heat up a frozen meal or a can of soup using a microwave and it relied on less tools. One participant even described how he used the microwave to save money, since it used less energy than the oven:

“Yeah, I do [use the microwave a lot]. Its faster, you know, saves energy frankly. When you look at the thermal mass of a heating up an entire oven, then you’re heating all that steel and everything else inside there, it takes a long time, a lot of power. I’ll just nuke it. Saves money and there is no difference nutritionally. That way I get to eat in 4 or 5, depending 6 minutes or 7 minutes. That was a 7 minute bowl. That’s only a 750 watt microwave. I bought it uhh, I had 2 microwaves before, kills me what I think of what I gave away in California [before moving].” (P394568)

P930181 suggested that having pantries give out tools would be just as important as them giving out food, in terms of increasing food access. She specifically described an idea she had for how pantries and the community could support this:

“You need to have a knife depending – and most people have some sort of knife or a jackknife, but you know, a knife. If you’re gonna do, some of the can stuff, like the little teeny pots like this big so you can put a can of green beans in ‘em. Some people don’t have those. I mean its just like basic cooking stuff. Not anything fancy and it, most of that stuff you can even get at the dollar store and its good stuff. You know, its almost like they need to have a food drive and then have a thing – we need these basic things, basic utensils so people can get them. And maybe one

time, the first time you go there, you can get setup. The very first time you go – here’s a potato peeler and a little pot and a little fry pan and then at least you can make something in a pan. And, you know, it makes me think about at work a lot of times at different corporations at Christmas time they adopt a family. And so they, they said the kids want a hula hoop or whatever. Well its almost like they could the same thing for this. So instead of doing food and also here’s some of the cooking utensils we need. Kind of like a make-a-wish – kind of like a ‘we can get stuff to people for Christmas’ so we can actually cook something.” (P930181)

Her idea emphasized the point that being able to eat food is at the core of food security. Although food access is an important part of that, without being able to translate the raw items from the store or pantry into edible foods, a person cannot have food security.

#### **6.4.3.4 Not all tools are equal**

For participants, having robust, hearty tools was especially important. They needed to use the tools that they had in multiple roles and rather extensively, since they couldn’t always afford different tools. Many participants had to deal with the elements on a daily basis, which further challenged the heartiness of the tools they had.

Robust, hearty tools were also important because if their tools were to break, they did not have the resources to replace them tools. They needed tools that could last long to avoid the costs of replacement:

“I’ve had [my cart] for a year and a half now and its about worn out. So I’m going to have to replace it pretty soon and that’s going to mean that I’m going to have to sacrifice something. I don’t know what yet. But something’s going to have to go for the month so I can pay for that. They’re not cheap. They’re pretty expensive actually. I paid 65 for mine. And its just one of the cheap ones.” (P130001)

P195733 would bike to get food everyday, no matter the weather. He relied on his bike to continue working in order to be able to access food each day. The integrity of his bike was a constant source of worry and stress for him *“I’ve been real worried, I’ve been doing a lot of ice riding you know going on top of a bunch of crunchy stuff and you know I’ve been a little worried about that but it’s been holding out so far.”* Without his bike he felt like he would likely have days where he

would be unable to get food, which was a problem since he didn't have a stockpile of food. He also relied on his shoes to be able to keep his feet dry in the winter and to be able to move around the community. Investing in a pair of reliable, heavy shoes was essential, even if it meant less money for food or other things:

“There’s my foot you know cause that’s transportation you know, that’s umm a pair of king Lexington’s that I bought for \$138 I paid that out of my own money I made one year and I have more than that right now as a matter of fact. Yeah that has a graphite safety kit. I bought it specifically so I could work and ride my bike cause that’s pretty hard to do that with boots you know? Riding a bike with work boots is hard. ... I got them in I think April of 2014 They’re almost two years old. I had a little trouble with the fit if you notice I only have them laced at the top because I was having a little tightness fit but I, I bought them directly through the mail so I didn’t have a chance to try them on. But I almost gave up on them but I decided one day I’d just do this and just lace them at the top yeah, and they’re waterproof and like I said graphite safety toes” (P195733)

The importance of resilient tools was most obvious when participants did not have robust tools and found them breaking or unable to perform their jobs. In these situations, they found themselves facing greater challenges to accessing food:

“I have a problem with my jaw where I can’t chew much. I mean I can chew a banana or something soft, but all these vegetables I can’t. So I’ll mostly blend them in a food processor and make like a thick soup and I don’t have a very good food processor so there’s limitations you know. Like – I describe it in here. Like some things for example that are really high fiber like Kale, Cabbage, Carrots, you know? They’re really tough vegetables. When I blend them, they’re still too chewy and I still can’t eat them. So I have to like blend them with softer, smoother types of things like apples or bananas or baby spinach – make something smooth enough that I can manage eating. And so like if I go to the food bank and I only get the tough vegetables then I [can’t just use those, I need the soft ones to go with it.] Or certain things like onions or turnips. If you blend them they get really strong, like, you know, so things like that. My food processor is kind of big, its not like a Vitamix. ... it’s not like a blender. A blender Vitamix would have a small circumference or diameter at the bottom so the blades will hit everything. Since my food processor is not like that, I need a quantity for it to even, so it can’t like, if [I] don’t have enough it can’t pick anything up. Things like that. And because my food processor isn’t that good it, like I have to blend for a good 20 minutes. You know and so, that’s equipment problems. ... I’ve been forced to [cook some], definitely. But then again, you come home with all these different vegetables that need to be cooked and different times for each and you only have one pan.” (P414698)

As P414698 went on to discuss, this was especially problematic for her because she had a health issue where she could not digest cooked vegetables as well as raw vegetables. Having a device that did not work well forced her to adapt in a way that caused her physical pain and distress: *“I can’t digest the cooked. So I’m like really have a lot of pain, physical pain trying to digest it. So I’m trying to figure it out.”*

#### 6.4.4 Technology and food access

Many participants were puzzled when we asked them about the ways that technology supported their food access. They did not conceptualize technology as a tool for helping them access or prepare food. It was a bit strange for many to think about technology helping them get food. When we asked P404382 about whether her phone played a role in her food access, at first she responded: “No. How [would it]? I [never] thought about that.” In fact, some participants even argued at first that technology couldn’t help them or may actually make their lives more difficult:

“I tend to stay away from [computers], not because I’m frightened of them, but because I’m afraid, I’m – you know people are very attached to these little things. And when there’s a computer meltdown there’s a human meltdown. I don’t really care about the computer meltdown, but I do care about the human meltdown. I don’t want to deal with human meltdown, which is why I don’t ... But all of these little bouncy toy things (referring to mobile phones and tablets) that require you to play with it, literally, instead of work on it, um, yeah, we’re going, we can’t get anything done and this is why. I think this is what frustrates a lot of people as well, with all this technology, why aren’t we better off than, why aren’t we better off?” (P223336)

However, upon further inquiry, we found that there were a number of ways that technology helped people get food. They were just not conceptualizing these practices as “using technology to access food.” Participants used technology to find food resources, to look up information about different food resources, to communicate with food programs, to look up information about foods and food preparation, to understand how their diet or dietary restrictions affected their food access, and to find discounts and deals. I discuss each of these in more detail in the following sections.

#### 6.4.4.1 Using technology to discover resources

When a person first identified that they needed or wanted help with food access, their first step was often to do a web search to discover services that could provide assistance. When people were focused on the issue of food, they would use a more food focused search to find options. This usually involved using a search engine, either on their own computer, phone, or a community computer (e.g., at the library):

“When I, last Fall, I did a Google search on ‘food banks’ in Boulder Colorado, so that’s when I got a list ... online was just Google and you know how Google just [lists the sites]. ... I went out to their websites and read more of the details about them.” (P414698)

People that searched for resources in this way found it to be an easy way to discover the main resources available in the community. With these searches, the major food pantries and county services were some of the first results.

Food insecurity also often coincided with other issues of poverty and so someone who identified needing help may be looking, not just for food pantries and food-specific resources, but also for broader services that could help them with different challenges they faced:

“Yeah, just Googled it. Googled the words... well first, I Googled, ‘Boulder County services’ General. There is a Boulder County services website. Within that website, they had various hyper-links, URLS to other websites, one of them was Harvest of Hope and the other one was this other one I think I referred to. It was on the Boulder County website, or Boulder City website, I’m not sure which one it was. But I know they alluded to services they had available in Boulder and Longmont” (P394586)

However, in order to successfully look for resources online, one would need to understand the concept of human services like food pantries and would need to know what to search for online. This was one area where cultural differences played a role. Participants from the Latin@ community described how they had not been familiar with the concepts of food pantries, social services, and government aid when they first encountered food insecurity. The idea that they could go and get free food from a place in the community was foreign to them. So it was unlikely for them to think



about looking for services online. In fact, none of the participants from the Latin@ community used online searches to discover resources. Instead, they relied heavily on word of mouth and receiving referrals from the schools and community organizations in which they participated.

#### **6.4.4.2 Using technology to learn more about resources**

In addition to resource discovery, participants also used technology to learn more about the resources that were available. As opposed to discovery, which would usually only be done once when first needing resources, participants looked up information about different programs on an on-going basis. Participants most commonly sought four specific types of information – their contact information, their hours of operation, the types of services they could provide, and how to get there.

Of these, looking up hours of operation and the types of services they offered were typically done early on in the process of someone learning the system and exploring their options. Over time, these types of information became internalized and part of their regular practices of getting food. Still, if a person were thrown off their normal schedule, they may have to refresh their knowledge of the hours. This was also the case for specific types of visits or programs that might be offered that had different hours from the normal programs they were using:

“Yeah totally and when I was going to EFAA, I would use it to call them, find out when when because they have different hours of like when you can go wait for that appointment that I was describing. Specific hours per week. Yeah, call them, and you know I would use [my phone] to call them, find out hours” (P525264)

Although looking up the location of and directions to a resource were also done when first using a program, some participants also continued to look this information up on an on-going basis, especially if they had not gone there in a while and may have forgotten the specific location:

“Yeah Map Quest, I just map it, Google Map. ... Sometimes I go to the food banks though and I Google food banks. I’ll do that. And I’ll need the direction to the food bank, because I haven’t gone to a food bank lately but the one I usually go to is Sister Carmen in Lafayette, but I haven’t gone for a while.” (P301092)

One participant constantly looked up information about how to get to the pantry because she relied on the bus system. Specifically, she used Google Maps to find out specific information about when the bus would be coming and when she should plan to leave her house in order to get places on time:

“It helps me a lot. Like, I go and see that Google Map and see the bus schedule and then when I’m in a strange place, like if I miss the bus and it gives me another route. Because I am not all the time able to have paper [bus route guide] with me. I would be like not even having a bag sometimes. Just phone and wallet. And I would not know where do I get the paper one. So this is helping me with Google Maps navigating.” (P468868)

By having Google Maps on her phone, she did not have to worry about getting lost or figuring out how to get to the store or pantry from a certain location. This allowed her to go to the store or pantry when she had time, even if she was not taking the bus from her home or from a location she was familiar with, so it provided her greater flexibility and control over when and where she could access food.

Commonly, participants discovered resources by word of mouth – from a friend, family member, or from another service. Once they were aware of the resource, they could go online and research it to learn more. For example, they would research whether they would qualify and where the resource was located:

“And even like, I found out from the phone itself ... it [told me] about the address of Harvest of Hope. I found out about Harvest of Hope, somebody told me [the name]. And then I didn’t know where to go, I see, she just told me to type ‘Harvest of Hope’. And I did and then it showed me the address and it was very convenient for me, not that bad. I take like 204 from here and get off at 19th and Iris and get 208 and it takes right there in front of it. So you just have to walk 2 minutes.” (P468868)

#### **6.4.4.3 Communicating with programs**

Often times, participants would need to get in contact with different programs to communicate information to them. They needed to communicate a number of pieces of information ranging from a change in their income or their inability to make an appointment.

The most common modality they used to communicate with programs was through telephone calls. This was an easier way for participants to have a conversation with program staff and enabled them to check in on their status or eligibility:

“Yeah, call them, and you know I would use [my phone] to call them, find out hours, check on the status of an application. I mean for applying for food stamps and stuff, I mean they do the interview over the phone. So you fill out the application and you get an interview but it’s a phone interview so you have to have a phone to get that done.” (P525264)

In this case, P525264 not only called to check on the status of her application, which was completed online, but she also needed to use a phone in order to complete an interview about her situation. This interview was required to receive services and she could either do it by phone or in-person. Given that she was busy working as a teacher during business hours, conducting the interview by phone made it possible for her to complete it without having to take time off work. This could have ultimately delayed her ability to get benefits. Filling out applications for programs online, like P525264 did in the situation, was another common use for technology in the context of food access.

One participant talked about using email as a quicker form of communication to update her caseworker about changes in her situation and asking for specific help with getting access to food:

“What I did tell my caseworker at EFAA and what I told her, she had updated the system that we had 6 families now that we need more food. And she did upgrade that one, update it, that information. But, she did not, I didn’t even talk about if my dad can come and [get food]. And one time I send an email, ‘I do not have – I am almost out of milk.’ I’m at my internship, my hours are, for the internship my hours are 8 to 4:30 and I cannot do it. EFAA closes at 4 and I cannot, no way I can do it. Even though I come in the bus, I don’t have to – I don’t have to take that many buses from Broadway, its just one bus. So I don’t really have to take many buses, but still I cannot make it because they close at 4. And, I said like, ‘Hey [caseworker], can I send my Dad to get some food, I’m totally out of food,’ or something like that. ‘Yeah you can,’ she said. And then she told me yes and then from next time I started, what I started doing was I would write a note [by email] what I need and [ask them], ‘could you please help my Dad, he does not speak English.’ He does not speak English, that’s the main problem, otherwise he could have come and gotten the food. He does not speak English and he does not know what to get, what not to get. Because its all American food he would not

recognize unless its Fruits and Vegetables. So that's why I like started doing that note. ... Like email response is such a quick thing because [my caseworker] – once I call and it goes to the voicemail or I have to wait so long because there will be other people – clients calling, so email works best for me. Because like, out there at [my job] where I work now as an intern, we have to be on the email all the time. Email opening, Outlook opening, all the time. So like email is helping me a lot.” (P468868)

With her job, trying to make phone calls until her caseworker could answer was not an option because she had to focus on her work. Leaving a voicemail and then hoping for a call back would have taken more time and would not have worked if she was unable to answer when she called back. Ultimately email was a more effective way for her to communicate her needs and get specific support from a resource she relied on.

#### **6.4.4.4 Seeking food and food preparation information**

Participants used technology to help them work with food that they had available to them. This took the form of looking for specific information about how to prepare food (e.g., finding recipes) and for how to manage food that they received from the food pantry.

Participants discussed two unique aspects of looking for recipes or preparation guidelines in the context of food insecurity – they often worked off of a specific “seed ingredient” and had to figure out how to work with foods that they had not necessarily chosen, but had received because they were available for free or at a substantially reduced cost (e.g., food from the pantry). In working off a “seed ingredient,” participants had to narrow their choices of food options because they needed to make sure they used what they had. But at the same time, this helped them more easily figure out what they would make for a meal:

“Yeah, so for example, we had the tuna, so I was like, ‘hmm’ so I told my mom, “lets make Tuna Noodle casserole.” And she was like there is tuna helper in the freezer, in the fridge, and I was like, “No I don’t want to make tuna helper, I want to make it from scratch.” And I did. So I Googled a lot of things. ... because [cooking from scratch] is better, it is healthier for you. I mean, and it is so easy to make. Why do I need the box of stuff that takes 5 minutes, it tastes yuckier. It tastes good, but not as good. Where as if you make it fresh, you will have fresh veggies, fresh noodles, fresh everything. So it is a lot better.” (P301092)

Looking up a recipe and cooking a meal from scratch enabled P301092 to prepare the food in a healthier way and in a way that they felt tasted better. So working within the constraints of what she received may have been a blessing in disguise in terms of prompting her to cook in a healthier way.

Participants often found themselves with food that they were unfamiliar with or had never seen before. In an earlier example, P130001 called a friend who she knew had a lot of recipes and culinary experience and asked her about a vegetable she had never seen before – romanesco. In this case, she didn't even know the name so she needed to be able to text her a picture of it and then talk to her over the phone about some specific recipes. More commonly, though, participants did not have access to someone who could help them work with foreign ingredients, so they often took to the Internet to look up more information about certain things they received and what they could do with them:

“So I use my computer a lot to look up recipes, like, what do I do with umm, god, I don't know like, a whole bunch of almond paste. The food bank has all sorts of weird stuff. Yeah, they have fancy cheeses sometimes, they have really like, and pate. You get all these really weird stuff ... I'll go online and look up recipes, I'll type 'What do I do with almond paste?' and I found this great macaroon recipe with almond paste. They were really good. Usually you make them with coconut, like shaved coconut, and then you whip up egg whites and then you sort of fold it together with sugar so it's a gluten free cookie and it's delicious. I made that with almond paste. ... I ended up with a bag of frozen meatballs and I wanted to make meatball masala. You can buy masala sauce, and I'm like, you can probably make that, right? So I looked it up and it's just tomato paste and cream and some spices. I made it up and it was so good with rice, so it gives me an opportunity to be creative and learn new things.” (P525264)

Not only were recipes important in figuring out how to use the ingredients that participants had, but they were also a way to save money over store-bought options. Here, P525264 was able to find a simple recipe online to use food that she had gotten instead of buying a store-bought sauce, which would have been more expensive. So home cooking and finding recipes was, in effect, a strategy for saving money.

In working with recipes, one challenge participants faced regularly was not having access to

certain ingredients. This called for participants to run to the store, look for an alternative recipe without that ingredient, not always an easy task, or to get creative and think about replacement ingredients and determine what ingredients they could do without. In some cases they would look up, online, replacements or whether a certain ingredient was necessary for a type of dish. But sometimes they would skip the ingredient and hope for the best. P404382 summarized this succinctly: *“if its essential I have to run to the store, but if its not essential then I make something up and go with it.”*

Several participants discussed being curious about how to best deal with certain food they received from the food pantry. For example, one participant found expired cans of food and wondered whether they could eat it past the date on the can. Another participant wondered how long sweet potatoes would last if there was mold on only a part of it. This practice of managing food helped participants try to both make the most of what they had, while at the same time protecting their safety. Although the instances we heard occurred once participants got food home, one can easily imagine this also taking place in the context of the food pantry or the store.

#### **6.4.4.5 Researching diets and dietary restrictions**

For those who faced a limited diet or dietary restrictions, due to any number of reasons (e.g., religion, health issues, personal choice), their food access was inherently limited. There existed fewer foods that they could eat, therefore reducing their choices. This caused serious challenges to their food access, especially at food pantries where they may not have been able to eat much of the available food because it did not fit their dietary restrictions:

“So anybody that’s like vegan or vegetarian doesn’t have – there’s absolutely no way they can walk out of a food bank with as much food as a meat eater because you go to the dairy you say, no thank you. You go to the meat section, you say, no thank you. You get to the canned veggie section, I take 3 cans of veggies just like the meat eater. And section after section after section its like that.” (P414698)

Technology played a role, for some participants with specific dietary needs, in helping them understand the specific foods they could eat and the foods they needed to avoid. It was valuable to

have this knowledge prepared in advance of going to the pantry so they knew what they could and couldn't eat. P150149 went into significant detail in describing how he did research on the different diets he was trying to maintain – some of which he had been prescribed by a doctor and some of which he had developed through research online around managing some health conditions:

“Mostly its, if I do, if I am doing food research its basically gonna be one of the diets that I'm putting into my one diet. So low phosphate, wait, it is a low phosphate, but a low oxalate, gluten-free, dairy-free, egg-free, low FODMAP diet. So I'll be printing lists of foods that have, that will show me what a low, moderate, and high FODMAP diet would look like and what a low, what are my choices for high oxalates, I need to avoid those, I can have some medium, and I can eat almost as much as I want to of the low oxalate foods. And uh, what are those and I print those out and I refer to those. I'm struggling, I'm struggling [to synthesize it]. I'm not doing that very well.

Um, I'm used to using a computer, so I would use a computer if I had one to do that, but since [it takes] hours, its too frustrating to do that right now because I don't know their, the programs that I can get through [the library], on Google Drive for example. And they're pretty much similar, but they're a little different and its frustrating to try to do something quickly there if you don't know the software. So I need something like a, what do you call it, to synthesize all that stuff I need a – one of two things. It'd be a database that I haven't used before or the spreadsheet, because I can sort a little bit with that ... but that's the way I would do it, otherwise I gotta do it and that's why I haven't done it because I have to, it's a mind-bender to try to – because they overlap.

For example, dairy is out no matter whether it's a low FOD – its actually a high FODMAP because if you have, if you're talking about milk it's a high FODMAP because it has, it has lactose in it and uh, so I can't have it because of that. So that's out across the board, so that's kind of the easy part. The difficult part is what's the individual food that's safe for all of them.” (P150149)

He encountered a major information management challenge in trying to compile and synthesize the different diets he was trying to adhere to. His work involved gathering disparate pieces of information and trying to integrate them to provide a guide that could inform his decisions about what food to get and eat. Although this is an activity that computers can typically be effective at supporting – he didn't necessarily have the tools or a specific program that could support this activity in a meaningful way. His work was both complicated by the fact that he didn't have his own computer and had to rely on using computers at the public library and that he was unfamiliar with some of the software available to him.

P150149's situation was fairly extreme in terms of the level of detail and breadth of his research because of the complexity of his diet. However several other participants described doing more focused research on specific foods that fit their diets, which ranged from gluten-free to vegan to post-gastric bypass. This research then informed their food access practices.

More broadly, a number of participants also discussed researching healthy eating online to learn more about general practices they could use to eat healthier. These participants did not have a specific diet they needed to maintain, yet wanted to learn more so they could make better decisions in the foods they were accessing to improve their health.

#### **6.4.4.6 Finding savings and discounts**

As previously discussed, strategies for saving money when grocery shopping were extremely important to participants. Participants employed technology in a few different ways to support these endeavors. Some participants would look up the sales that were going at different stores by looking up their ads and information online. Although looking it up online made it easier for some participants to find information about the sales that were going on at different stores, others found that it made it more difficult for them to compare prices and sales between stores. This practice of comparing ads, was actually more important because it allowed them to go beyond finding an item that is on sale at a specific store to actually finding the cheapest price for an item across all stores. P301092's practice of comparing ads involved taking the paper ads, laying them all out across the table, and directly comparing each page (see Figure 6.7) – something that she would have a more difficult time doing online. She needed to be able to reference multiple ads at once and see them all visually:

“I just look at the prices and kind of, now, this is what I want to do. I wasn't doing it before, but I want to go, lay down the ads, different ads, and then maybe like write down the things I need and check each ad, and write down where is cheaper. That is what I want to start doing because I think that will really help me, help save a lot of money. [I prefer them all visible] because then I could look through, look on each page. For example, the fruits and veggies, then turn the page and see what else I need. I think that would help save a lot of money so that is what I am





Figure 6.7: P301092 spreads out the different ads she got in the mail and in the newspaper to find the cheapest options for food.

going to start doing with my mom. ... I notice that they do produce on the front, and their meat is on the second page, and they do like condiments and stuff. So you know, I just kind of look all over and see what I can find.” (P301092)

Participants also found out about sales online from friends and through social network applications. P881183 described a Facebook page she learned about from a friend that helped people in the Latin@ community learn about deals and sales that were going on at different stores. The page, which was in Spanish, pointed out sales and coupons specifically beneficial in their community:

“Yeah I have this [page] that I [liked] from Facebook that is basically an app for coupons so – and that’s how I’ve seen that if I had access to that magazine I could uhm learn how to use them and in that way. Let’s say I can save money and pay only 3 dollars or 10 dollars for X of a thing. So, it’s been 3 or 4 months since I liked the page, it’s not an application, its a page. So they post specials and they say ‘Come to Walgreens and your coupon is ready to be used and you could have 3 or 4 deodorants for x amount of money.’ 3 or 4 month ago I liked the page but I check it out constantly and their postings. yes because sometimes those are specials that uhm, they are running at the store and you don’t need the physical paper coupon. So then I see if it’s something that I need or is an offer that I can take advantage of. It is in Spanish – I think it is [named] ‘Cuponenado’ or something like that.” (P881183)

As P881183 referenced, both the sales and coupons that they found online were beneficial to helping them save money. Other participants also looked online to find coupons that they could use. By finding coupons online they could overcome the barrier that several participants suggested to using coupons, which was the cost or access to the Sunday paper: *“I try to [use coupons], but you know, to be honest, coupons you have to buy dollar fifty, the dollar seventy five for Sunday’s paper.”* (P468868)

Several participants who did not already use coupons suggested that they were excited to learn about them and try to use them more often in the future. P651480 had a friend who constantly used coupons and who had offered to teach her, so she could use them herself. In discussing coupons, P651480, and several other participants, described using them as a practice to be learned. She had been too intimidated to try using coupons on her own because she was worried about getting the wrong thing or using the coupon incorrectly. But having a friend to help her learn the process could help address the barriers she faced to using them.

## 6.5 Discussion

As expected, one of the defining aspects of the experience of food insecurity was the inability to access food. Based on our findings food access meant the physical and emotional ability to acquire food and then prepare and consume it. An inability to prepare and consume foods also contributed to a lack of access to that food. However, somewhat unexpected, was the importance of specific foods, for example fresh, high-quality fruits and vegetables. This was grounded in the immense value that participant placed on being able to get these foods. For these participants, having food access not just meant being able to get a sufficient amount of calories of food, but it meant being able to get high-quality, healthy, culturally appropriate foods that fit their dietary restrictions. These were not only the foods that they preferred, but also the foods that they believed were necessary to live a full, healthy life.

In the following sections, I first discuss how our findings expand the way that the community food environment has been conceptualized in prior research and describe how the environment affected people experiencing food insecurity. Next, I discuss ideas for how we can use a greater understanding of the community food environment to create healthier food environments with people who experience food insecurity. Lastly, I describe the role that technology could play in doing so. Specifically, I identify several ways that technology could be designed with people who experience food insecurity to help improve their access to food.

### 6.5.1 Expanding the conceptualization of the community food environment and its effects

When researchers talk about the food environment, they often speak from a positionality where food outlets – places that food can be bought (e.g., grocery and convenience stores, restaurants) – are considered the only, or at least primary, source through which people access food. Our findings suggest that there are other sources of food that play a significant role in some peoples' experiences accessing food. Specifically, food pantries, food rescues and food recovery programs,

the natural environment (via gleanings and foraging), and community meals – hot meals prepared and served by community organizations, groups, or individuals (e.g., soup kitchens and shelters). Certainly there has been research exploring these different food sources to some extent. However, in the context of describing the food environment and its effect on health, these food sources are rarely a part of the analyses.

For people experiencing food insecurity, food outlets may not be the primary source of food or even a source of food at all. Many participants in our study relied completely on food pantries and community meals in order to access food. This research suggests expanding the definition of the community food environment [90] to include the food sources that were so important for people experiencing food insecurity. In this model, much like most other research focusing on the food environment, the definition was narrowly focused on food outlets.

Traditional thinking about the impacts of the food environment on behavior tend to focus on measures of the geography of food access [214]. In this thinking, there is a certain level of access to and prevalence of grocery stores or other food outlets that enables people to get healthy food and that these healthy outlets are in competition with unhealthy outlets. Creating a greater prevalence of outlets with healthy food that are closer to people will translate to greater access to healthy food and an increased consumption of it. Unfortunately, it is not that simple. Take for example, the context of this research – Boulder, Colorado – where, according to maps and traditional measures of food access and food security, there should be little difficulty for people to access healthy food. However, rates of food insecurity hover around the national average. Our research suggests that there are other factors that contribute to food insecurity and that make it difficult for food insecure people to get healthy food. Factors like the ability to get transportation to food resources are beginning to gain some attention in thinking about food access [36]. However, the experiences people face in getting food are rarely considered in thinking about food access or the barriers to eating a healthier diet. Experiential factors like respect, comfort, and the usability of services and food outlets (e.g., the red tape and paperwork required) had major effects on participants' ability to access food. Our research suggests these are important factors to consider in thinking about

how people access food and why they choose certain options. Based on these findings, internal and external negativity (i.e., shame and stigma, a lack of respect from staff) play a major role in the ability for people who experience food insecurity to access food. It is certainly telling when participants would rather have less food than deal with the experiences they faced trying to get food.

### **6.5.2 Creating healthier food environments with people facing food insecurity**

Given that people experiencing food insecurity had a lack of access to healthy foods and that access to healthy foods is a precursor to creating a healthy food environment, increasing the access to healthy foods needs to be the primary focus of interventions for this community. This means reducing the barriers people face in getting healthy food – improving transportation options to food resources, creating systems where healthy food is brought directly to people with mobility issues, increasing the financial resources of people who experience food insecurity, abolishing application processes and the practice of making people prove their poverty, extending the hours of operation for food resources, increasing the discoverability of food resources, among others. Many of these barriers are community-level barriers, so they can be best addressed with community-level interventions [148]. Others are broad, societal-level issues that demand efforts at re-envisioning our food system, so that food access becomes a right of all people [43].

As food access resources, like food pantries and community meals, were major sources of food for people experiencing food insecurity, they present an opportunity as spaces by which we could help people increase the availability and accessibility of healthy food in their lives. As suggested by participants, simply increasing the availability of higher quality, fresh fruits and vegetables at these sources would make a significant impact. That means both increasing the quantity and quality of those foods, so that they last longer and fill a greater portion of the foods people consume. Similar to previous research, participants described an overwhelming demand for more of these foods, implying that if they were provided, they would take them and eat them [102, 95]. A previous study developed a comprehensive food pantry program that provided greater access to healthy foods as an

intervention to improve food security. They found that the program reduced food insecurity among its users. Furthermore, they found that their program, which included motivational, educational, and awareness-oriented components, was able to increase fruit and vegetable consumption and sustain those changes at one year [148]. Interventions that couple both greater access to healthy food with psychosocial components could be most effective at supporting people experiencing food insecurity in eating healthier [37].

In addition to increasing access to healthy food through these food resources, other research has suggested changing the choice architecture within these spaces to nudge users towards healthier choices [224, 225]. Our research urges caution in using these kinds of approaches in the context of working with people who experience food insecurity. Firstly, these resources often did not have sufficient quantities of fresh, high-quality healthy foods to meet the current demands of people, making it unlikely for a healthier choice architecture to have an effect. Previous research has similarly found that clients face an insufficient quantity and quality of fresh fruits and vegetables at food pantries [102, 95]. Nudging people towards a behavior that they already want to do and that the environment itself cannot support would likely be ineffective.

Secondly, we found that one of the defining experiences of food insecurity was a lack of control and choice in their food access. Participants described feeling powerless over this area of their life. Although choice architectures do not aim to explicitly remove control from people, there is still an effort to bias people towards certain decisions. People who experience food insecurity are primed to be sensitive to issues of control and agency, so diminishing their control, in even a small way, raises concerns. Certainly, one could argue that the people may never know about the choice architecture, since these approaches are often invisible and work best under conditions when people do not know their behaviors are being influenced [92]. I challenge this notion on two grounds. First, as we found, people experiencing food insecurity are acutely aware of their food environment and are smart and thoughtful around their food choices. They may very well notice and speculate on the reasons if a food pantry were to make changes to their current arrangement. Because there is a great sensitivity around control and concern with the “system,” they may speculate that the pantry is trying to

control their behaviors, leading them to be more wary of using the food resource. Second, even if people were not to realize these decisions were being made, there is an issue of morality around imposing the will of researchers, interventionists, and others – people in positions of power – upon those who are in positions where they have limited power [156].

Within the fields of philosophy and ethics, there have been significant debates over the morality of nudging and choice architectures. And although there are no definitive conclusions in these debates, our research, in working with marginalized communities, supports a more conservative consideration of the morality of these approaches. A position summarized by Hausman and Welch: “to the extent that it lessens the control agents have over their own evaluations, shaping people’s choices for their own benefit seems to us to be alarmingly intrusive” [104].

Our work suggests two alternatives to traditional applications of choice architectures in creating healthy food environments in the context of spaces serving people who experience food insecurity. Similar to an idea discussed in Study 2, one route would be to raise the awareness of the biases that people face in making food choices and provide strategies to overcome those biases. The idea would be to provide people with the knowledge and support to make healthy choices and create healthy environments in their lives. By knowledge I do not necessarily mean general knowledge about healthy eating. This may be appropriate in some contexts, but our research suggests that many people experiencing food insecurity already have a good foundation of knowledge around what healthy eating means. Instead, knowledge should be practical and skill-oriented, providing ideas about specific practices one can engage in to overcome their biases that make healthy eating more difficult. Martin and colleagues developed and piloted the Freshplace program, which coupled greater access to healthy foods in a food pantry program with skill and capacity building through goal setting, motivational interviewing, and cooking classes [148]. They found that the program had a significant effect on reducing food insecurity and increasing fruit and vegetable consumption amongst participants. As suggested by their program, any education or skill-building program around healthy eating requires a component focused on providing greater access to healthy foods in the first place. Our research suggests that these types of education and skill-building programs

could be enhanced with awareness-raising and skill-building around managing biases in food choice, borrowed from the foundational psychology behind choice architectures [211, 212].

Secondly, our work suggests that there may be value in a participatory approach to creating choice architectures. Participants in our study felt like they did not have a voice in the programs they used, yet they wanted to participate to a greater extent. There is nothing within the framework of choice architectures that precludes participation, but it's important to emphasize an inclusive, participatory approach that gives a voice to those affected by the architecture. I propose a participatory approach to architecting choices within the context of programs serving marginalized people.

In a participatory choice architecture approach, decision makers and people in positions of power within service programs would come together with people who use those services to discuss ways to structure the service to support people in making healthy decisions. This could take many forms. For example, it could involve a group with equal representation of both program administrators and users that can collaboratively make decisions around how to architect choices. Alternatively, program users could submit ideas and vote on designs that they think would be most helpful for them. Regardless of the approach, it's important to ensure an equal voice of those affected by the architecture in its design.

Given the challenges that people experiencing food insecurity face with transportation and the limited time they have available, there is reason to believe that technology could play a role in facilitating participation. There is a growing literature around the use of technology in supporting participation in public decision-making, most prevalently as the concept of “digital democracy” [228]. However, this body of research primarily focuses on participation in larger governmental systems, as opposed to participation in community-based service organizations. Le Dantec and colleagues developed a system to support participation of service users in creating public information about services [137]. Although they found that the system created dialogue around services amongst clients and between clients and the organization, there was no way for clients to participate in decision-making through this system [138]. Our work suggests a need to explore the way technol-



ogy can facilitate participation by service users in decision-making processes at these organizations.

### **6.5.3 Designing to support food access with people experiencing food insecurity**

We must acknowledge that sociostructural and policy interventions, not technology, hold the greatest potential to improve food access among people experiencing food insecurity. There is a need for greater economic opportunity to provide people the resources to access foods that they prefer. Programs could provide richer benefits that open doors to greater access to quality, fresh foods. Better options for transportation and mobility support need to be more readily available for people with limited resources. However, our research suggests that technology can be leveraged as part of larger efforts to reduce food insecurity.

HCI researchers face a significant challenge in working in this space because there exists great diversity in the experiences of food insecurity. As we found, there was no single experience with food insecurity. Some people developed ritualistic practices of visiting certain resources regularly and were able to feed themselves and their families for every meal. Others were unable to get enough to eat most days because health issues limited the food choices available to them. Some had regular access to fresh fruits and vegetables, but found that they spoiled too quickly to eat. Others could not even get these foods on a regular basis. The varied experiences challenge designers to envision interventions that could be beneficial across a broad range of experiences with food insecurity.

There were several core experiences people described in facing food insecurity that we can look to in thinking about how we might design with people experiencing food insecurity. In the following section, I discuss how these consistent aspects of the experience of food insecurity can inform design. I also look to the ways that people currently used technology to support food access as inspiration for envisioning expanded uses for technology.

#### **6.5.3.1 Control**

We found that the experience of food insecurity was characterized by a lack of control that people faced in different areas of food access. A lack of control was one of the consistent facets

of the experience of food insecurity and underlied many of the other experiences participants had. They described a lack of control over their transportation to and from food sources because of their reliance on public transit and community ride services. When they went to a food pantry, they had little control over the food that was available to them and the quality of that food. When applying for assistance, they had almost no control over whether or not they would qualify. These experiences, where so much was out of their control, had a profound impact on their ability to get food and on their emotional health and wellbeing.

In designing with people who experience food insecurity, it's important that technologies provide opportunities for users to exercise control. This includes control over the technology itself, certainly. In addition, we can look for opportunities for technologies to support users in exercising control over other aspects of their experience accessing food.

**Exercising control over technology** In thinking about how sociotechnical interventions can provide users control over the system itself, it's important to consider usability and transparency. Broadly, good usability is important in system design, however its importance really becomes apparent in systems with poor usability. Specifically, participants described interacting with online systems for receiving help with food access. These were typically online applications to receive benefits. Participants described major challenges with the usability of these websites and identified feeling like they did not have control because of the challenges they faced. Not knowing how to use a system can lead a user to feel powerless and frustrated [15], relieving them of a sense of control over the system [173]. In this study, we found that these usability challenges affected their sense of control over their lives and being able to get the help they need.

Transparency ensures that users know what the system is doing so that they can make informed decisions about how to interact with it. This empowers users with information that can put them in control of their interactions. Transparency is a commonly cited principle of good design [168, 165], however it can be at tension with other design goals, like tailoring systems to the specific needs of users. Tailoring or adapting systems is often obscured and done without the user's awareness. Operating behind the scenes and making decisions about the kinds of information

that are visible to the user takes control away from the user in order to, ideally, provide a better experience that better meets their needs. In the context of food insecurity, however, where people described feeling like little was under their control, this could add to the feelings of powerlessness that they experienced. Researchers are exploring ways to create personalized experiences where users retain significant control over the systems they use [124, 163]. These types of approaches could help bridge this tension between providing tailored experiences that meet users' needs and preserving their control. When tailoring systems intended to be used by marginalized communities, designers and researchers should make every effort to leverage approaches that create transparency and preserve control for the user.

**Exercising control through technology** In supporting the exercise of control in food access through technology, we can look to practices where participants were able to exercise control as a starting point. For example, preparing food, especially cooking a meal from scratch, in itself, was a practice of exercising control. P301092 described how cooking a meal from scratch allowed her to control all aspects of the preparation. She could control the choice of ingredients, the quality and proportions of those ingredients, the level of seasoning, and ultimately the healthiness of the preparation. Technology can enable these types of practices by providing instrumental and informational support around how to enact them. It could also raise an awareness of opportunities to exercise control.

#### 6.5.3.2 Build upon current technology practices

We found that participants used technology to *discover* resources, *search* for information, *learn* how to stretch their money, and *communicate* with others. As people have already adopted technology in these ways, building upon these current uses of technology increases the chance we can meet users' needs and gain adoption and use. Our research suggests that these four verbs (in italics above) are four ways people experiencing food insecurity can use technology to support their food access – they can use it to discover, search, learn, and communicate. These verbs provide a scaffold for designers in envisioning systems in this domain. In this section, I focus the discussion

on using technology to support discovery, searching for information, and communication.

**Navigating the system: At the intersection of discovery and searching** There are many ways that technology can support discovery and the practices of searching for information around food access. Certainly the discovery of real-world resources is a well-documented problem that technology has been used to address [2, 187]. We also uncovered a number of different types of information that participants searched for – dietary restrictions, directions, hours of operation, new recipes – which provide exciting opportunities for the design of novel technologies. Although each of these “verbs” are interesting to consider, in the context of this dissertation, I consider the intersection and synthesis of “discover” and “search” as “navigating.” Specifically, navigating the community food environment and the resources available to people experiencing food insecurity.

Participants described ways they already used technology to navigate the food environment – they looked up bus routes, the qualifications for resources, the weekly sales, among others. However, this could be time consuming and the information provided was purely factual in nature (e.g., hours of operation, addresses, etc). Navigating the system, as participants explained, did not rely simply on objective data alone. Effectively navigating the system relied on knowledge and expertise gained through experience. For example, information about the best day of the week to go to the pantry, the best places to get certain foods, or the staff members to avoid, were all gained through personal experience or word of mouth. There was no way to find this information online. Word of mouth was especially strong among the houseless community and the Latin@ community and it was the primary method by which people in those communities learned about resources. This is a similar finding to previous research exploring information practices in these communities [107, 203, 42]

Taken together, these findings suggest that others who experience food insecurity are the best resource for navigating the community food environment. Technology can play a role in facilitating this kind of sharing of knowledge between people in a community context [65, 57, 87]. Grimes Parker and colleagues’ work developing the EatWell system demonstrated the feasibility and value in supporting people in resource-limited communities in sharing their knowledge [96, 98]. As in EatWell, a multimedia enhanced approach including voice, video, and pictures may help to

preserve some of the qualities that make word of mouth so effective. The enthusiasm we received from participants about being able to share their experience during the study further supports the potential for this approach.

**Facilitating communication** We primarily found that when participants used technology to communicate, it was often with food resources, especially around their applications for assistance. People would complete an online application and then often find themselves uncertain about what would come of it. Certainly technology can be better used in enabling greater transparency in these application processes by helping people understand the status of their application and keeping them updated as to its progress. This would remove the burden from people in calling and sending emails to inquire about their situation. Previous work has uncovered the opportunity to use technology to help marginalized communities better communicate with the resources that are available to them [138, 68]. Our research builds upon this by identifying a specific communication need – greater transparency in application processes including regular updates from resources as to their status and a method for checking this information on their own, if desired.

Additionally, technology could be used to coordinate interactions between people who experience food insecurity. One participant described how her friend would call her whenever she had gotten extra food to share. They then used the phone call to coordinate a meeting. These informal interactions could be more formally supported through technology and expanded beyond close social networks. This is especially important as we found some of our participants did not have strong social support and were relatively isolated in their struggles of food insecurity. For example, P398427 described how she found her social networks slowly slipping away as she became less able to afford social activities and as she got older. Other research has similarly argued that technology can be a means to support people from marginalized communities in maintaining and expanding social networks [58, 189]. Similar to Le Dantec and Edwards [58], our work suggests caution in the use of technology as a replacement for in-person interaction, but instead suggests that technology could help connect people who have specific shared goals. In their work, they suggested engaging those living on the street who shared the goal of getting off the streets and

supporting them in sharing knowledge. In our case, we may organize people around the specific barriers they encountered in accessing food. For example, around the shared challenge of getting transportation to a food resource or in navigating a specific diet in the context of food insecurity.

## Chapter 7

### Discussion

This research evolved significantly over the course of its conduct. When we started, we focused on the psychosocial factors that affected eating behavior and developing an intervention around those factors because, at the time, they appeared to be the most tractable for a technology-based intervention. But we found, repeatedly, that environmental factors played a major role in what people ate. Participants in both Study 1 and Study 2 highlighted effects of the environment on their eating behaviors. However, between the two studies, they emphasized different aspects of the environment. Participants in our first study focused more on the community and consumer food environment (i.e., the macro-environment that included things like price and their ability to access grocery stores), while participants in the second study more readily discussed the microenvironments they encountered (i.e., the home, work place, and school). This difference was, in part, accounted for by the fact that participants in the second study identified less issues with food access. They were more able to access healthy food and therefore were less concerned with the macro-environment and were instead more concerned with the environments closer to them, such as their homes.

These studies revealed food access as an issue that was foundational to healthy eating. Ultimately, people are limited by the foods they can access. They cannot eat carrots if there are no sources of fresh vegetables within their reach, no matter how many times we recommend them. Our research evolved to follow this line of inquiry and better understand the challenges people face in accessing food. Specifically, we considered the issue of food insecurity where people were

unable to consistently access sufficient quantities of healthy, culturally-appropriate foods. People experiencing food insecurity have, by definition, the greatest challenges in accessing food.

Across these three studies, we came to understand that there were areas where technology may be able to play a role in addressing environmental factors that affect eating behaviors. This marks a significant shift from our original thinking and opens up new avenues of research within HCI. Certainly there are broader implications of this research beyond HCI that suggest a need for change at a systemic and societal level where food access is made a right for all people. More work must be done to create food systems that effectively engage people and increase access. But in the context of HCI, I discuss two ways that technology may be able to support efforts to increase food access and address the environmental factors that affect eating behaviors. First, researchers and designers can acknowledge and design for and around the constraints people face in their lives. Second, we can engage people in the process of creating their own healthy food environments either through environmental restructuring, which I discussed at length in the context of Study 2, or through participatory structures (i.e., participatory choice architectures, participatory programs). In the following sections, I discuss these implications and highlight the opportunities for future research that could build upon them.

### **7.1 Constraint-aware: Considering the constraints people face**

In our research, people faced different environmental barriers to health eating and food access. Certainly, financial barriers were common. However, some people faced barriers primarily related to their lack of transportation or mobility. Others faced emotional barriers and social isolation that kept them from engaging with services that may help them. Technologies designed to support healthy eating and food access must consider the specific barriers that each person faces.

Some of the barriers participants faced related specifically to the resources and systems within the communities they lived and worked. These issues are highly context-specific in terms of the community environment. Participants discussed specific programs they used to get food (e.g., food pantries and community meals), transportation services they used to get around the community,



and stores they visited as key aspects of their experience interacting with the food environment. These types of resources and institutions differ from community to community. Given this, our work suggests that systems designed to be community-specific may be more effective at supporting healthy eating and food access. This challenges HCI researchers to understand the experiences of people within a specific community and design for that context. Because technology alone cannot solve these issues, we can build upon and enhance resources that already exist in the community.

Even within a single community, specifically the community of Boulder in our third study, we found that there were variations in the types of barriers that individuals faced specifically in accessing food. For example, several people reported missing tools for preparing food, however they reported missing different tools – some were missing cooking utensils, while others were missing tools for opening cans and packages. In essence, each person had a unique food access context composed of the resources and abilities available to them to help with food access. This context could be considered a set of constraints under which each person was trying to access, prepare, and eat food, which could be considered in designing systems.

Our study suggests that adapting systems to the unique constraints that each person faces would be one way by which we could help facilitate food access for a number of people given they have different experiences and face different challenges. Systems could consider the constraints a person faces in accessing food and adapt accordingly. This could mean tailoring information presented through the application, as discussed with Study 1, or connecting them with other people who share their specific challenges, as discussed in Study 3. Ultimately, if a person had limited challenges with food access, like many of our participants in Study 2, the application may focus instead on supporting environmental restructuring to make foods more available and accessible.

Tailoring is a common topic of research in public health [164], health psychology [167], and computing [171]. In the context of computing research, there are specific types of tailoring such as ‘context-aware computing’ [16, 70] and ‘adaptive systems’ [50, 124]. When thinking about tailoring systems, one of the challenges is identifying the dimensions or individual characteristics around which to tailor. Most commonly, tailoring in the context of health interventions is most often

done based on demographic characteristics or psychosocial variables, which can include beliefs and perceived barriers [32]. However, our work suggests that actual barriers, or constraints, should also be considered in tailoring, not just the barriers that people perceive.

Ideally, systems that adapt their behavior to the constraints faced by users, which I refer to as ‘constraint-aware’ systems, could aim to provide the best possible support given the constraints a person faces in their efforts to access food. This idea of ‘constraint-aware’ systems relates to both context-aware computing and research into personalized and adaptive computing. Broadly speaking, there are two types of information used in context-aware and personalized systems. First, there is information concerned with more ephemeral or momentary forms of contextual information such as location, the time of day, or the activity history of a person [41, 22, 16]. On the other hand there are more enduring, identity-oriented forms of information like demographics, membership to specific groups, and beliefs and attitudes [133, 63]. In the first case, there is an effort to constantly evaluate the context and update the system in reaction to context changes. In the second case, much of the personalization can be done initially or infrequently as the information about the user is less likely to change.

Information about the constraints a person faces, which would be the most relevant information to inform adaptive systems to support food access and healthy eating, straddles both of these areas. Some constraints were more fleeting in nature, such as the food currently in their home or the food preparation tools they had available to them. Other constraints were more enduring such as a permanent physical disability. Financial resources could be considered either, depending on the situation of the individual. A person who was currently looking for work or looking for a new job that pays more may see their financial resources change in the near future. However, someone who is unable to work due to their age or disability may be living off a fixed income such as social security or disability and would be very unlikely to see changes in their income.

As discussed in Study 3, there is a need to be cautious in creating systems that adapt their behavior without the knowledge of the user. Adapting systems without the knowledge of users can serve to take control out of their hands – a very sensitive issue for people experiencing

food insecurity. Our research suggests that we should be conservative in how these systems are implemented and put more control in the hands of the users. This does not mean to disparage the value that ‘constraint-aware’ systems could bring. Instead, it challenges researchers to think about how to develop these systems in a way that they are both transparent and controllable.

### **7.1.1 Envisioning a ‘constraint-aware’ system**

What might a ‘constraint-aware’ system look like? I illustrate the idea with an example of a system that one could envision to help food pantry users make the most out of the food they receive from the pantry. Commonly, participants described getting specific items from the pantry that they needed to construct meals around and having limited ingredients and tools to do so. In this envisioned system, users could enter specific items they received from the food pantry to look for guidance on preparation, such as specific recipes. However, presenting users with recipes that use ingredients that they do not have or that use preparation methods for which they lack the tools would not be very useful. In fact, it could be very frustrating, as we found. Furthermore, the user may be cooking for only themselves or they may be cooking for an entire family and need to stretch the food as far as possible to feed everyone. So instead of presenting all recipes possible for a given set of ingredients, the system may present a reduced set of recipes containing only those that fit within their constraints.

A single mother of three who doesn’t have many spices nor a stove may receive ideas for simple, cold preparations using the food she received from the food pantry. In addition, she could receive recipes that use the microwave instead of the oven or stove top. As an example, this mother may have gotten a package of pork tenderloin from the pantry and is looking for guidance on how to prepare it. The previous week, she brought home some dry pasta and instant rice from the food pantry the previous week – both items that could help stretch out the meat she got. The dry pasta would be difficult to make without a stove top to boil water, though not impossible. This may complicate a recipe using the dry pasta and prompt the system to provide details on how to prepare dry pasta using the microwave. Instant rice, on the other hand, is often intended to be prepared

using the microwave, so since this is easier and more straight forward, a recipe using instant rice may be prioritized in a list of recipes over one using the dry pasta. There may only be a handful of recipes that can be used to prepare pork tenderloin with rice using a microwave and without any spices, so those may be the recipes that are displayed first.

In thinking about how we can try to make the system transparent and provide control to the user, a simple way would be to add a message informing users that only a subset of recipes were being shown that meet certain criteria. From there, users could adjust these criteria if they wanted to. For example, maybe the single mother in the previous example had a neighbor with an oven she could use. In this case, she would want to adjust the constraints to include recipes that use the oven. This would ensure greater transparency of the system's behavior and provide the control to make changes in the way the system behaved. However, more complex approaches, such as scrutable user models [124], may be more generalizable and effective at ensuring control stays with the users.

This envisioned system certainly presents many challenges around how it could be implemented. For example, how could we easily collect and keep track of information about the food that is available to a user? What information would users need to enter and what information could be sensed automatically? How would people, especially people who are food insecure, respond to adaptive systems that change their behavior automatically? These are certainly difficult challenges that open up opportunities for future research in HCI and computing. I intend this to be a simple illustration to exemplify how a system might consider specific constraints people face.

## **7.2 Participatory structures to enhance the food environment**

Our research suggests that there are opportunities to engage people in creating healthier food environments. In fact, participants across all three studies already engaged efforts to make environments under their control more supportive of healthy eating. These were practices of environmental restructuring. However, I believe, this concept could be expanded beyond the environments under an individual's control to other environments they encounter. Our findings, especially those from

Study 3, suggest that people would be interested in such opportunities. But how might it work?

This work suggests two ideas for how this could work – broadly in enacting the concept of participatory choice architectures and through specific service organizations, such as food pantries and community meal programs. Our research suggests that organizations, defined broadly to include governments, workplaces, non-profits, and businesses, could create spaces for people to participate in the development of choice architectures that are intended to influence their behaviors. This would serve to reduce the potential negative consequences of subverting people’s choices and may increase the effectiveness of those architectures as they include insights from the people they are intended to affect [92]. In the second case, service organizations could facilitate participation in various areas of their programs ranging from the food available to their hours of operation and the way application processes work.

In both these cases, this would require buy-in and support from organizations and people in positions of power. Instead of making decisions unilaterally, they would need to agree to allow participation in decision-making processes – something that would be radical for some, but come easily for others. Even if organizations were to support participatory involvement, there are other barriers to participation. Across all three studies, though to a greater extent in Study 1 and Study 3, participants described a lack of time, their busy schedules, and a lack of transportation as major barriers to food access. If people do not have the time or resources to get food, then how will they be able to commit time and effort towards participating in decision making processes? Previous research suggests that technology may be able to help here and enable participation from a distance and at different levels of commitment [57].

In further considering the role of technology and in thinking about the community food environment in aggregate, technology could be used to crowd-source insights around the food environment and areas where healthy eating is supported and areas where it is not. Grimes Parker and colleagues implemented a similar idea with the EatWell intervention, which served to facilitate dialogue amongst people living in a community around healthy eating [96]. However, their intervention was not focused entirely on the environment itself, though participants in their field-trial

of the system did discuss these issues [98]. What I propose focuses on engaging people to critically evaluate the environment itself. One could imagine building knowledge around the limitations of the community food environment, in an inclusive, participatory way. This could inform collective action by concerned citizens, activists, community organizations, and governmental bodies. Community members could use mobile phones and GPS-technology to document information about their surroundings and this information could be contributed to a central resource that is publicly available. Though informed by our findings, this idea is primarily speculative. However it serves to envision a novel way of thinking about participation, technology, and the food environment to stimulate future avenues of research. Work done by other researchers suggests that this line of thinking could be productive [200, 130]. For example, Le Dantec and colleagues integrated crowd-sourced data into city transportation planning processes [59]. In exploring the process, they found that they were able to effectively create a form of participation by the public, though it came with challenges involving how to be more inclusive of marginalized voices.

### 7.3 Limitations

In considering this research, its important to acknowledge several limitations. First, this work is primarily qualitative in nature and, as such, does not make claims around causality and does not formally test any models or constructs. We also did not use any formal researcher triangulation procedures in our analysis (e.g., intercoder agreement or reliability) , which presents a threat to the internal validity of this research. Furthermore, the data analyzed in the three studies was primarily generated from interviews where people verbalized their beliefs and perceptions of their behaviors and the challenges they face in different aspects of their lives. These are extremely important perspectives as they represent individuals' experiences and lived realities. However, they are reported through the complex lens of each individual's life experiences and mental processes, which may bias their reporting. We must also acknowledge that our sample sizes for all three studies were small, limiting the generalizability of the findings.

There are also limitations to consider around the recruitment and composition of the par-

ticipants in the three studies. In the first study, we relied on our community partner, the Bridge Project, in identifying families who may be interested in participating. This convenience sample excluded representation from some populations who had participated during formative phases of this research, including Somali refugees and refugees from other nations, with whom we had originally designed the Family Snack Buddy application. We also had limited representation from participants who identified as Black or African American as well as from participants who identified as Asian, which was problematic given that many people from these races and ethnicities lived in this community.

In the second and third studies, we used purposeful sampling approaches that aimed to get representation from different important demographics and participants with differing experiences across relevant dimensions. Although we were able to get representation across these different dimensions, we did not have equal representation from different groups and in some cases we had disparities in representation. In the second study, some of these disparities included a greater proportion of young adult participants than older adults, we had more participants with high intentions to change their eating behaviors as opposed to participants with low intentions, and we had few participants who identified as low SES. In the third study, we only had four participants who had non-conforming housing situations, which may have led us to miss capturing different aspects of how that experience affects their experiences accessing food.

Across all three studies, especially the first and third studies, we had a lack of representation from people who identified as male. This was especially true of participants from the Latin@ community in our third study who identified exclusively as female. This may have significantly biased our results and captured certain perspectives, while failing to represent others.

## **Chapter 8**

### **Conclusion**

In this dissertation, we conducted three studies that explored the ways that technology may be able to support healthy eating and food access. We built an Android application, Snack Buddy, which we used as a probe to explore the factors that affect people's eating behaviors in two field-trials. The first trial focused on a family version of the application, Family Snack Buddy, while the second study used an individual, theory-driven version of the application, Individual Snack Buddy. In conducting these studies, we found that environmental factors were described as being highly influential in driving participants' eating behaviors. Participants were both affected by their environment and also worked to modify it, through practices we identified as environmental restructuring. Environmental restructuring, which refers to the practice of altering one's environment to make it more supportive of healthy behaviors, presented a design opportunity around which technology could help address the environmental determinants of eating behavior.

Through these two studies, we found that one specific environmental factor, food access, was foundational in enabling people to eat healthier. Food access refers to an individual's ability to acquire food, which is central to being able to eat healthy foods. For instance, it would be difficult for a person to eat healthier if they cannot access fresh fruits and vegetables because they lack the financial means, have mobility challenges, or have a busy schedule that prevents them from getting to the store or food pantry.

These learnings from our first two studies led us to explore the issue of food access in more detail and examine whether technology may have a role to play in improving it. Food access is



intricately tied to food insecurity – those who do not have access to a sufficient quantity of healthy, culturally-appropriate food experience food insecurity. Therefore, in thinking about technology's role in improving food access, it makes sense to work with people who have the greatest barriers to access. In the final study, we developed a community-based participatory research project with Boulder Food Rescue, a local non-profit working to improve food access in Boulder, Colorado. This partnership served as a foundation for exploring the experiences of people facing food insecurity. We conducted a two week multimedia-elicitation interview study with 26 people who experience food insecurity.

In this last study, we found that people faced a variety of barriers to food access that included a lack of financial resources, limited transportation, a lack of respect from service organizations, and challenges in discovering the resources available to them. There were a number of ways that people used technology to support their own food access, which included using it to discover resources and services, look up information about how to get help, learn about how to manage their dietary restrictions and prepare food, and find ways to save money. The current ways that people use technology can inform the design of future systems. Our findings suggest that we can design to help people navigate the food system and to support communication throughout the community. Specifically, it may be beneficial to help people experiencing food insecurity connect with others who face similar challenges in order to pass along valuable experiential knowledge. Additionally, it may also be beneficial to use technology to better connect people experiencing food insecurity with the services intended to help them.

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## **Appendix A**

### **Relevant theories of health behavior**

The design of interventions in this research was influenced by a number of theories of health behavior that come primarily out of the fields of psychology and public health. Specifically, the interventions were influenced by Social Cognitive Theory (SCT) [18], Transportation Theory [94], and the Integrated Behavioral Model (IBM) [76]. We leveraged these theories to varying degrees across the different research studies. This appendix provides an overview of these theories, with an emphasis on certain aspects that are most relevant to this dissertation.

#### **A.1 Social Cognitive Theory (SCT)**

Albert Bandura developed Social Cognitive Theory (SCT) out of research on how people learn from their environment [18]. SCT emphasizes the relationship between an individual and their environment, including broader social influences that can be highly influential. According to SCT, behavior is determined by an interplay of social and cognitive factors that are ultimately driven by our individual differences [19]. The key construct in SCT is self-efficacy, which is an individual's beliefs of control over their actions and their capability to perform a specific behavior. Secondly, SCT suggests that individuals have outcome expectancies, which are their perceptions of the possible consequences of their actions. These perceptions will drive behavior and in part mediate the effects of self-efficacy on behavior. Additionally, SCT includes goals and sociostructural factors. Sociostructural factors includes both facilitators, things that support the behavior, and impediments, things that prevent the behavior. Although there is no consistent diagrammatic

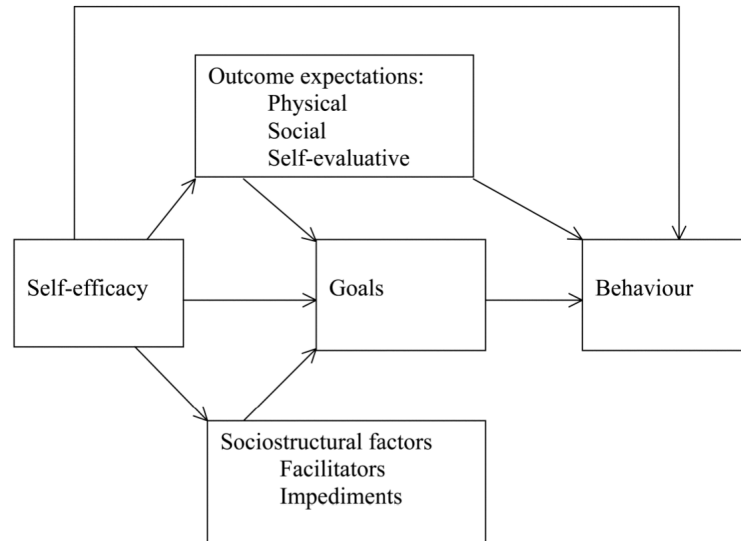


Figure A.1: Path diagram describing Social-Cognitive Theory [20]

model of SCT, Bandura's path model is one of the most prevalent (see Figure A.1).

### A.1.1 Self-efficacy

Self-efficacy, the central concept in SCT, refers to an individual's beliefs in their abilities to organize and enact a certain behavior. It is unlikely that an individual will engage in a behavior if they do not believe that they will be successful in doing so. A significant amount of research has explored the construct and how to influence it in an individual. Bandura proposes four routes to enhance self-efficacy – personal experience, vicarious experiences, verbal persuasion by experts or trusted persons, and emotional arousal [52]. The strongest of these influences is personal experience and accomplishment, which can be highly predictive of future behavior [19].

### A.1.2 Reciprocal Determinism

Reciprocal determinism is the idea that environments influence and shape people, while at the same time people can exert influence over their environment. There is the potential, then, that people can alter their environments or construct different environments to support their ability to engage in certain behaviors. Often, this is considered in the context of organizations and groups

of people engaging in collective action towards creating change in the macro-environment. For example, a group may work together to create a grocery co-op that improve access to fresh fruits and vegetables or a governmental body may pass a policy that taxes sugar-sweetened beverages in hopes of decreasing their consumption.

## **A.2      Transportation Theory**

Transportation Theory suggests that individuals' beliefs and attitudes are affected whenever they engage in an immersive narration [94]. The decisions people make during the narrative can induce changes in their beliefs about performing a behavior, which can in turn increase the likelihood of them performing or not performing a behavior once they have left the narrative. Components that facilitate transportation include emotional reactions, mental imagery, and loss of access to real-world information. Individuals receiving the narrative can also be affected by a relatable protagonist. Once an individual has developed a strong attachment to the protagonist, the character's beliefs and experiences can transfer to the individual.

## **A.3      Integrated Behavioral Model (IBM)**

The IBM seeks to combine aspects of prevalent health behavior theories that have the most empirical support [77]. Specifically, the theory draws upon the Health Belief Model [188], SCT, and, most directly, the Theory of Reasoned Action [7]. At its core, the IBM represents a reasoned action approach to understanding health behavior in that it assumes individuals have beliefs around specific behaviors that in turn determine their performance of those behaviors. The beliefs an individual has about a behavior are informed by various other factors or "background influences" [76], which include demographics, mood, and past behavior, among others. Furthermore, these beliefs may be completely rational or irrational. Regardless of the rationality of their beliefs, they are predictive of the behaviors that follow. For example, if one strongly believes, though irrationally, that they will get abducted by an alien if they run around their neighborhood, then they will be less likely to engage in that behavior.

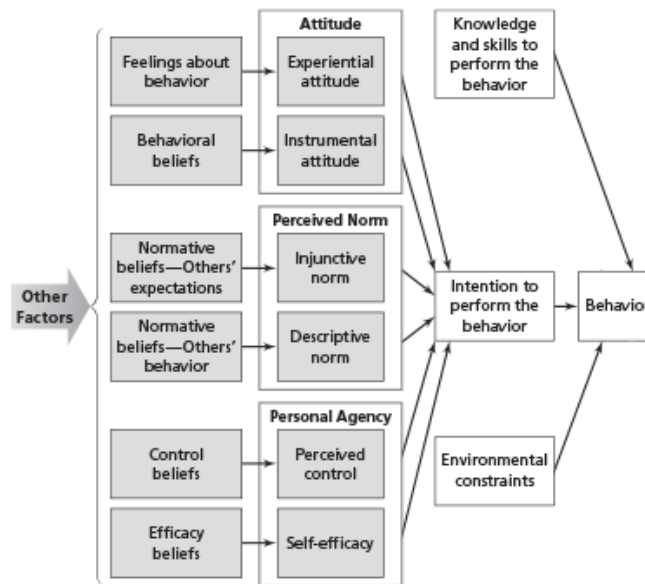


Figure A.2: Path diagram describing the Integrated Behavioral Model adapted from Moñtano and Kasprzyk [158] and the original formulation by Fishbein [76]

As shown in figure A.2, the different types of beliefs an individual holds work directly through three main constructs – attitudes, perceived norms, and personal agency. Attitudes represent an individual’s overall feelings of favorableness towards performing a behavior, while perceived norms reflect the social pressures that an individual feels to perform a behavior. Personal agency represents an individual’s perceived ability to overcome barriers and the extent that they feel they have control over their performance of a behavior. These constructs in turn influence an individual’s intentions to perform a behavior, which is a direct determinant of behavior [158].

In addition to intentions, the IBM specifies two other direct determinants of behavior – 1) environmental factors and 2) skills and abilities. Thus, an individual will be likely to perform a behavior in the case where they have a strong intention to perform that behavior, along with the skills necessary and support from environmental factors. If there is a deficiency in one or more of these areas, then they will be less likely to engage in that behavior. For example, an individual can have every intention to eat fruits and vegetables for snack, however if they have no access to fruits and vegetables (environmental factor) or do not know how to prepare fruits and vegetables (skills

and abilities), then they will be less likely to perform that behavior. In the following sections I describe the three determinants of intentions – attitudes, perceived norms, and personal agency – in greater detail as they are central to my proposed research.

### **A.3.1 Attitudes**

The first of these determinants, attitudes, accounts for the overall sentiment that an individual holds towards performing a behavior. It can range from extremely negative to extremely positive, and the more positive their attitude towards the behavior, the more likely they are to perform it. The singular construct of attitudes is composed of affective (or emotional) attitudes and instrumental (or cognitive) attitudes. Affective attitudes capture an individual's emotional response towards performing a behavior, which differs from the instrumental attitudes that are determined by an individual's assessment of the potential outcomes, negative and positive, of engaging in a behavior. An individual may believe that eating healthy snacks will reduce their risk of heart disease, which is a positive evaluation of the behavior, and thus will have a more positive instrumental attitude towards that behavior. On the other hand, they may feel that healthy snacks will cost them more and leave them with less money overall, leading them to develop a more negative instrumental attitude towards the behavior.

### **A.3.2 Perceived Norms**

The second construct that works through intentions is perceived norms, which is an individual's perceptions of social pressures to perform or not perform a behavior. Like attitudes, there are two components to perceived norms – injunctive norms and descriptive norms. Injunctive norms represent the perception of whether others think the individual should or should not perform a given behavior. This is informed by what others say, how they respond to the individual, and ultimately the internal beliefs that the individual develops around what they think others want them to do. Descriptive norms represent an individual's assessment of what other people do, largely informed by what they see other people do. The effect of these perceptions depends on the importance of the



people that the individual considers. People that are more important to them, such as a romantic partner, best friend, or parent, will have a stronger effect on both injunctive and descriptive norms. In terms of descriptive norms, an individual considers the referent groups with which they associate themselves. For example, if a person identifies strongly as a University of Colorado (CU) student, then seeing other CU students eat healthy food will be more influential than seeing students from a rival school, such as Colorado State University, eat healthy food.

### **A.3.3 Personal Agency**

Personal agency is an individual's perceptions of the barriers that they face in performing a behavior and their confidence in their own abilities. It is best described by the two components that make up the construct – perceived behavioral control (PBC) and self-efficacy. PBC captures the perceptions an individual has about the extent to which they have control over the performance of a given behavior, based on environmental barriers and challenges. Self-efficacy in IBM is similarly conceptualized as in SCT above – the individual's confidence in their abilities to perform a behavior in the face of obstacles and barriers. Conceptually and empirically, self-efficacy and PBC are the same and have been found to be highly correlated and difficult to discern [6]; however, they are often assessed using different questions.

## Appendix B

### Demographics Questionnaire for Study 1 for Primary Caregivers

The purpose of this questionnaire is to provide us with some background information about yourself, your family, and your experience with technology.

#### About You

**Gender:**

**Age:**

**Race:**

**Ethnicity:** White / Hispanic / African American / Other

**Work Status:** Not Working / Part-time / Full-time  
If so what do you do?

**Education:** Primary School / Middle School / High School / College / Graduate  
Level

#### Your Family

**How many children do you have?**

For each child that you have, please enter their age and gender in the box provided below:

Age	Gender

If anyone else helps you look after your children, please state their relationship to you (e.g. sister, friend) and what they do to help in the box below:

Relationship	What they do to help

### Technology

**1. Do you have a computer at home? Yes No**

**If so, how often do you use it?**

- a. Everyday
- b. A few times a week
- c. A few times a month
- d. A few times a year
- e. Not at all

**2. Do you have access to a computer somewhere other than your home?**

**If so where?**

**How often do you use it?**

- a. Everyday
- b. A few times a week
- c. A few times a month
- d. A few times a year
- e. Not at all

**3. How much experience do you have using computers?**

- a. Less than 1 year
- b. 1-2 years
- c. 2-3 years
- d. 3-4 years
- e. 4-5 years
- f. More than 5 years

**4. Do you own a mobile phone?                      Yes    No**

**If so, how often do you use it?**

- a. Everyday
- b. A few times a week
- c. A few times a month
- d. A few times a year
- e. Not at all

**5. How much experience do you have using mobile phones?**

- a. Less 1 year
- b. 1-2 years
- c. 2-3 years
- d. 3-4 years
- e. 4-5 years
- f. More than 5 years

6. On a scale of 1 to 5 with 1 being *no confidence at all* and 5 being *complete confidence*, please check how confident you are at using the mobile phone for the following tasks (if you have never used a computer for a task, please check *never used*).

	1 No Confidence	2	3 Some Confidence	4	5 Complete Confidence	Never Used
Make / Receive phone calls						
Send / Receive text messages						
Take photos						
Download applications						

7. On a scale from 1 to 5, please mark how strongly you agree or disagree with the following statement:

*I am aware of the snacks I eat throughout my day.*

1. Strongly disagree    2. Disagree    3. Neither agree/disagree    4. Agree    5. Strongly agree

8. On a scale from 1 to 5 please mark how strongly you agree or disagree with the following statement:

*I am aware of the snacks my family members eat throughout the day.*

1. Strongly disagree    2. Disagree    3. Neither agree/disagree    4. Agree    5. Strongly agree

9. On a scale from 1 to 5 with 1 being *very unhealthy* and 5 being *very healthy*, please mark the answer that best completes the following sentence:

*The snacks that I normally eat are \_\_\_\_\_.*

1. Very unhealthy    2. Unhealthy    3. Neither healthy/unhealthy    4. Healthy    5. Very healthy

10. On a scale from 1 to 5 with 1 being *very unhealthy* and 5 being *very healthy*, please mark the answer that best completes the following sentence:

*My family eats \_\_\_\_\_ snacks.*

1. Very unhealthy    2. Unhealthy    3. Neither healthy/unhealthy    4. Healthy    5. Very healthy

11. Fruits are available in my house.

1. never    2. rarely    3. Sometimes    4. Often    5. Unsure

12. Vegetables are available in my house.

1. never    2. rarely    3. Sometimes    4. Often    5. Unsure

13. The types of food I eat affect my health.

1. Strongly disagree    2. Disagree    3. Neither agree/disagree    4. Agree    5. Strongly agree

14. The types of food I eat affect how I do in school or work.

1. Strongly disagree    2. Disagree    3. Neither agree/disagree    4. Agree    5. Strongly agree

**15. How much fruit do you think that you eat?**

1. Very little      2. Little      3. Some      4. Much      5. Very much

**16. Do you think that you eat more or less fruit than most people your age?**

1. Much less      2. Less      3. The same      4. More      5. Much more

**17. How many vegetables do you think that you eat?**

1. Very few      2. Few      3. Some      4. Many      5. Very many

**18. Do you think that you eat more or less vegetables than most people your age?**

1. Much less      2. Less      3. The same      4. More      5. Much more

**19. Please rate the following snacks based on how healthy you think that they are on a scale from 1 to 5 (1 being very unhealthy, 5 being very healthy):**

*a. Potato chips*

1. Very unhealthy      2. Unhealthy      3. Neither healthy/unhealthy      4. Healthy      5. Very healthy

*b. Apples*

1. Very unhealthy      2. Unhealthy      3. Neither healthy/unhealthy      4. Healthy      5. Very healthy

*c. Spicy Cheetos*

1. Very unhealthy      2. Unhealthy      3. Neither healthy/unhealthy      4. Healthy      5. Very healthy

*d. Cookies*

1. Very unhealthy      2. Unhealthy      3. Neither healthy/unhealthy      4. Healthy      5. Very healthy

*e. Broccoli*

1. Very unhealthy    2. Unhealthy    3. Neither healthy/unhealthy    4. Healthy    5. Very health

### **Health Status**

20. Would you say that in general your health is...

- a. Excellent
- b. Very good
- c. Good
- d. Fair
- e. Poor

21. Are there any foods that you cannot eat due to your health or beliefs?

22. Do you have any chronic illnesses? (i.e. diabetes, high blood pressure, or heart disease)

23. Do you have health insurance right now?

- f. Yes
- g. No
- h. Not sure

24. IF YES TO QUESTION 23: Which of these is your main health insurance?

- i. Medicare
- j. Medicaid
- k. I'm covered under my work insurance
- l. I'm covered under my partner's plan where they work
- m. I buy my own insurance
- n. Other
- o. I'm not sure



## Appendix C

### Demographics Questionnaire for Study 1 for Secondary Caregivers

The purpose of this questionnaire is to provide us with some background information about yourself, your family, and your experience with technology.

#### About You

**Gender:**

**Age:**

**Race:**

**Ethnicity:** White / Hispanic / African American / Other

**Work Status:** Not Working / Part-time / Full-time  
If so what do you do?

**Education:** Primary School / Middle School / High School / College / Graduate  
Level

## Your Family

What tasks do you help your family complete around the household? (i.e. shopping for groceries, preparing meals, preparing snacks)

How many siblings do you have?

For each sibling that you have, please enter their age and gender in the box provided below:

Age	Boy/Girl

If anyone else helps you look after your siblings, please state their relationship to you (e.g. sister, friend) and what they do to help in the box below:

Relationship	What they do to help

**Technology**

**1. Do you have a computer at home? Yes No**

**If so, how often do you use it?**

- a. Everyday
- b. A few times a week
- c. A few times a month
- d. A few times a year
- e. Not at all

**2. Do you have access to a computer somewhere other than your home?**

**If so where?**

**How often do you use it?**

- a. Everyday
- b. A few times a week
- c. A few times a month
- d. A few times a year
- e. Not at all

**3. How much experience do you have using computers?**

- a. Less than 1 year
- b. 1-2 years
- c. 2-3 years
- d. 3-4 years
- e. 4-5 years
- f. More than 5 years

**4. Do you own a mobile phone? Yes No**

**If so, how often do you use it?**

- a. Everyday
- b. A few times a week
- c. A few times a month
- d. A few times a year
- e. Not at all

**5. How much experience do you have using mobile phones?**

- a. Less 1 year
- b. 1-2 years
- c. 2-3 years
- d. 3-4 years
- e. 4-5 years
- f. More than 5 years

6. On a scale of 1 to 5 with 1 being *no confidence at all* and 5 being *complete confidence*, please check how confident you are at using the mobile phone for the following tasks (if you have never used a computer for a task, please check *never used*).

	1 No Confidence	2	3 Some Confidence	4	5 Complete Confidence	Never Used
Make / Receive phone calls						
Send / Receive text messages						
Take photos						
Download applications						

- 7. On a scale from 1 to 5, please mark how strongly you agree or disagree with the following statement:**

*I am aware of the snacks I eat throughout my day.*

1. Strongly disagree    2. Disagree    3. Neither agree/disagree    4. Agree    5. Strongly agree

8. On a scale from 1 to 5 please mark how strongly you agree or disagree with the following statement:

*I am aware of the snacks my family members eat throughout the day.*

1. Strongly disagree    2. Disagree    3. Neither agree/disagree    4. Agree    5. Strongly agree

9. On a scale from 1 to 5 with 1 being *very unhealthy* and 5 being *very healthy*, please mark the answer that best completes the following sentence:

*The snacks that I normally eat are \_\_\_\_\_.*

1. Very unhealthy    2. Unhealthy    3. Neither healthy/unhealthy    4. Healthy    5. Very healthy

10. On a scale from 1 to 5 with 1 being *very unhealthy* and 5 being *very healthy*, please mark the answer that best completes the following sentence:

*My family eats \_\_\_\_\_ snacks.*

1. Very unhealthy    2. Unhealthy    3. Neither healthy/unhealthy    4. Healthy    5. Very healthy

11. **Fruits are available in my house.**

1. never    2. rarely    3. Sometimes    4. Often    5. Unsure

12. **Vegetables are available in my house.**

1. never    2. rarely    3. Sometimes    4. Often    5. Unsure

13. **The types of food I eat affect my health.**

1. Strongly disagree    2. Disagree    3. Neither agree/disagree    4. Agree    5. Strongly agree

**14. The types of food I eat affect how I do in school or work.**

1. Strongly disagree    2. Disagree    3. Neither agree/disagree    4. Agree    5. Strongly agree

**15. How much fruit do you think that you eat?**

1. Very little    2. Little    3. Some    4. Much    5. Very much

**16. Do you think that you eat more or less fruit than most people your age?**

1. Much less    2. Less    3. The same    4. More    5. Much more

**17. How many vegetables do you think that you eat?**

1. Very few    2. Few    3. Some    4. Many    5. Very many

**18. Do you think that you eat more or less vegetables than most people your age?**

1. Much less    2. Less    3. The same    4. More    5. Much more

**19. Please rate the following snacks based on how healthy you think that they are on a scale from 1 to 5 (1 being very unhealthy, 5 being very healthy):**

*a. Potato chips*

1. Very unhealthy    2. Unhealthy    3. Neither healthy/unhealthy    4. Healthy    5. Very healthy

*b. Apples*

1. Very unhealthy    2. Unhealthy    3. Neither healthy/unhealthy    4. Healthy    5. Very healthy

*c. Spicy Cheetos*

1. Very unhealthy    2. Unhealthy    3. Neither healthy/unhealthy    4. Healthy    5. Very healthy

*d. Cookies*

1. Very unhealthy    2. Unhealthy    3. Neither healthy/unhealthy    4. Healthy    5. Very healthy

*e. Broccoli*

1. Very unhealthy    2. Unhealthy    3. Neither healthy/unhealthy    4. Healthy    5. Very health

**Health Status**

20. Would you say that in general your health is...

- a. Excellent
- b. Very good
- c. Good
- d. Fair
- e. Poor

21. Are there any foods that you cannot eat due to your health or beliefs?

22. Do you have any chronic illnesses? (i.e. diabetes, high blood pressure, or heart disease)

23. Do you have health insurance right now?

- f. Yes
- g. No
- h. Not sure

24. IF YES TO QUESTION 23: Which of these is your main health insurance?

- i. Medicare
- j. Medicaid
- k. I'm covered under my work insurance

- l. I'm covered under my partner's plan where they work
- m. I buy my own insurance
- n. Other
- o. I'm not sure



## Appendix D

### Demographics Questionnaire for Study 2

The purpose of this questionnaire is to provide us with some background information about yourself, your family, and your experience with technology.

#### About You

**Gender:**

**Age:**

**Race:**

**Ethnicity:**

**Work Status:** Not Working / Part-time / Full-time  
If so what do you do?

**Level of Education:** Primary School / Some High School / Completed High School /  
Some College / Completed College / Advanced degree (e.g., Masters, PhD, MD, JD)

**Annual household income:** Less than \$10,000 / \$10,000 to \$14,999 / \$15,000 to 24,999  
/ 25,000 to \$49,999 / \$50,000 to \$99,999 / \$100,000 or more

**How many people live in your household, including yourself, that you help to support financially?** (children, partner or spouse, parent, grandparent etc)

## Appendix E

### Integrated Behavioral Model Construct Elicitation Questions

- How would you describe your snacking behaviors?
- What drives your decisions about the snacks you eat?
- How do you feel about the idea of eating healthy snacks every time you eat a snack?
- How do you feel about the idea of eating healthy snacks every time you eat a snack, even if it does not taste as good?
- What do you like about the idea of eating healthy snacks every time you eat a snack?
- What do you dislike about the idea of eating healthy snacks every time you eat a snack?
- What are the benefits, for you, of eating healthier snacks than the ones you are eating now?
- What are the disadvantages, for you, of eating healthier snacks than the ones you are eating now?
- Who would actively support your eating healthier snacks than the ones you are eating now?
- Who would be against your eating healthy snacks every time you eat a snack instead of unhealthy snacks?
- What are your barriers to eating healthier snacks?
- What makes it easier for you to eat healthy snacks every time that you eat a snack?
- What makes it more difficult for you to eat healthy snacks every time that you eat a snack?
- How confident do you feel about your ability to choose a healthy snack, like a fruit or vegetable, when you have more unhealthy options?
- What are the snacking behaviors of the people that you know or see on a consistent basis?
- What kinds of snacks would the people that are important to you want you to eat?
- How do you feel about making healthy snacking a part of your everyday life?
- What plans do you have to work towards more healthy snacking in your life?

## Appendix F

### Social Stream Content Templates

- 63% of [insert referent group] eat mostly fruits and vegetables for snacks
- Fresh fruits, which are very healthy snacks, are popular snacks among [insert referent group]
- This week, over half of the [insert referent group] using Snack Buddy ate a 5-star snack
- Yesterday was a great day for snackers in your community, the average healthiness was 4 stars
- [insert referent group] eat healthier snacks in the morning than at other times of the day
- 19 [insert referent group] chose to drink water instead of sugary beverages
- Only 10% of [insert referent group] ate a half star snack this week
- 10 [insert referent group] replaced sugary coffee drinks with less sweet alternatives
- As a group, [insert referent group] ate 37 more healthy snacks than unhealthy snacks this week.
- 17 other [insert referent group] had their healthiest day of snacking yesterday
- Half of [insert referent group] improved their evening snacking this week
- 60% of [insert referent group] tried a snack that we suggested
- People like you ate fruits and whole grains more often than any other snacks this week
- This week, 22 [insert referent group] tried at least one of their healthier snack suggestions.
- 7/10 [insert referent group] improved their overall snack healthiness this week
- 24 [insert referent group] have an average snack healthiness over 4 stars.
- [insert referent group] have started eating 1 more fruit or vegetable each day. Can you?
- 73% of [insert referent group] have not eaten a snack less than 2 stars this week
- Today, 6 out of 10 [insert referent group] using Snack Buddy ate more fruits and vegetables than other snacks

- Over half of the [insert referent group] using Snack Buddy have an average snack healthiness over 3.5 stars
- Only 10% of [insert referent group] ate less healthy snacks today than yesterday.
- [insert referent group] are some of the healthiest snackers using Snack Buddy. 80% of [insert referent group] ate fruits and vegetables for most of their snacks.
- This week, the average snacking healthiness for people that share your attributes was 3.5 stars
- Today, 6 out of 10 [insert referent group] using Snack Buddy ate a five star snack
- On average, [insert referent group] improved their snack healthiness by half a star this week.
- 7/10 [insert referent group] are making their late night snacks healthy ones
- Almost every [insert referent group] ate a fruit or vegetable for a snack this week
- Yesterday, 17 [insert referent group] tried at least one of their healthier snack suggestions.
- Fruits, vegetables, and whole grains foods are the most popular snacks eaten by people like you.
- [insert referent group] have an average snack healthiness of 4 stars.
- 25% of [insert referent group] eat only fruits and vegetables for snacks
- Today, 63% of [insert referent group] ate a fruit or vegetable for at least one of their snacks.
- 15 [insert referent group] ate more than one 5 star snack yesterday

## Appendix G

### USDA 6-item Food Insecurity (English)

1. “The food that (I/we) bought just didn’t last, and (I/we) didn’t have money to get more.” Was that often, sometimes, or never true for (you/your household) in the last 12 months?

☐ Often true ☐ Sometimes true ☐ Never true ☐ DK or Refused

2. “(I/we) couldn’t afford to eat balanced meals.” Was that often, sometimes, or never true for (you/your household) in the last 12 months?

☐ Often true ☐ Sometimes true ☐ Never true ☐ DK or Refused

3. In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?

☐ Yes ☐ No (Skip 4) ☐ DK

4. [If Yes above] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

☐ Almost every month ☐ Some months but not every month ☐ Only 1 or 2 months ☐ DK

5. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?

☐ Yes ☐ No ☐ DK

6. In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?

☐ Yes ☐ No ☐ DK

## Appendix H

### USDA 6-item Food Insecurity (Spanish)

1. La comida que (compré / compramos) no rindió lo suficiente, y (no tenía / no teníamos) dinero para comprar más." (Para Ud. / En su hogar), ¿ésto ocurrió frecuentemente, a veces, o nunca en los últimos 12 meses?  
  

<input type="checkbox"/>	<input type="checkbox"/>	Frecuentemente
<input type="checkbox"/>	<input type="checkbox"/>	A veces
<input type="checkbox"/>	<input type="checkbox"/>	Nunca
<input type="checkbox"/>	<input type="checkbox"/>	DK or Refused
  
2. “(No tenía / No teníamos) recursos suficientes para comer comida variada y nutritiva.” (Para Ud. / En su hogar), ¿ésto ocurrió frecuentemente, a veces, o nunca en los últimos 12 meses?  
  

<input type="checkbox"/>	<input type="checkbox"/>	Frecuentemente
<input type="checkbox"/>	<input type="checkbox"/>	A veces
<input type="checkbox"/>	<input type="checkbox"/>	Nunca
<input type="checkbox"/>	<input type="checkbox"/>	DK or Refused
  
3. En los últimos 12 meses, ¿(Ud. / Ud. u otro adulto del hogar) redujo alguna vez la cantidad de sus comidas o dejó de desayunar, almorzar o cenar porque le faltaba dinero para alimentos?  
  

<input type="checkbox"/>	<input type="checkbox"/>	Sí
<input type="checkbox"/>	<input type="checkbox"/>	No (Skip AD1a)

☐ ☐ DK (Skip AD1a)

4. **[IF SÍ ABOVE, ASK] ¿Con qué frecuencia sucedió esto? Casi todos los meses, algunos meses pero no todos, o solamente en 1 ó 2 meses?**

☐ ☐ Casi todos los meses  
☐ ☐ Algunos meses pero no todos  
☐ ☐ Solamente en 1 ó 2 meses  
☐ ☐ DK

5. **En los últimos 12 meses, ¿comió Ud. alguna vez menos de lo que pensaba que debía comer porque le faltaba dinero para alimentos?**

☐ ☐ Sí  
☐ ☐ No  
☐ ☐ DK

6. **En los últimos 12 meses, ¿Tuvo Ud. hambre alguna vez pero no comió porque le faltaba dinero para alimentos?**

☐ ☐ Sí  
☐ ☐ No  
☐ ☐ DK



## Appendix I

### Script provided in Study 3 to explain the MEI

#### **In English:**

***If you record any individuals in your family, we ask that you explain the research study to them as follows and ask if it's okay for them to be in recordings:***

I am participating in a study being conducted by researchers from the University of Colorado Boulder. The study is about my experiences and challenges getting, preparing, and eating food. They are trying to learn about how they can improve the food system in Boulder so it's easier for people to get food.

They asked me to use this device for a couple weeks to take pictures, record videos, and record voice diaries about my experiences and challenges getting food. The purpose of taking the pictures, videos, and voice recordings is so that they can see my experiences through my eyes. Because you are a part of my everyday life, I might want to take pictures of you so that they can understand me better.

They will be collecting the pictures, videos, and voice recordings I create as part of the research study. So if I take any pictures, videos, or voice recordings that you are in, they will collect them and may be able to see or hear you. Is it okay for me to take pictures, videos, or voice recordings that you might be in? If not, that is totally okay. I will just make sure I don't record you.

If you want me to stop recording you or if there are any situations where you feel uncomfortable with me recording, just tell me and I will stop.

***If anyone asks you why you are taking pictures or has concerns about you taking pictures, we ask that you explain the research as follows:***

I am participating in a study being conducted by researchers from the University of Colorado Boulder. The study is about understanding the challenges that people face trying to access, prepare, and eat food.

They asked me to use this {camera phone or voice recorder} for a couple weeks to take pictures, record videos, and record voice diaries about my experiences and challenges getting food. They are trying to learn about how they can improve the food system in Boulder so it's easier for people to get food.

Just so you know, I am avoiding taking pictures or video or voice recordings of other people, so I won't be taking any pictures of you or recording any videos or voice diaries that have you in them. If there are any pictures that have other people in them, such as yourself, then they are going to be edited so those people are blurred out. And if there are any videos or voice recordings with any other people in them, then they will be deleted.

If you've got any questions you can contact the research team at [phone number] or [email].

***If anyone asks you to stop taking pictures or recording video or voice diaries, even if you are not recording them directly, you should cease those activities immediately.***

## En español:

***Si usted graba a algún individuo de su familia, le pedimos que usted le pida autorización para estar en las grabaciones y le explique el estudio en el cual usted está participando de la siguiente manera:***

“Yo estoy participando en un estudio que es conducido por investigadores de la Universidad de Colorado de Boulder. El estudio es acerca de mis experiencias y obstáculos al obtener y preparar alimentos. Ellos intentan aprender cómo pueden mejorar el sistema alimentario en Boulder para que sea más fácil tener acceso a los alimentos.

Ellos me pidieron usar esta (cámara o grabadora de voz) por un par de semanas para tomar fotografías, grabar videos o grabaciones de voz acerca de mis experiencias y obstáculos al obtener mis alimentos. El propósito de tomar fotografías, videos, y grabaciones de voz es para que ellos puedan presenciar mis experiencias a través de sus ojos. Precisamente porque usted es parte de mi vida diaria, quizás yo quiera tomar fotografías tuyas para que ellos me puedan entender mejor.

Ellos van a recopilar las fotografías, videos y grabaciones de voz que yo capture como parte del estudio de investigación. Así que si tomo fotografías, videos o grabaciones de voz en las que usted está, ellos las van a recopilar y podrán verlo o escucharlo a usted. ¿Está bien si usted aparece en fotografías, videos o grabaciones de voz? Si no está de acuerdo, está bien. Solo me debo asegurar de no capturarlo.

Si usted quiere que yo interrumpa alguna grabación o si hubiera alguna situación en la que usted no se siente cómodo(a) con que quede documentada, dígamelo y yo voy a detenerme.”

\*\*\*\*\*

***Si alguien le pregunta o tiene alguna preocupación acerca del por qué usted está tomando fotografías, le pedimos que explique la investigación de la siguiente manera:***

“Yo estoy participando en un estudio que es conducido por investigadores de la Universidad de Colorado de Boulder. El estudio es acerca del entendimiento de los obstáculos que las personas enfrentan al acceder, preparar y consumir alimentos.

Ellos me pidieron usar esta (cámara o grabadora de voz) por un par de semanas para tomar fotografías, grabar videos o grabaciones de voz acerca de mis experiencias y obstáculos al obtener mi comida. Ellos intentan aprender cómo pueden mejorar el sistema alimentario en Boulder para que sea más fácil tener acceso a los alimentos.

Le quiero hacer saber que estoy evitando tomar fotografías, grabar video o grabaciones de voz de otras personas. Así que no estoy tomando fotografías, grabando videos o su voz en las que usted esté presente.”

Si usted tiene algunas fotografías en las que salgan otras personas, incluyéndose a usted mismo, debe saber que van a ser editadas para que esas personas se vean borrosas. Y en caso de que hubiera videos o grabaciones de voz en las que otras personas estén presentes, van a ser borradas.

Si usted tiene alguna pregunta puede llamar al equipo de investigación al [phone number] o enviar un correo electrónico a [\[email\]](#)

***Si alguien le pide que no tome fotografías de ellos(as) o que no grabe video o sus voces, usted debe detenerse inmediatamente inclusive si usted no los está enfocando directamente a ellos (as).***

## **Appendix J**

### **Multimedia-elicitation Interview (MEI) Guide for Study 3**

#### **Questions about media collected:**

- Can you tell me what is going on in this piece of media?
- Where was this recorded?
- When was this taken?
- How often does this happen (daily, weekly, monthly)?
- Is this a unique/strange experience?
- Can you recall how you felt at the time you recorded this?
- Is there anything else you want to share about this picture [or video]?

#### **Questions about broader experiences of food insecurity:**

- How do you get your food?
- Where do you get food?
- What does your best meal look like?
- What does your worst meal look like?
- Ideally, how would you want to get food?
- What makes it easier for you to get food?
- What tools or technologies do you use to access food (cell phones, online information, transportation)?
  - Do you have a cell phone?
    - How useful is your cell phone in helping you get food?
    - Does your cell phone make it easier or more difficult to get food?
    - What about your cell phone makes it easier or more difficult?
  - Do you have access to a computer?
- Where do you use computers?
  - How does using a computer affect your ability to get food?
  - Does using a computer make it easier or more difficult to get food?
  - What about your computer makes it easier or more difficult?
- Do you use coupons or other discounts when you get food?
- How do you get to places where you get food?
  - Do you take the bus?

- What are your transportation expenses when getting food?
  - Which buses do you take?
  - How does the bus system affect your ability to get food?
- What programs do you use to access food (farmer's market, food stamps, pantries, etc.)?
  - How long have you been using each of these programs?
  - How did you find out about each of these programs?
  - Do you prefer any programs? Why?
  - Have you had any bad experiences with any programs?
  - What does it look like when you use [insert program name]?
  - How do you feel when you use [insert program name]?
- How much time do you think you spend each week getting food? What activities make up that time?
- Who helps you get food?
  - Do you get food with anyone else?
- Are there any barriers that prevent you [and/or your family] from accessing and eating desirable food for all your meals?
- Have you ever gotten food that would otherwise go to waste (for example 'day old bagels', food from your job, or dumpster diving)?
  - Where did the food come from?
- Where do you live?
  - How long have you been there?
- Do you ever shop at the grocery store?
  - What does it look like when you go to the grocery store?
  - What stores do you go to?
  - How often do you get to go grocery shopping?
  - Does anyone help you with grocery shopping?
- Have you ever lost access to any of the programs you use to access food?
  - What program(s) did you lose access to?
  - Why did you lose access to that program/those programs?
  - Did you resolve it?
    - How?
    - Did anyone help you resolve it?
    - How long did it take to resolve it?
  - When you lost access to that program, did you access food in other ways?
    - How?
- What is one time when you felt really frustrated when trying to get food for yourself or for your family?
- How much time do you think you spend each week preparing food?
- To what extent do you feel like getting food affects other aspects of your life?
- What would make it easier for you to get food?
- Could you describe what a typical meal looks like at your house?
- Can you tell me about the role of food in your personal and family life?

- Is there anyone, like a friend or family member, who you help get food?
- What does your best meal look like?
- What does your worst meal look like?
- Ideally, how would you want to get food?