

Using Design to Contextualize Food Purchasing Data and Help Grocery Shoppers Transition to Healthier Food Purchasing Behaviors

A thesis submitted to the School of Design, Carnegie Mellon University, for the degree of Master of Design in Design for Interactions

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Abstract

Cardiovascular disease and diabetes are leading causes of death in the U.S. Both are nutrition-related diseases and can be mitigated by managing or decreasing the consumption of sugar, sodium, fat, and saturated fat. The purpose of this Master's Thesis is to determine how design can help grocery shoppers gain more clarity about the sugar, sodium, fat, and saturated fat in their food purchases, encourage healthier food purchasing behaviors, and decrease the risk of disease. Design research methods were utilized to learn how consumers think about nutrition while making food purchases. Results revealed that research participants consider themselves to be health conscious, but that their actual food purchasing behaviors are not as healthy as they think they should be. The solution is to show consumers the average amounts of sugar, sodium, fat, and saturated fat in their purchases and compare those numbers to the amounts recommended by health professionals. This information helps consumers contextualize the nutrition in their purchases, identify specific problem areas, and modify their purchasing behaviors to become more healthy.

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Chapter 1: Introduction – Designing for better nutrition by starting with itemized financial transaction data

Introduction

The goal of this thesis project is to decrease nutrition-related diseases that are leading causes of death in the United States, such as cardiovascular disease and diabetes, by helping consumers make more healthy and informed food purchases. However, it did not begin that way. The original goal was to help consumers gain more clarity about their spending practices. By exploring digital itemized transaction data, I began thinking about how consumers could learn more about their financial consumption. Later on I applied this data to nutritional consumption.

Why It Is Relevant

Preventable nutrition-related diseases are a serious health risk for Americans today. The consumption of sugar, sodium, fat, and saturated fat increases the risk of developing cardiovascular disease and diabetes—diseases that tens of thousands of Americans die from each year. However, adults still consume nearly twice as much sodium— a cause of high blood pressure and heart disease— than is recommended by the American Heart Association, for example (American Heart Association, 2014). One reason for overconsumption of negative ingredients like sugar, sodium, fat, and saturated fat may be that Americans may not realize how prevalent these ingredients are in foods and how bad these foods can be for their health. According to NPR, 75% of Americans rank their diet as healthy (Aubrey & Godoy, 2016). However, a study conducted by the Mayo Clinic found that only 37.9% of Americans had healthy diets (Loprinzi, Branscum, Hanks, & Smit, 2016). This suggests that Americans' concept of what constitutes a healthy diet may be far from reality. My thesis project helps consumers see how the amounts of sugar, sodium, fat, and saturated fat in their food purchases compares to the recommended nutritional standards suggested by health professionals from the Food Standards Agency (Food Standards Agency, 2007). This information gives consumers a starting point for healthy behavior change.

Problem Definition

The problem I set out to solve was inspired by my summer internship with Capital One Labs. There I worked to make transaction data easier for consumers to understand. When I began my thesis, I decided to build on that problem space. My design question was, "How might design help consumers gain more meaningful insights, more clarity, and more sense of control over their personal finances?" Money is the universal enabler, the medium by which people can exchange goods, services, and experiences. Many people struggle to understand their money— where it is going, how much they need for the future— and miss opportunities to feel confident and secure about many aspects of life.

Audience

I chose to focus on young consumers, ages 18–40, who may be undergoing a first-time financial transition, whether it be getting a first full-time job, buying a house, or managing student loans.

Hypothesis

My hypothesis was that emerging artificially intelligent technologies could utilize consumer financial data to help people make sense of their current and future financial states. I was specifically interested in aggregated digital itemized transaction data and the detailed insights that information could provide for consumers.

Argument

“Do you know where your money is going?” This is a question I asked handfuls of research participants at Capital One Labs this year as I worked on a project to help consumers make more sense of their money. While some people simply answered, “No.”, some said they track their spending mentally, some by checking their bank statements or aggregator apps, and others by keeping their receipts. Each of these methods has pros and cons. Keeping track of expenses mentally is difficult to do because of the frequency and complexity of expenditures and the physical limitations to human memory. Referring to bank statements is great for knowing with whom money was spent and when, but those statements do not provide itemized details about the specific goods or services that were purchased. Lastly, receipts provide machine-focused itemized details about purchases, but they are often printed on paper or dispersed throughout an email inbox, making a holistic view of expenditures over time difficult. None of the above solutions are ideal for helping consumers get a holistic picture of where their money goes. I argue that a better method is in store: universal access to digital personal itemized transaction data.

Suppose that consumers could access a digital, comprehensive, aggregated financial expenditure report that gave them detailed information not only about where they shopped and what the total cost was, but specifically which items they purchased along with the relevant attributes for each of those items (e.g. weight, color, material, manufacturer, packaging, warranty terms, etc.). Over time, consumers could collect rich data sets that could reveal helpful insights about their consumption behaviors. They would truly know the answer to where their money goes.

According to an article written in New York Times Magazine, “Almost every major retailer, from grocery chains to investment banks to the U.S. Postal Service, has a “predictive analytics” department devoted to understanding not just consumers’ shopping habits but also their personal habits, so as to more efficiently market to them (Duhigg, 2012).” Clearly large organizations have access to enough detail to understand the intricacies of consumer behaviors. Suppose that consumers had access to the same granularity of data and analysis. Imagine the kinds of insights they could glean about their own personal behaviors, habits, patterns, and practices.

According to a study from Duke University, it is estimated that 45 percent of the choices consumers make are shaped by habits rather than conscious decision-making (Neal, Wood, & Quinn, 2006). Itemized transaction data could help consumers identify their subconscious spending and evaluate how that fits into their financial wellness. According to New York Times Magazine, thanks to data collection,

researchers have figured out how to stop people from habitually overeating and biting their nails. They can explain why some of us automatically go for a jog every morning and are productive at work, while others oversleep and procrastinate. There is a calculus, it turns out, for mastering our subconscious urges. For companies like Target, the exhaustive rendering of our conscious and unconscious patterns into data sets and algorithms has revolutionized what they know about us and, therefore, how precisely they can sell (Duhigg, 2012).

If there is a “calculus” for mastering subconscious urges, then why shouldn’t consumers take advantage of the math and utilize itemized transaction data to help them understand and master their subconscious spending? According to Alan Warde, a sociologist, “...consumption occurs within and for the sake of practices. Items consumed are put to use in the course of engaging in particular practices... and being a competent practitioner requires appropriate consumption of goods and services (Warde, 2005).” This means that itemized transaction data not only sheds light on the consumption patterns of individuals, but also on their practices. A famous example is when Target learned that a teenage girl was pregnant before her father did (Duhigg, 2012). By analyzing her purchasing data, they were able to identify patterns in her behavior that related to pregnancy.

Chapter Summary

Often times merchants have access to very detailed data about consumers’ purchasing patterns and can use that information to predict and understand their behaviors, urges, and practices. Today, consumers do not have access to that detailed information about their own spending. If they did, however, they could learn more about their spending practices and better understand where their money goes. The same could be said for gathering data about the nutrition in consumer purchases and learning about their health behaviors.

Chapter 2: Exploratory and Generative Research From Literature Reviews to Applied Research

Introduction

I spent time reading about money, behavior, and consumption then conducted primary research to find out what kind of relationship my target audience had with money. I used a generative research method to understand the organizational models people use to understand where their money goes.

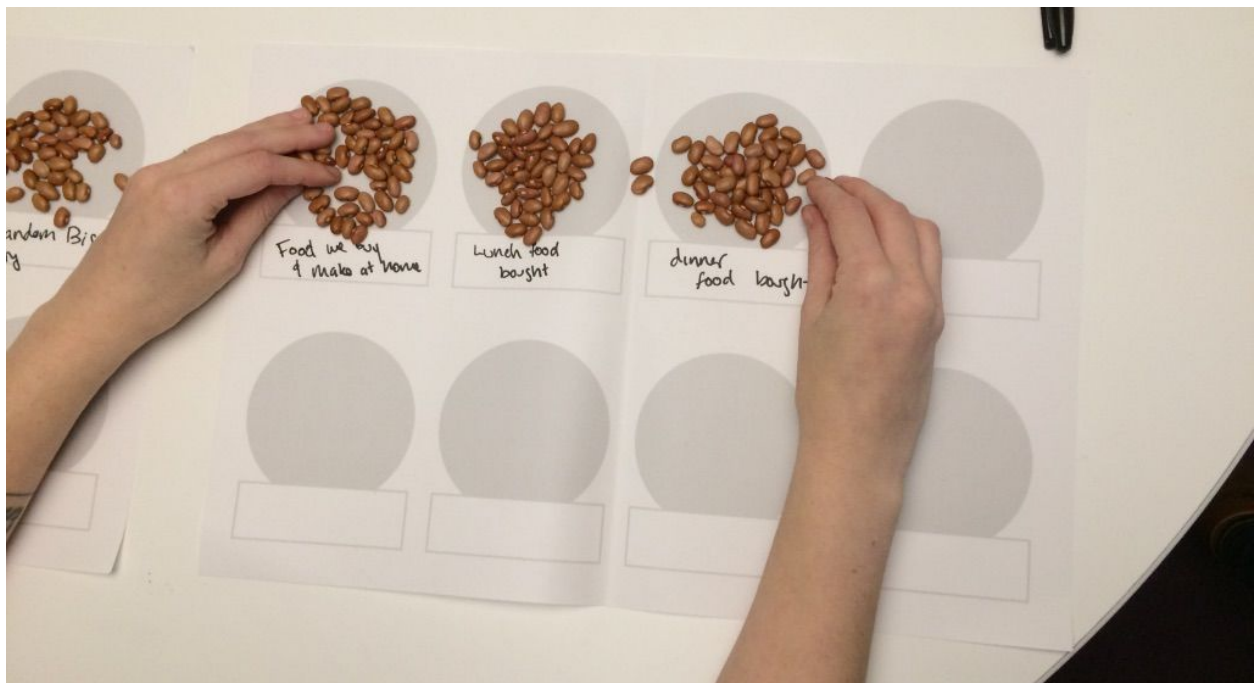
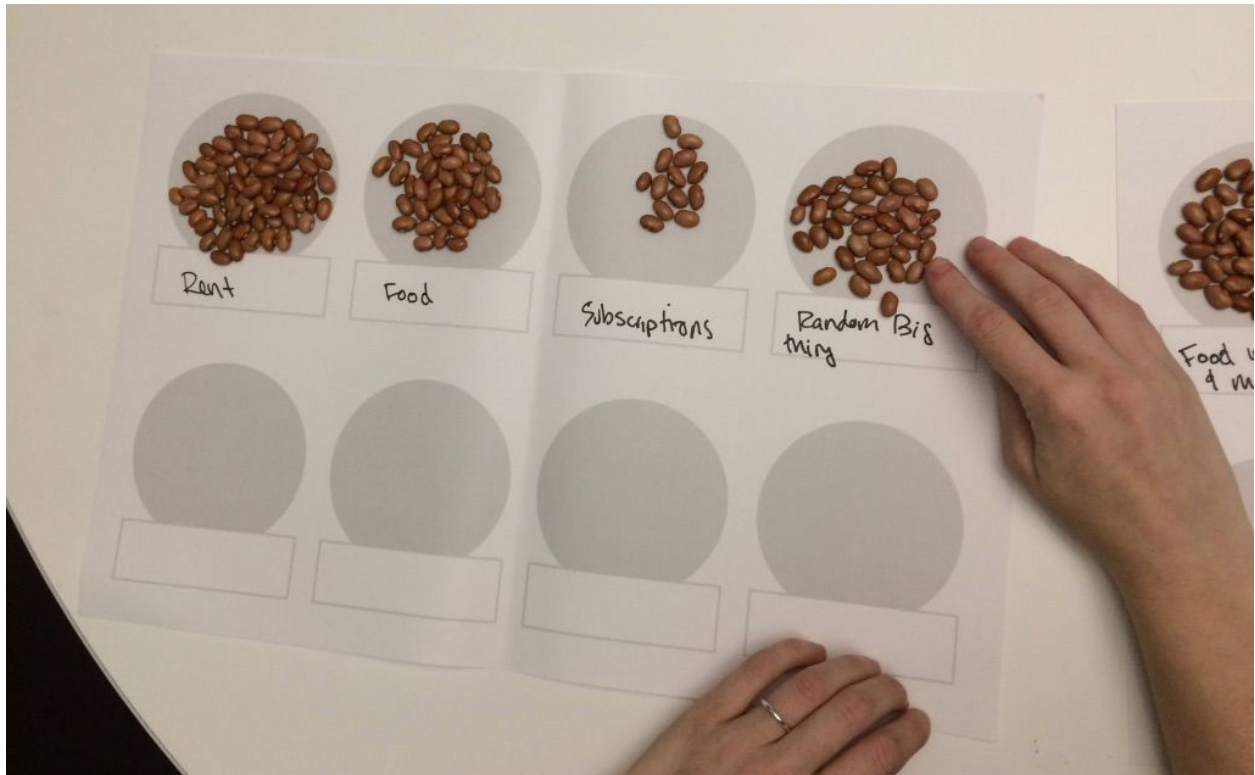
Literature Review

I began my research by reading articles related to the philosophy of money, practices and consumption, and mental value systems, and budgeting methods. I also wanted to learn why consumers don't have access to aggregated transaction information from merchants. Even credit card companies don't get this data. It was difficult to find the answer to this question. The people I spoke with at Capital One told me that it had to do with merchants not wanting to reveal their pricing structures, inventory, etc. so they can compete in the marketplace. This is also a design opportunity space that is worth exploring, however, is out of scope for this project.

Primary Research

The objective of the first study conducted with participants was threefold. I wanted to discover to what extent participants knew where their money goes, the pain points and barriers associated with knowing where money goes, and the cost-benefits of tracking where money goes. I recruited five participants and started each session by asking questions about their relationship with money, how they track their money, and what knowledge gaps they had about their spending. Next I gave them a worksheet with several blank circles on it and a pile of dried beans. I asked them to categorize their spending from the last month and use the beans to represent the proportions of money spent in each category.

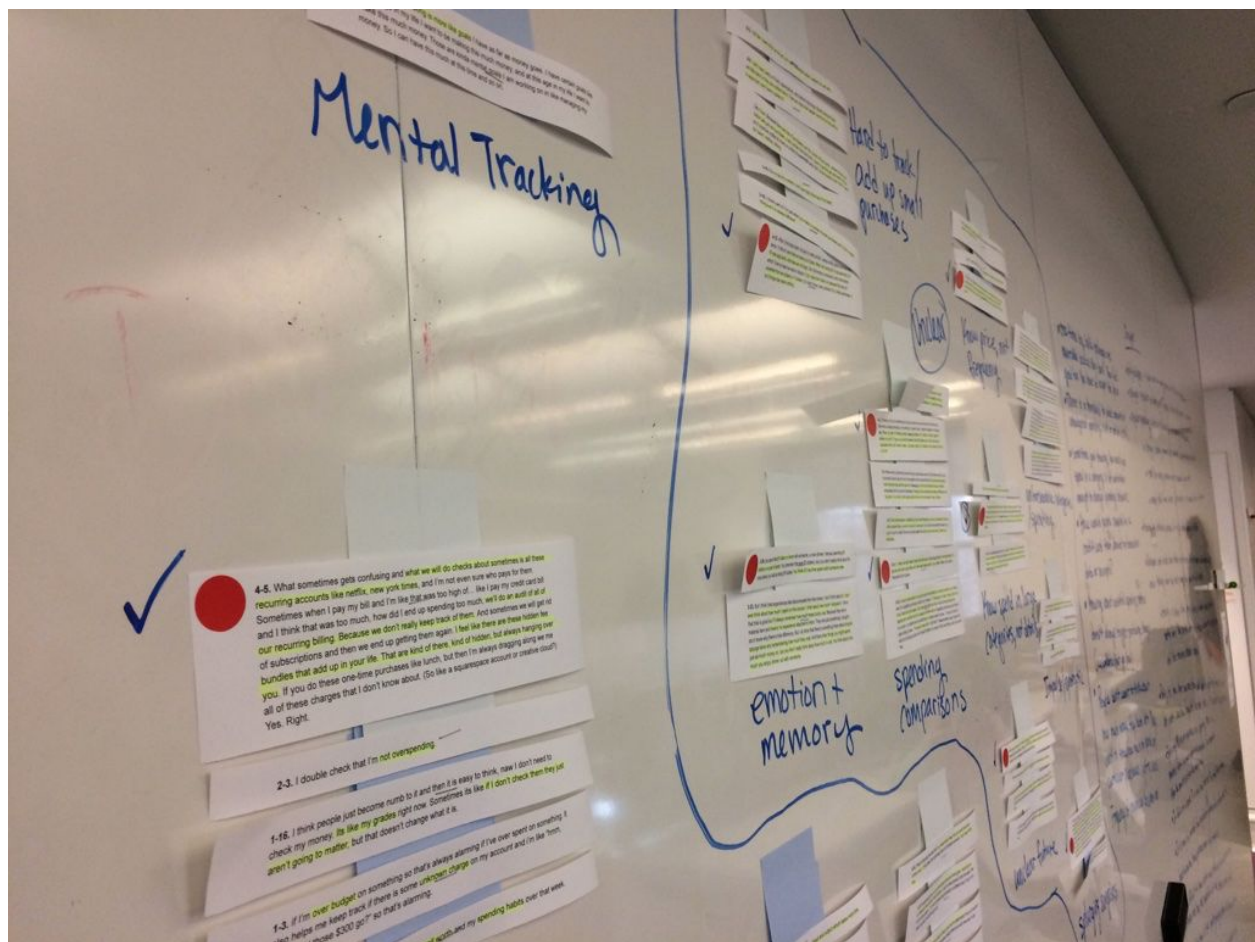
Once they completed the exercise, I asked them to rank their confidence in the accuracy of their proportions on a scale from 1 to 10. I asked them for which categories they had the most and least clarity about the details of their spending. After the participant identified the category that they had the least clarity in, I asked them to repeat the bean exercise by breaking that category into subcategories. This task was much more difficult the second time. After the task was completed, I asked the participants to identify the main barriers to having clarity about where their money goes. I also asked them what the pros and cons are about having more clarity in spending.



Synthesis

I photographed each participant's worksheets, took note of their confidence ranking, and audio recorded their comments throughout the research session. I transcribed their comments and started combing through the transcripts and collected the most surprising comments. I printed

and cut out these comments and started affinity mapping them to find overlapping ideas and similarities. From that I started developing insights, hypotheses, and preliminary concepts.



Key Insights

- Contextualizing individual purchases and understanding how they fit into a monthly spending cap is difficult.
- Participants tend to think about the appropriateness of each discretionary expenditure rather than thinking about how much money they have left to spend.
- Participants generally know about how much they spend on specific purchases, but they are not sure how frequently they make those purchases and thus aren't sure what their expenditures add up to.

Chapter Summary

Through generative research methods and synthesis I learned the areas of spending that people tend to have the least clarity on. I also learned how confident people are in their knowledge of where their money goes. I came up with insights that helped me develop my next concepts.

Chapter 3: Concept Development and Testing – Basic Concepts, Storyboards, and Pivoting to Nutrition

Introduction

Insights gathered from my generative research lead me to the following three basic concepts. The intent of each concept is to help people meet budget goals, better understand their spending, or prioritize spending. I didn't realize until later that each of my concepts included a food element. Eventually I expanded these concepts into storyboards that showed similar concepts in context. I tested the storyboards and learned more about the perceptions my target audience had about food and purchasing. I explored other projects, methods and theories that inspired the direction of my thesis and narrowed the scope of my project.

1. Transactional Spending Suggestions

This concept suggests to consumers how much money to spend on average, for example, each time they go out to eat. The average is based on the frequency of their eating out patterns and is adjusted after each spend to keep them on track for their monthly budget. The goal is not to change how frequently consumers eat out, but instead to guide their spending decisions in those moments so they can stay on budget.



2. Categorize Most Impactful Spending

This concept helps inform consumers about which of their small purchases add up the most over time. It utilizes itemized transaction information to identify which individual products or services make up the most spending and categorizes them based on their similarities.

Grocery Receipt	
Apples	\$3
Oreos	\$4
Chips	\$3
Iccream	\$6
Flour	\$2
Beans	\$1
Cookies	\$4
Bananas	\$2
<hr/>	
TOTAL	\$25

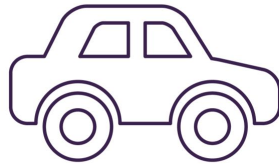
68%
spent on junk food

3. Cost Benefit Comparison

This concept helps consumers make spending decisions by comparing the cost-benefit of similarly priced purchases. The goal is to help consumers decrease spending in areas that have low cost-benefit.



VS.



\$7 Coffee

\$7 Rideshare

Pivot (Thinking about consumption in a different way)

At this point in the thesis process, I went on winter break and had a chance to reflect on the direction of my project. I realized that a common thread between each of the three concepts I developed was food, a space where many of my research participants had the least amount of clarity on in their spending practices. As I ate with my family over the holidays, I reflected on how big of a role food plays in health. When I returned for spring semester, I started a class with Kristin Hughes that focused on food and its impact on the community.

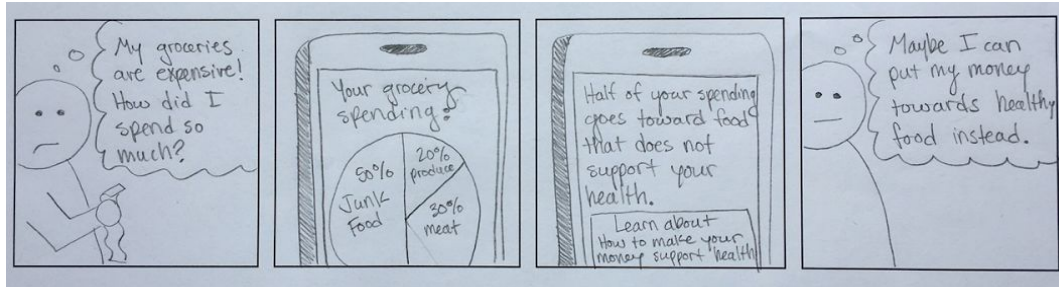
I thought back to my “Categorize Most Impactful Spending” concept and realized that rather than focusing on the monetary value of grocery items, I was interested in focusing on the nutritional value of items and getting people to think about how they invest in their health each time they go to the grocery store.

Storyboards

I took the concepts I developed and started developing variations of them in the form of four-panel storyboards. The point of the storyboards was to give design concepts context and then get feedback about each concept from potential users. Following each session, I asked users how they would rank their health consciousness on a scale from 1–10.

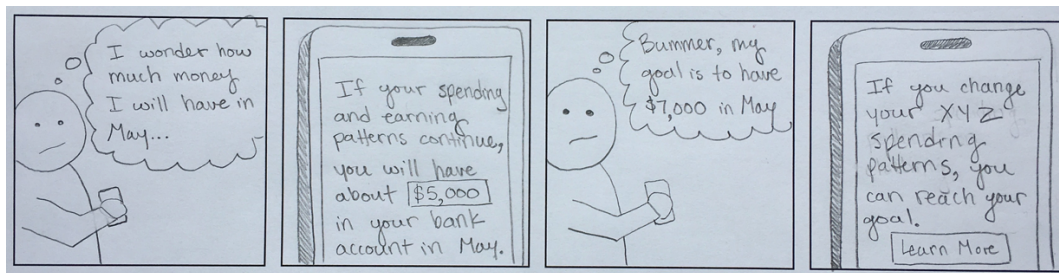
1. Thinking About Food Quality

This storyboard shows a shopper who can’t fathom how they spent so much on groceries, checks an app that breaks down their grocery spending, and realizes that most of their money is going to junk food— food that does not support their health. The shopper becomes less concerned about how much they are paying and more about how they are investing their money in their health.



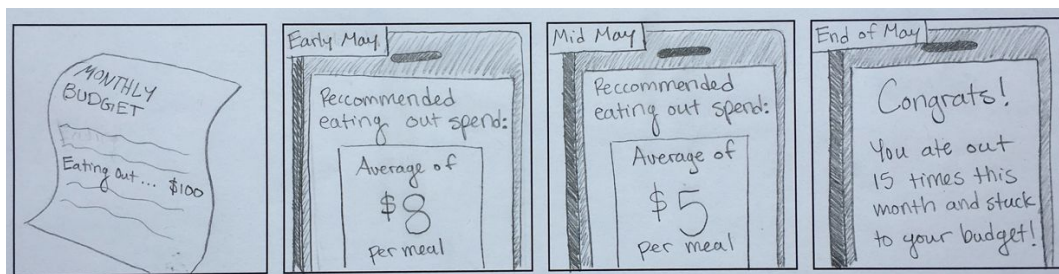
2. Forecasting Funds

This storyboard shows a consumer who is trying to figure out how much money they will have next month. They pull out an app and it tells them that if their spending and earning patterns continue, they will have \$5,000 in the bank. The consumer is disappointed because they were hoping to have more money at that point. The app then suggests spending changes that will help them reach their goal.



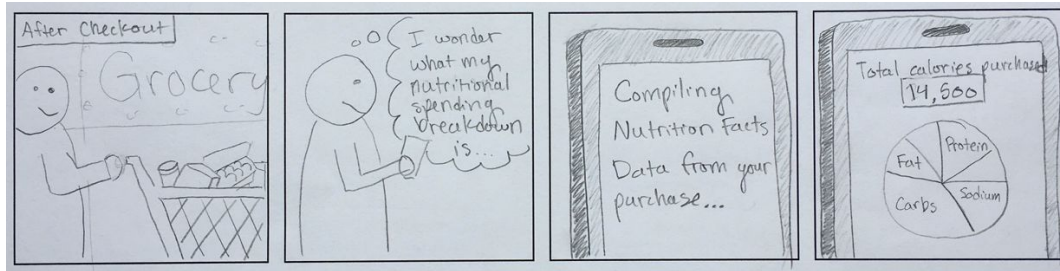
3. Recommended Average Spend

This storyboard shows an “eating out” monthly budget of \$100. Then an app, which is aware of the general frequency of the user’s eating out practices, suggests an average eating out spend of \$8 for the month. As the month progresses, the suggested average spend adjusts to keep the user on track to meet their \$100 monthly budget. At the end of the month, the app sends out a message that informs the user that they were able to go out to eat 15 times and still maintain their budget.



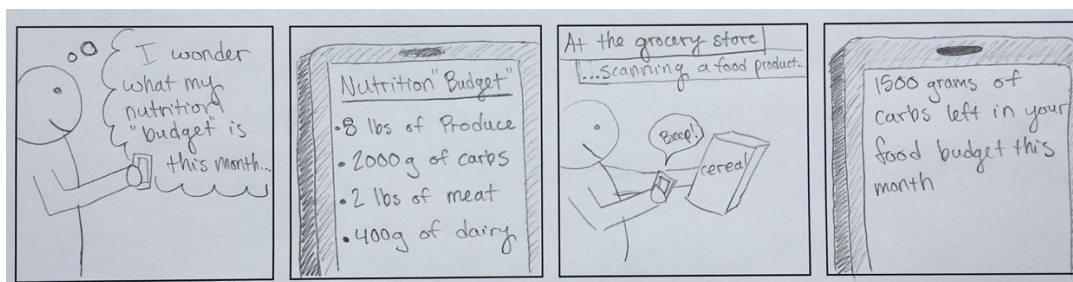
4. Nutritional Spending

This storyboard shows a grocery shopper who completed checkout and is curious about the breakdown of their nutritional spending. The app tells the shopper how many calories they purchased as well as the proportions of fat, carbs, protein and sodium in their purchase. The grocery shopper can see how they used their money nutritionally.



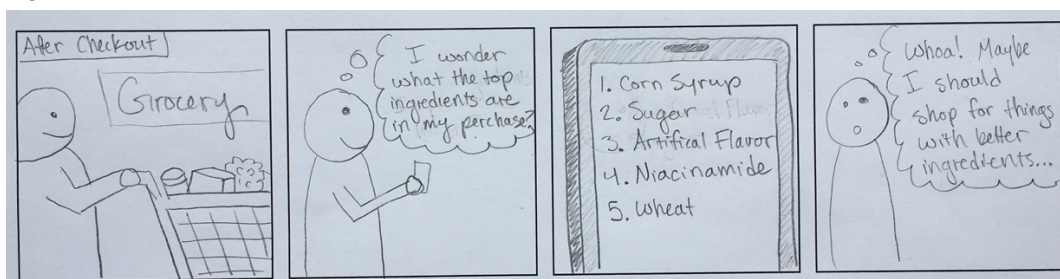
5. Nutrition Budget

This storyboard illustrates the concept of having a nutritional budget. Rather than a monetary budget, the user checks their nutritional budget to see how much produce, carbs, meat, and dairy is left in their budget. As they shop, they scan barcodes that instantly update the remainder of nutrition in the budget.



6. Most Common Ingredients

This storyboard shows a grocery shopper who has completed checkout and is curious about the ingredients in their purchase. They check their app and see that the most common ingredients in their cart are corn syrup, sugar, artificial flavor, niacinamide, and wheat. They are surprised and become motivated to shop for food with better ingredients.



Key Insights

1. It is hard to contextualize nutritional measurements and what they mean
2. Some claim that money is more important than nutrition
3. Participants acknowledge that their health consciousness is high but their health behaviors are lower

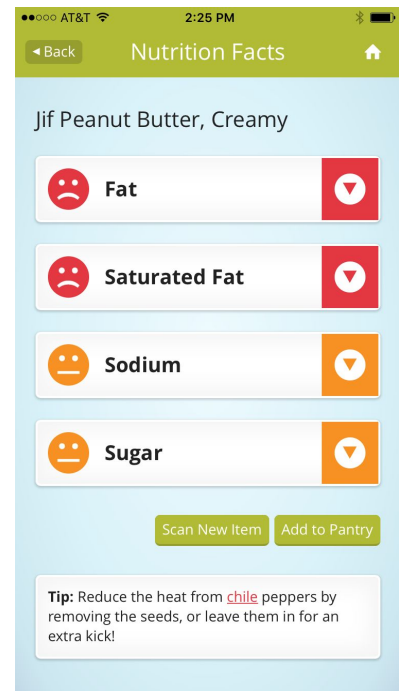
Exploring Existing Projects, Models, and Theories

Based on what I learned from the storyboard research, I realized that I need to think more about behavior change and how to design for it. I began exploring more literature and relevant projects.

Green Light Foods

I was introduced to Green Light Foods, an app developed by Phipps Conservatory and Botanical Gardens in collaboration with Carnegie Mellon University students, Red House Communications and Wahila Creative. The app helps consumers identify the nutritional profiles of food products so they can make healthy food purchasing decisions. It utilizes a traffic light model to indicate the levels of fat, saturated fat, sugar, and sodium in each product. According to Phipps Executive Director Richard Piacentini, research shows that

many people find it very difficult to discern whether or not a food is truly nutritious just by looking at the label. We wanted to see if we could make this process much easier for parents, caregivers and children, allowing them to quickly make healthier decisions while shopping at the grocery store (Lizarondo, 2015).



Stages of Change Model

Because several research participants indicated that their health consciousness was better than their actual health behaviors, my advisor recommended that I look to the Stages of Change model to learn more about behavior change (Norcross, 2011). I was able to conclude that most of the research participants were in the contemplation stage in relation to the purchasing of healthy food. This framework helped me scope down my thesis work to focus on consumers who are willing to consider a healthier approach to grocery shopping and design a tool that could help them transition to the determination stage, to commit to healthier shopping behaviors. From this framework, I learned that my solution needed to raise consciousness, to help users think, "This is serious. I need to do something about this," but also clarify that the decision is theirs (Norcross, 2011).

Nutritional Metrics

I began exploring healthy eating metrics. I found that there are many different ways to measure the health of food. Nutrition density, organic, minimally processed, non-GMO, low calorie—these are all different ways that people think of healthy food. I decided to follow the model that Green Light Foods used, which is to eliminate negative ingredients (salt, sugar, saturated fat,

and fat), because those are the ingredients that contribute to leading causes of death in the U.S. including cardiovascular disease and diabetes.

Chapter Summary

The insights from testing my concepts and storyboards helped direct my thesis and focus on the goal of behavior change—to help people take health and nutrition more seriously. Green Light Foods, the Stages of Change Model, and the sodium, sugar, fat, and saturated fat nutritional metrics guided the prototypes in the next steps of my thesis.

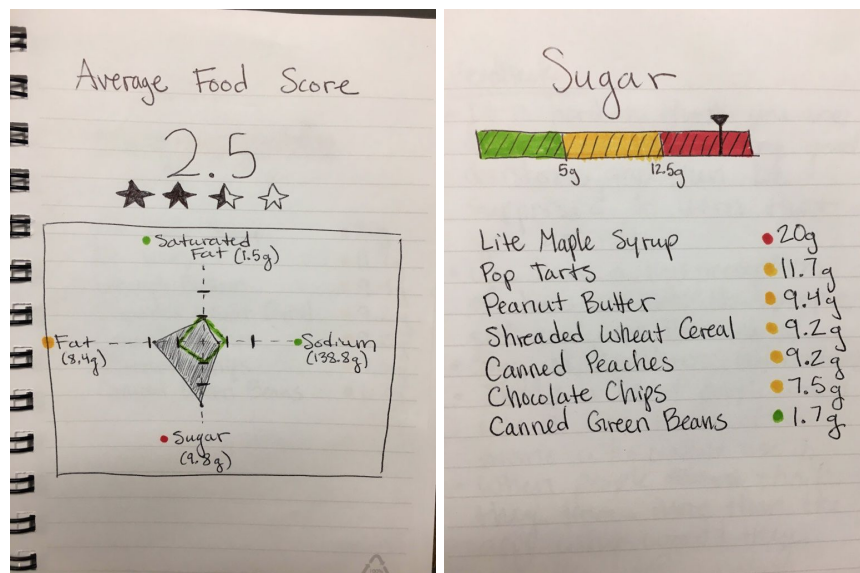
Chapter 4: Evaluative Research – Sketching, Low and High Fidelity Prototypes, and Evaluation

Introduction

I started making ideas to help people contextualize the purchase of sodium, sugar, fat and saturated fat. I began by sketching, getting feedback, then making low fidelity prototypes and later, high fidelity prototypes. I tested my prototypes to understand if they could help change the perception of healthy purchasing and if they communicated effectively.

Sketches

I began to think about a system that could help people quickly see how they are doing from a nutritional spending standpoint. I started exploring a visualization design that could compare the average fat, saturated fat, sugar, and sodium amounts in an entire grocery purchase to the amounts recommended by health authorities. I also came up with a high-level 4-star scoring system to help consumers instantly understand how well they were able to stay within the recommended amounts of these ingredients. Users could also learn how each individual product contributed to their overall score and overall averages.



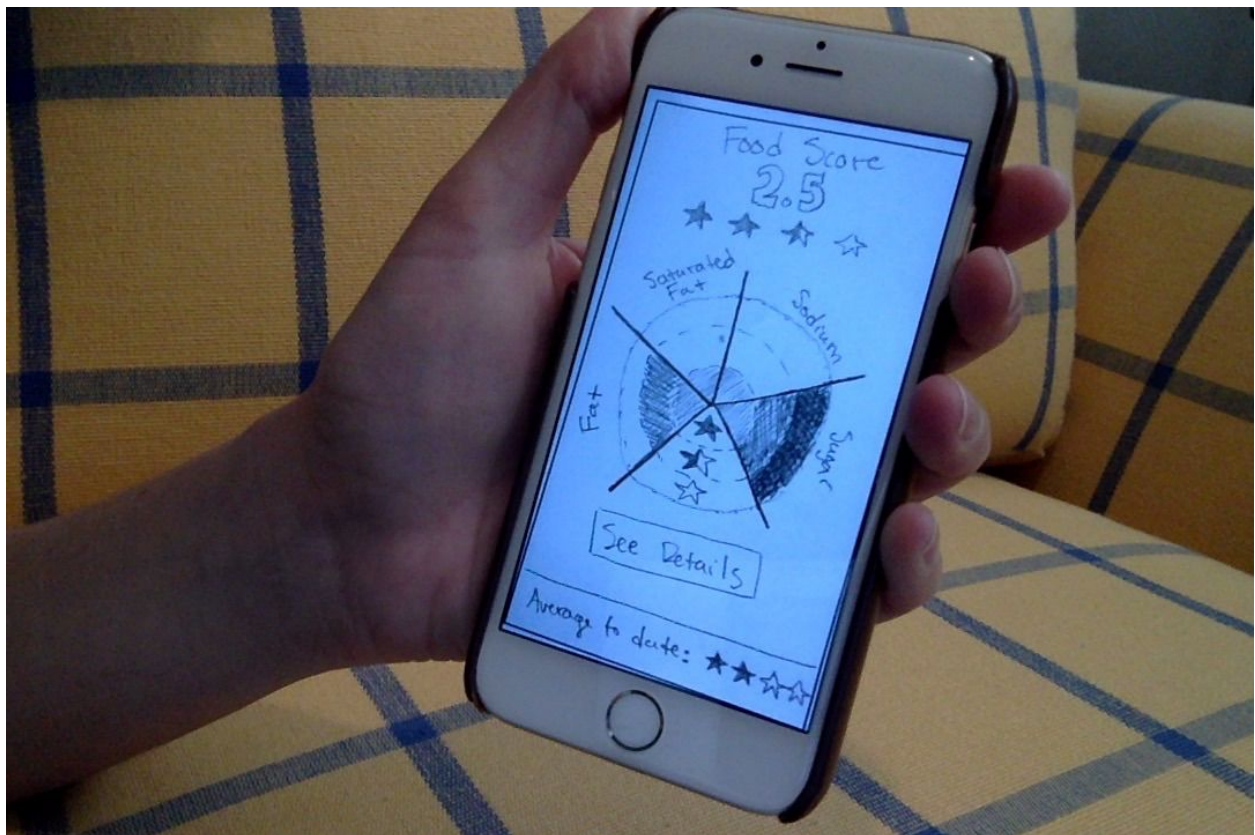
Testing

I got positive feedback from people I showed my sketches to. They acknowledged that often times there are misperceptions about how healthy we think we are eating compared to how we are actually eating and that this system can help people get a reality check. There were also concerns about the gap between purchasing food and actually physically consuming food. This concept does not measure anyone's diet, but only the food that they invest in. It is important to make that point clear because even though groceries may go to one household, everyone eats differently based on age, taste, etc.

Low Fidelity Prototype

I made a low fidelity working prototype by photographing sketches and making them interactive using Marvel's Pop app (<https://marvelapp.com/pop/>). It helped me think through the flow of information and contextualize the user experience to the shopping experience. I designed the prototype application to be used with the checkout process at a grocery store. The idea is that after all the groceries are scanned and paid for, the consumer would get a digital receipt that details the cost and nutrition of all the products. It also aggregates all of that information into a visual that shows the average amounts of fat, sugar, sodium, and saturated fat in the purchase, how those averages compare to the recommended amounts, and it shows an overall score.

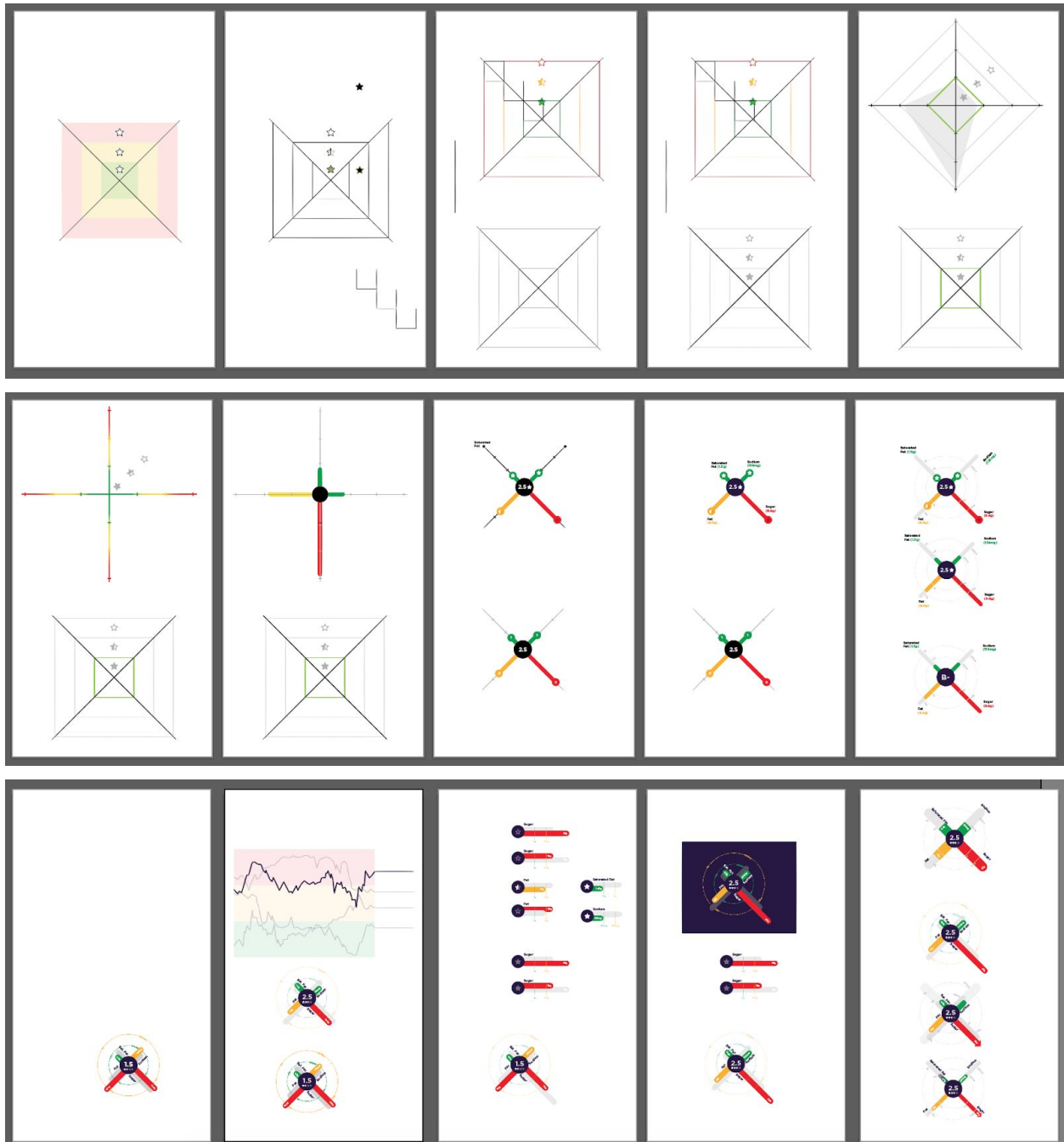
This prototype was helpful for me to think through how the tool could be effective for the user, however, I did not test this prototype with users because I did not want to focus on the digital interactions at this point. In order to make the prototype work, I had to make buttons and determine where to swipe, etc. But I did not want to test those things. I felt like I still needed to iron out the communication side of the design and make sure that the solution makes sense to people regardless of the digital interaction.



Iterations

I continued iterating on the communication design of the project. My first priority was to clearly convey the comparison between the actual ingredients purchased and the recommended amounts of those ingredients. Next I wanted to communicate a scoring system that helps people

quickly understand how their purchasing practices are doing in terms of health. As I continued to iterate, I realized that I could also visually compare recent purchasing behavior to overall purchasing behavior to help the user see if their purchase is regular or irregular, improving or getting worse. I also wanted to allow the users to see the actual measurements of each ingredient, in grams or milligrams, so they can learn to understand when numbers are high or low in the context of nutrition.

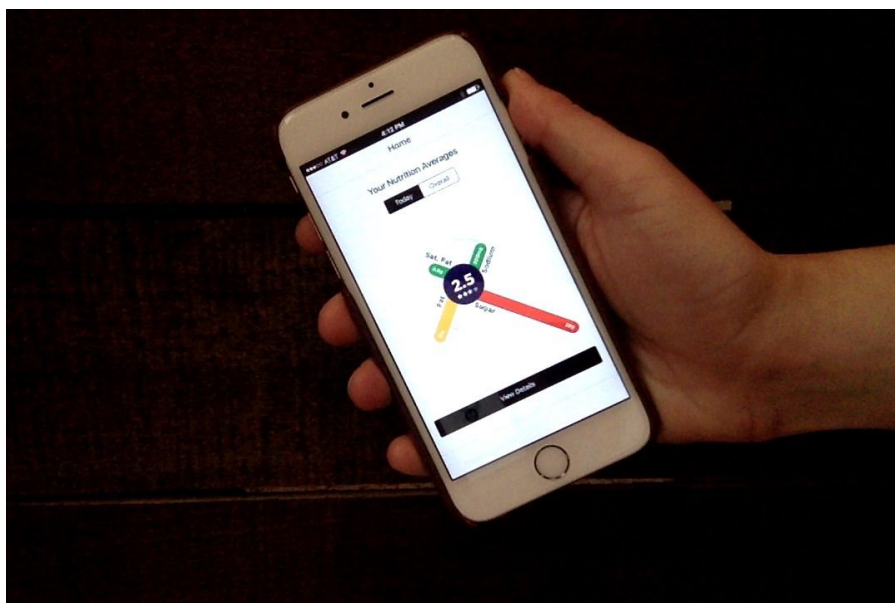




High Fidelity Prototype

High Fidelity Prototype

Once I was happy with the communication design, I decided it was the right time to make a high fidelity interactive prototype. I used InVision to make screens that allow users to toggle between their most recent nutrition averages and their overall nutrition averages. Other screens allow users to see the product breakdown for each of the nutritional categories so they can identify which products are highest in sugar, etc.



Evaluation

To evaluate the validity of my concept and prototype, I printed out blank versions of my graph design, gathered eight grocery items, and asked participants to fill out the graph based on what they think the average nutritional values of those eight products were. I also asked them to score the purchase with a 4-star system based on the content of sugar, sodium, fat and saturated fat. This exercise helped me compare users' nutrition perceptions to reality and judge how users perceive the scoring system. After that exercise, I showed them the prototype. I told them to imagine that they had just purchased the eight products on the table and that they are looking at an app that instantly analyzes that nutritional data from that purchase and provides that information along with their receipt. I asked them what they thought of the information in the prototype.



Feedback

Almost every participant disapproved of the scoring system. Some said it needs more context to understand how the score is calculated, others said that they are skeptical of the star system or find it deceiving.

Most participants named other ways that they determine whether or not their diet is healthy. They talked about natural sugar versus refined sugar, processed versus non-processed food, protein, vitamins, etc. Not everyone related to the salt, sugar, fat, and saturated fat model.

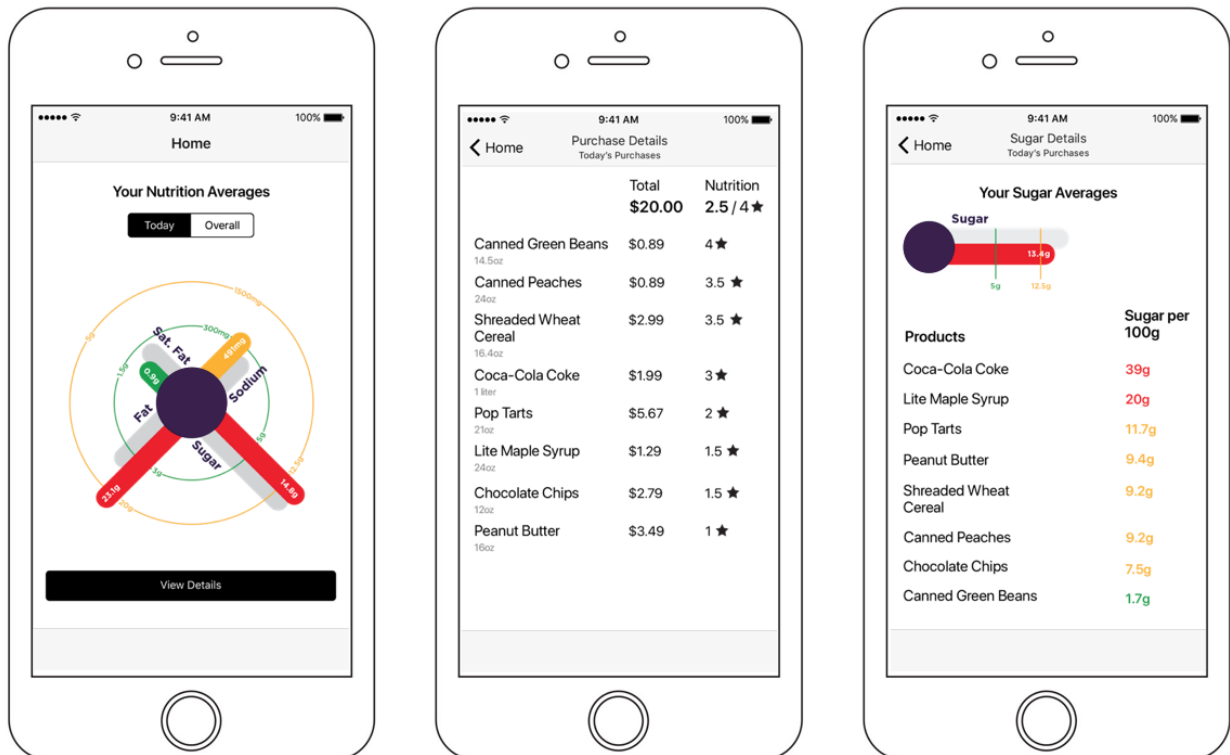
Chapter Summary

Through iteration of communication design and prototyping interaction, I learned how to use visual information to convey the comparison of a consumer's purchased nutrition to recommended nutritional standards. Testing my prototypes helped identify strengths and weaknesses in my design.

Chapter 5: Final Iteration and Summary – Impact and Behavior Change

Introduction

In my final solution, I removed the scoring mechanism and kept the focus on the comparison graph. After completion of the project I reflect on what I learned and how my project could make a difference in the world.



Reflection & Evaluation

As I reflect on this project, I think about the design process and how it has the flexibility to pivot throughout the process to land on a solution that can help solve a very human problem. My project took a technological approach to a solution, which is another way for people to spend more time looking at a screen. I'm a bit concerned about that, but the tradeoff is that perhaps people will be able to live more nutritionally healthy lives as a result.

Conclusion

The project helps users think more about their current food purchasing behaviors and learn specifically how positive or negative their food purchasing behavior actually is. It helps contextualize nutritional measurements and helps users answer the question, "Am I doing ok?". The solution can help users transition from the contemplation stage, where they haven't yet

decided to make a change, to the determination stage, where they make a decision to change their behavior. However, the concept needs to be pushed to the contemplation stage users, because they are not at the point when they would be seeking out such information. This would be most effectively pushed to these users by adding nutritional information to the financial information on a receipt after purchase. With exposure to this information the transition to the next stage will more easily occur.

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