

# **Design and Food Practices**

**Encouraging Sustainable Food Choices through Persuasive Design**

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## Encouraging Sustainable Food Choices through Persuasive Design

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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特别感谢我的爸爸妈妈, 谢谢你们无私的支持和培育, 让我能够安心学习, 顺利完成学业。

Finally, I am grateful to my cohort in the School of Design for sharing our frustrations and vulnerability together throughout this journey.

## Abstract

Human food production and consumption is a leading cause that contributes to climate change. Although systematic transformations are imperative to tackle sustainable issues, individual food-related behaviors can be significant drivers for larger systematic changes. However, the complexity of individual food choices proposes challenges for sustainable dietary transitions due to cultural and market forces, high barriers to nutritional knowledge, and a variety of motivations behind a single food choice.

The thesis investigated how persuasive design might support a shift toward more sustainable food practices for individuals with different dietary motivations. Through the literature and artifact review, I studied how persuasive design can implicitly change food-related behaviors with the psychological and social theories behind it, and identified the opportunities, challenges, and gaps in current food systems and existing tools. I conducted contextual inquiries, diary studies, and generative activities with participants to better understand their behaviors, mindsets, and attitudes in a variety of scenarios throughout their food experiences. As a result, I explored potential concepts and designed an alternative food experience to demonstrate how people may learn climate footprint in food through social interactions. In conclusion, persuasive messages for food sustainability can be more effective if the design leverages multiple persuasian techniques and encourages active participation from users.

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# INTRODUCTION

## Overview

Human food-related behaviors play an important role in environmental changes—both at the global level and individual level, and from the initial production stage to final consumption. As a leading cause of climate change, agriculture generates many global environmental changes through food production, such as deforestation, species extinction, and greenhouse gas emissions.

While large-scale, top-to-bottom transformations—such as infrastructure and policy change—are imperative to tackle sustainable challenges, individual food-related choices are also critical to the problem. Individual actions do not require approval from higher authorities. In fact, changes to individual behaviors and mindsets can be significant drivers of larger systemic or policy-based changes. Although it is not solely individual responsibility to face the global crisis, individual actions can be considered “as a form of communication, as an invitation for others to join you, then your actions can lead to other actions that can actually lead to change” (Poon, n.d.).

Individual food consumption can have major impact, but behaviors are difficult to change due to the profound cultural, social, and historical implications of food. Cultural and market forces, high barriers to nutritional knowledge, and the complexity of motivations behind choosing one diet type can make dietary habits difficult to change. At the same time, individual ecological impacts are almost imperceptible because climate change is an aggregate and gradual process. The lack of immediate feedback can further impact low motivation in changing diet habits. All elements above build up the complexity of changing food-related behaviors.

This thesis investigates how persuasive design can play a role in changing individual food choices. Persuasive design focuses on psychological and social theories to influence human behaviors and attitudes. Specifically, this thesis employed the embedded design approach to implicitly persuade people by concealing or interweaving the real intention (Dr. Kaufman’s Special Topics: Persuasive Design in HCI, Fall 2021). Many people feel guilty when they realize that their lifestyles impact the environment negatively, but implicit persuasion can bypass the resulting self-defense mechanism related to sustainability. I hypothesized that implicit persuasion can make sustainable mindsets and practices more accessible to individuals.

## Research Question

The thesis aims to design an experience that provides individual autonomy in making food choices available, and reduces the negative environmental impact of individuals' diets. I explored the following question:

**How might persuasive design support a shift toward more sustainable food practices for individuals with different dietary motivations?**

More specifically:

- What are existing patterns in motivations for food choices and dietary transitions, especially the ones that are eco-friendly?
- How do people prioritize various values associated with food sustainability at the moment of decision-making?
- How does current food production and consumption, both on individual and industrial levels, impact environment?
- How do people view, understand, and practice food sustainability (compared to sustainability in general)?
- What are the advantages and limitations of persuasive techniques, and how can they be leveraged in supporting sustainable food practices for individuals?
- How might design balance sustainability with other food-related values associated that can have negative environmental impacts (e.g., eating beef associated with being strong and fit)?

## Scope and Limits

Food impacts the environment in various ways: greenhouse gas emissions from meat and dairy industries (the destruction of forest ecosystems, livestock digesting food, etc.), labeling, packaging, food composting, local food, gardening, and consumers' perceptions of food (shape, size, color, etc.). This thesis project mainly focuses on purchasing decisions, diet, and other experiences that have strong connections with daily activities and decision-making in individual food consumption.

Design opportunities in agriculture and food production are important for addressing the significant impacts resulting from larger systems. However, they are not the focus of the thesis project. Questions of food and agricultural policy are outside of the scope as well.



## Design Process

I studied published works in design and decision-making literature to learn about persuasive design theories and experiments, systematic overviews, challenges, and opportunities. I conducted contextual inquiries, diary studies, and generative activities with participants to better understand their behaviors, mindsets, and attitudes in a variety of scenarios throughout their food experiences. Lastly, I developed an interactive prototype for a potential intervention to help support sustainable dietary transition.

In this thesis, I propose a novel food experience leveraging social interaction scenarios as a case study for how designers can apply persuasive techniques to encourage sustainable food transitions for individuals. The intervention provides an alternative way of social gathering on the surface, while subtly expanding users' decision-making strategies for supporting food sustainability.

# EXPLORATORY RESEARCH

## Literature Review

I began exploring the problem space through the review of literature in the domain of persuasive design, and food sustainability on both systematic and individual scales. The literature helped me understand the effectiveness of current and potential approaches to sustainability, and identify the psychological framework and techniques for habit forming, behavioral change, and decision making. My literature review helped me understand three key relevant aspects of my problem space:

- persuasive strategies & psychological theory,
- potential opportunities for food sustainability, and
- systematic challenges to sustainability in the current food landscape.

### Persuasive design theories to influence purchasing decisions and habit formation

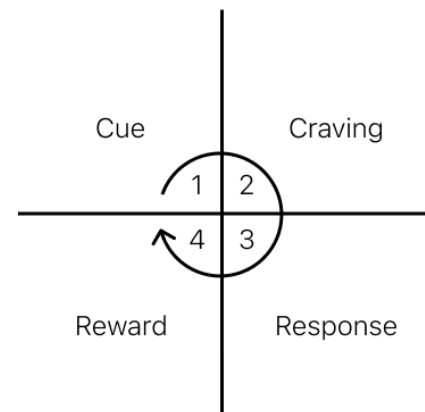
**Atomic Habits** reveals how to build small but impactful long-term habits through changing the system and providing tools and techniques to transform habits. Changing a habit is not just achieving goals, but also changes in mindsets and identities. Identity change is core, and it is achieved through changing habits (Clear, 2018).

The habit loop (Fig. 1) is the foundational model of the book. It demonstrates that all habits form through four stages: cue, craving, response, and reward (Clear, 2018, pp. 47-53).

1. The cue is the information that signals a potential reward to our brain and triggers an action.
2. The cravings are our motivation behind the action. It is our reason or desire to act in order to get the reward.
3. The response is the action we take or habit we perform to obtain the reward.
4. Rewards are the feedback that reinforces the desire for a habit.

For my area of inquiry, craving is a tricky step in the habit loop. Motivation for food varies based on individuals. Genetically, our brains naturally crave high-calorie food for survival. In today's society, the motivations behind food choices are highly complicated. Some crave joy from the flavor and texture of food. Some crave the emotional memory connected to certain dishes. Some crave their ideal body weight from low-calorie food (Clear, 2018, pp. 131-133). How might we transform the cravings for food in favor of sustainability?

Rewards are the satisfying feedback that is provided for the effortful actions. For my thesis, the reward is a critical step because the benefits from changing diet are usually not immediately perceivable, such as health, body shape, mental state, or even productivity. Meanwhile, Clear discussed the concept of "time inconsistency" where our brain values



**Fig. 1** The Habit Loop

present rewards more than future rewards. Therefore, it is difficult to complete the feedback loop and form new diet habits due to the last step. People do not have much control over the rewards/feedback from dietary change, which leaves more room for design opportunities.

This framework provided me with a systematic view of the framework and techniques to create good diet habits and food consumption behaviors and break bad habits.

Another similar model that helped me understand attitude and behavior change is **Transtheoretical Model** (Dr. Kaufman's Special Topics: Persuasive Design in HCI, Fall 2021). While both models are based on a circular path of behavioral change, this model presents a thorough and detailed process of the change of attitudes and actions during a behavioral change in the following six stages (Fig. 2):

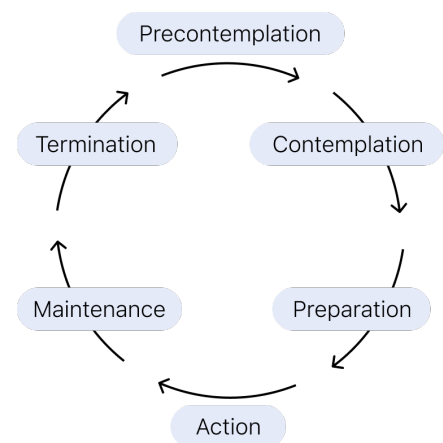
1. Precontemplation: No intention, no actions
2. Contemplation: forming an intention, action in the foreseeable future
3. Preparation (Determination): a strong belief in healthy belief, ready to take action but may need guidance
4. Action: changed behavior, intend to keep moving forward by modifying current behaviors and acquiring new healthy behaviors
5. Maintenance: sustain the behavior for a while, intend to maintain, but may relapse to earlier stages
6. Termination: No desire to return to previous behaviors, rarely reached.

This model is helpful in assessing which stages can be a potential beginning or ending for sustainable food practices.

These two models together helped me generate a more simplified model (p. 19) to understand dietary transitions and figure out the focus of the thesis when synthesizing the exploratory research.

Additional research papers on persuasion techniques include **Increasing Security Sensitivity With Social Proof: A Large-Scale Experimental Confirmation**. It indicates that social proof can potentially change users' behaviors on security features by leveraging social announcements of the intended behaviors among their friends. Social proof is "our tendency to look to others for cues on what to use and how to behave" (Das et al., 2014, p. 1). This learning aligns with the technique suggested in *Atomic Habit* of leveraging potential social groups: "the close (family and friends), the many (the tribe), and the powerful (those with status and prestige)" (Clear, 2018, p. 122).

**Thinking, fast and slow** discusses how people make decisions in personal lives and businesses through psychological and economic theories. The first chapter, "The Characters of the Story," presents a fundamental theory of decision making by describing two modes of thinking: System



**Fig. 2** The Transtheoretical Model

1 and System 2 (Kahneman, 2011):

System 1 thinking is the automatic, unconscious, and fast thinking that requires little or no effort. Examples include picking up items of the same brand in the same location in the grocery store every time we go grocery shopping.

System 2 thinking is the conscious, reliable, and slow thinking for effortful mental activities. Examples include analyzing food labels on packages to inform food purchasing decisions.

Our habitual behavior is operated by system 1 thinking, which is effortless and immediate. When changing a habit, the interaction between the two systems constantly happens as people effortfully challenge their old beliefs, learn new knowledge, and consciously modify their behavior (Fig. 3). As Kahneman states, "System 2 is mobilized when a question arises for which System 1 does not offer an answer..." (Kahneman, 2011, p. 24).

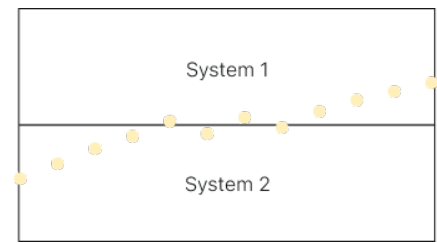
The book brought me insights into how our brain allocates our limited mental capacity, and how people make decisions in their food choices. It provided me with the knowledge to consider the context to activate system 1 or system 2 thinking in order to change food consumption habits.

### Potential opportunities for food sustainability

Opportunities exist at the level of consumer awareness and behavior to make an impact on food sustainability. In *Consumer Attitudes Towards Environmental Concerns of Meat Consumption: A Systematic Review*, the authors investigate consumers' attitudes and meat consumption behaviors in relation to environmental motives with the focus on three main stages of behavioral change: awareness (pre-contemplation), willingness (contemplation and preparation), and change/actions (action, maintenance, and termination). The result demonstrates a low awareness of the environmental impacts of meat production and consumption, and a low willingness to reduce meat consumption for environmental reasons. In terms of the demographics, consumers who already reduced meat consumption are "female, most likely young, partial meat limiters and reside in Europe" (Sanchez-Sabate & Sabaté, 2019, p.5).

One of my biggest takeaways from this paper is that the potential large consumer group to target "are those not ready to give up meat, but who have, or are willing to consider reducing meat consumption," also known as "meat reducers or flexitarians" (Sanchez-Sabate & Sabaté, 2019, p. 2). While vegetarians and vegans have received much attention for decades, meat reducers have been rarely studied.

In *Psychological effectiveness of carbon labelling*, the author believes that carbon labelling is not effective right now, but we can increase the effectiveness of carbon labelling in the future to make people respond to carbon information with both system 1 and system 2 thinking. He suggests that calorie and fat content on current food labelling triggers emotional meaning to consumers due to the concrete and



**Fig. 3** System 2 thinking repeats frequently and form into system 1 thinking

personal impacts on our bodies. At the same time, emotional responses are key with shopping when time is very limited and information is overloaded. According to Beattie, "We need to make carbon labels more psychologically salient and make sure that they impact on both the automatic and more rational systems" (Beattie, 2012, p. 3). Leveraging elements that trigger emotional responses may help people repeat system 2 thinking and eventually form system 1 thinking for sustainable food actions.

The sustainable food experience presented in *Designing sustainable food experiences: Rethinking sustainable food tourism* was particularly inspiring for my thesis. The author believes that designing sustainable food experiences in the field of food tourism has the potential to "inspire more sustainable food consumption and anti-consumerist lifestyles" (Leer, 2020, p. 66). He describes the food experience that took place during his students' visit to Faroe Island in their study tour and demonstrates the importance of participatory food experience and alternative economic models based on it.

My biggest takeaway from this paper is that designing food experiences with a focus on participation is critical for the transition to long-term sustainable food practices. For example, during the study tour, the students were involved in the process of foraging, cooking, and manual labor of the food materials which they ate later. In this experience, the role of participation and sharing "has a potential for disrupting the understanding of the consumer as a passive role" (Leer, 2020, p. 67). Instead of traditional passive dining, this tour enables participants to obtain hands-on sustainable skills and collect food materials in their original forms through collective cooking and sharing. The form and depth of participation left larger impacts compared to a traditional food experience, because it made it easier for participants to adapt the experiences and skills when they returned home.

Another insight was that sustainability in food tourism encompasses social, economic, and cultural considerations (Leer, 2020, p. 66). The premise of sustainable design in food tourism is that the carbon emission from traveling cannot be offset by eating more sustainably during the trip. However, designers in food tourism can focus on the universal potential of local sustainable practices and alternative modes of participation, provided that people are going to travel or keep certain habits. For my thesis, the goal is not to make individual food consumption carbon neutral, but to leverage existing experiences, even the unsustainable ones, to educate and inspire long-term sustainable behaviors.

When explaining why the students' food experience was innovative, the author mentioned "... there was little talk of sustainability. Sustainability was performed rather than addressed, it was 'done' rather than 'said' " (Leer, 2020, p. 77). This point supports my argument to utilize implicit persuasion in the designed experience so that users do not face the term, "sustainability", but experience it in person.

## Systematic challenges to sustainability in the current food landscape

***Net Zero: principles for successful behaviour change initiatives*** is a research paper on key principles from past government-led behavior change and public engagement initiatives in various aspects of daily life. In the diet changes section, while it suggests a larger role for interventions on upstream and midstream strategies and a less important role for downstream intervention for individuals, it also emphasizes the importance of shifting dietary habits (Londakova et al., 2021, pp. 42-43). Ideally, interventions for individual dietary change should support the large-scale systematic change in order to achieve environmental benefits.

The paper provided me with one important insight: “food consumption is a largely automatic, habit-based behavior, strongly driven by cues in our environment” (Londakova et al., 2021). This confirms that most individuals’ food choices utilize system 1 thinking. The reliance on environmental cues also aligns with the idea of habit from Clear (2018): “Every habit is context dependent” (p. 83). Therefore, unsustainable food choices are more than individual responsibility. Design for individual dietary transitions needs to consider the complexity of the existing food landscape.

***What the Health*** is a documentary that exposes the collusion and corruption between the US government and big businesses that sacrifice consumers’ health and mislead our concept of a healthy diet (Andersen, 2017). It advocates for a plant-based diet for health purposes. The documentary infers the need of supporting individuals to make sustainable and healthy food choices when facing widespread misleading information and the broken food system.

In ***Designed Pleasure, How Advertising Is Selling Food as Drugs***, the author argues that the pleasure-driven advertising for highly engineered food imitates that for illicit drugs. The food industries maximize their profit through advertising physical pleasure and social aspects of food, and engineering food to make it addictive (Vodeb, 2015). Although a food is high in sugar, salt, and fat, this does not always mean that it has negative environmental impacts. Many highly engineered food is processed food that required extra resources to produce.

These two sources both reveal that systematic forces in food industries make it difficult for individuals to change their dietary habits. This validates my argument that we need to empower individuals to navigate through the manipulative food systems.

## Artifact Review

Many interventions already exist to combat sustainability issues, whether reducing food waste, raising consumers' awareness, or displaying climate footprint information. I was able to identify the following three categories of tools that may help users transition to a more sustainable diet.

### Alternative Services to Reduce Food Waste

#### Too Good To Go

Too Good To Go is a mobile app that fights food waste by connecting customers to restaurants and stores that have unsold food surplus. Businesses, including restaurants, bakeries, supermarkets, etc. can add food surplus they have. Users can access food at more affordable prices within the app. Globally, Too Good To Go has millions of users.

#### Imperfect Foods

Imperfect Foods is a grocery delivery service that eliminates food waste. It started with selling "ugly" fruits and vegetables that don't meet store standards and expanded to include products with surplus inventory, size or weight imperfections, and many other imperfection reasons. It provides summaries of positive environmental impacts that users made on their platform.

### Tools with Carbon Footprint Focus

#### Footprint Calculator

Footprint Calculator is a quiz to estimate the ecological footprint of individual users by asking questions about their life consumption and lifestyle. The result indicates the number of earths that would be required to support the world's population if everyone lived in the same way as the user. It also provides data on ecological footprint and carbon footprint, shows results by land type and consumption category, and compares their results to countries.

Not all data can be easily interpreted and understood. The web merely presents information and does not provide actionable advice for users to change their behaviors. The burden of research and learning is on users in this tool.

#### CarbonCloud

CarbonCloud is a webpage to search for the carbon footprint of specific food items based on geographical location and production stage. They also offer API for third party apps.

It simply displays information for each food item. There's no comparison between the carbon footprints of different food products.



**Too Good To Go**

**Fig. 4** Too Good To Go is a mobile app that addresses food waste.



**Fig. 5** Imperfect Foods is a grocery delivery service that sells "ugly" produce.



**Fig. 6** Footprint Calculator estimates individual ecological footprint through a quiz.



**Fig. 7** CarbonCloud is a webpage for searching food's carbon footprint information.



## Carbn

The app measures users' carbon footprint through onboarding questions and motivates users to cultivate ten personalized sustainable habits. Users can compare their progress with other users through leaderboards, and exchange GreenMiles for sustainable products.

Under My Profile, users can check the overall and breakdown data of their carbon footprint, as well as a comparison to the global average. The app explains users' carbon footprint by the number of trees it takes to absorb their carbon footprint.



**Fig. 8** Carbn is an app that helps users cultivate sustainable habits.

## Carbon Information Embedded in Platforms that don't prioritize sustainability

### Chipotle Real Foodprint

Real Foodprint (Fig. 12) is a sustainability impact tracker that introduces detailed data about its ingredients (carbon, water, soil health, etc) at the order confirmation screens.

### Google Flights carbon emission

Google Flights search results display carbon emission estimates for users to make more sustainable flight choices.

## Habit Forming Tools as Potential Dietary Transition Support

### Fabulous

Fabulous is a habit tracking app that uses behavioral science to help users build healthy habits. It enables users to plan daily routines and provides habit suggestions on a variety of topics. It also includes additional features like challenges, audio coaching, and circles for sharing and socializing.

The combination of goal setting, routine planning, and small challenges empowers users with a sense of autonomy and competence in habit-changing. However, the app allows multiple habits tracking at the same time, and is not targeted toward dietary habits only. The behavioral changes in diet solely depend on users' motivation.



**FABULOUS**

**Fig. 9** Fabulous is a habit tracking app for all healthy habits.

## Gaps

### Current positive feedback on sustainable food behaviors mostly does not trigger users' emotional responses.

The forms of positive feedback on users' sustainable behaviors are mostly numbers and common data visualization diagrams (Fig. 10–15). Users most likely do not perceive these types of feedback to have strong personal impact. The feedback may not trigger users' emotional response, so they are not effective (Beattie, 2012).



Fig. 10 Imperfect Foods interface

Name	Organization	Category	Market	Stage	Footprint
MilQ	KeenWah MilQ	Food product	Australia	Unspecified	<b>0.37</b> kg CO <sub>2</sub> e/kg
MilQ Chocolate	KeenWah MilQ	Food product	Australia	Unspecified	<b>0.50</b> kg CO <sub>2</sub> e/kg
Almond milk	CarbonCloud Benchmark	Benchmark food product	Australia	At store	<b>0.62</b> kg CO <sub>2</sub> e/kg
Milk chocolate	CarbonCloud Benchmark	Benchmark food product	Finland	Unspecified	<b>5.2</b> kg CO <sub>2</sub> e/kg
Milk chocolate	CarbonCloud Benchmark	Benchmark food product	Sweden	Unspecified	<b>4.5</b> kg CO <sub>2</sub> e/kg
Milk chocolate	CarbonCloud Benchmark	Benchmark food product	United Kingdom o...	Unspecified	<b>5.0</b> kg CO <sub>2</sub> e/kg

Fig. 11 CarbonCloud interface

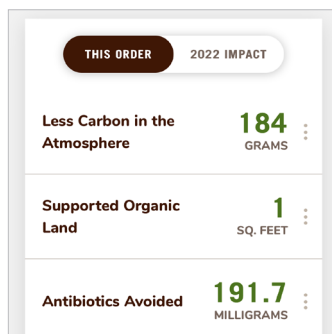


Fig. 12 Chipotle interface

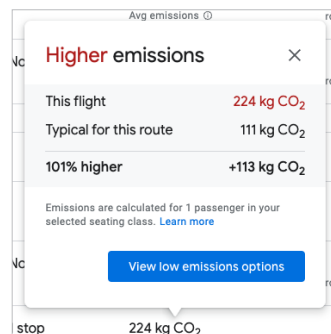


Fig. 13 Google Flights interface

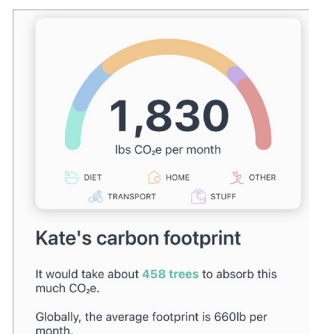


Fig. 14-1 Carbn interface

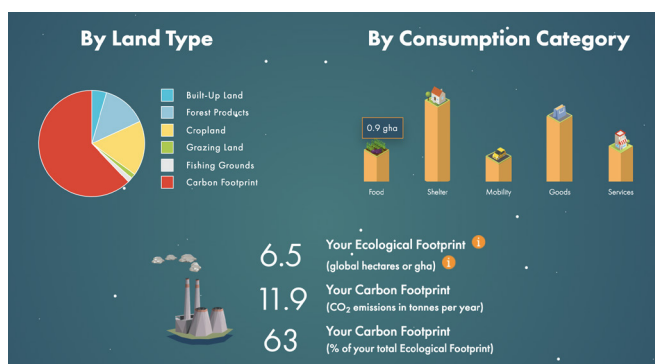


Fig. 15 Footprint Calculator interface

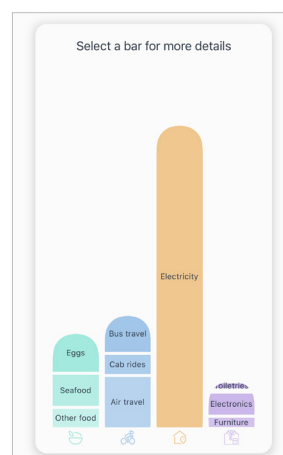


Fig. 14-2 Carbn interface

**Alternative food services do not educate users on how to make food choices based on climate footprint information through the perspective of persuasive design.**

Imperfect Foods and Too Good To Go are effective in changing users' mindsets on food systems. For example, users may be more open-minded to imperfect food products or purchasing groceries or meals from niche channels. However, both services rely on users' initial incentive of saving food waste to start using the service.

## Contextual Inquiry

I conducted contextual inquiries with 5 participants at the grocery stores of their choice. Because I intended to use my early research to help me narrow in on a specific audience, for these sessions I included individuals with a variety of diet habits, demographics, and sustainable practices.

My goal for contextual inquiries was to answer the following questions:

- **How do people make purchasing decisions at grocery stores?**
- **What are the motivations behind choosing different food items/products? What are the patterns in motivations?**
- **Knowing the impacts of manipulative food industries, how do people navigate through the information to make food choices currently?**
- **How do people understand food sustainability? Is it different from sustainability in general?**

### Part 1: Gathering background information

In order to gather background information and screen participants, I asked participants questions on general information about their **diet habits and transitions** either in person or through Zoom. The underlying goal of the conversation was to make sure that the participants shop at grocery stores regularly. Participation in this part took approximately 30 minutes. Responses were captured as transcribed text through voice recording. The key questions included:

- Tell me about your diet generally.
- What is your diet type? Why do you follow this type of diet?
- What challenges do you face having this type of diet?
- Did you experience dietary changes gradually or significantly? How did it change? Why?
- How do you motivate yourself to change your diet?

## Part 2: Observation

Once I had gathered background information about the participants, they each joined an observation session at a scheduled time. The first part included a standard shopping trip with each participant in his or her typical shopping location. I prompted participants to think aloud about their decision-making process and asked questions related to their purchasing decisions and understanding of food sustainability. Key questions included:

- How do you understand the term “xxx” on the package?
- Why did you choose this item among other similar products?
- Is there any other information that you would like to learn more about in order to decide what to buy?

The second part of the observation included a tour of the participants’ kitchens, either in person or remote, given the participants’ permission. The time for each observation session varied from around 1-2 hours depending on the time each participant usually spends on grocery shopping.

## Part 3: Follow-on questions

After observation sessions, I asked the participants a set of follow-on questions. Participation in this part took approximately 20 minutes. Responses were captured as transcribed text through voice recording. Key questions included:

- Is there anything integrated into your diet habits that I didn’t see related to your decisions in sustainability?
- On a scale of 1-8, 1 is “I don’t know anything” and 8 is “I am well immersed,” how would you rate your understanding of sustainability in food? What makes you feel like you understand it at this level?



**Fig. 16-1** Observation



**Fig. 16-2** Observation

## Diary Study

I conducted diary studies with 5 participants concurrently. My goal for the diary studies was to answer the following questions:

- **How do people make decisions on daily food choices?**
- **How do people understand their relations with food and its impacts on their well-being?**
- **How do social and cultural aspects impact people's decision-making on food?**
- **What are current sustainable practices?**

### Process

I asked each participant to choose 2 typical workdays and 2 typical days off to conduct the diary study remotely. During the 4 days, I asked participants to record a video or photo of every meal, and describe whether they were by themselves or with other people, whether they were having this meal for any special reasons, and, if so, why. After participants sent me the information about each meal, I prompted them with a few questions to answer through google forms. The prompts included:

- Why did you choose the food? What were the biggest factors?
- In an ideal world where there is no time/energy/cost constraint, how would you envision your ideal diet?
- How do you think this meal can potentially impact the ecological environment?
- Today I am particularly interested in the environmental impacts of food. Any time you think about food from an ecological perspective, make me a video or send me a message to explain your thoughts and the reasons.

What's the thought process of choosing this meal? What are the biggest factors?	there is no time/energy/cost constraint, how do you want to change this meal?	How do you think this meal can potentially impact the ecological environment?
These are some of the materials I bought on Monday, and if I don't find a time to cook it they'll perish. I foresee that I might dine out at lunch and dinner so I better cook it in the morning. I guess my consideration is to clean up the fridge, and this is also not a complicated dish to prepare.	I love to add more veggies and fresh ingredients to this dish. For example, I would mix potatoes and ground beef and add some tomatoes on the top. I'd also like to make the guacamole myself.	Usually, only the expiration date.
My friend liked ramen, we shopped at the mall before lunch and this ramen place is pretty close so we just went for it.	I hope the portion of noodles is smaller so that I can try more side dishes. Having a balance in a meal is super important to me but there's only carb and meat in ramen...but I just don't have the budget and appetite to have other food.	I assume that the raw materials in ramen are imported from Japan so that the carbon footprint might be massive.

**Fig. 17** Diary study responses

## Synthesis

After the contextual inquiries and diary studies, I synthesized participants' key responses into insights that informed my evaluative research and final design. The synthesis included affinity diagramming of the responses, which are summarized into the model of dietary transitions, existing challenges in sustainable diet transition, and other potential opportunities.

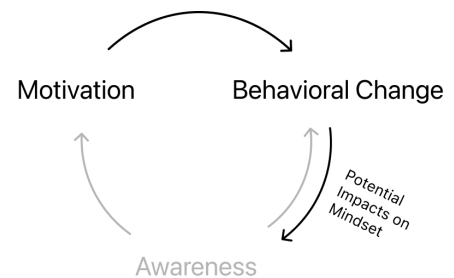
### Model of Dietary Transition

Based on the habit loop in *Atomic Habits* (Clear, 2018, p.50) and the transtheoretical model (Dr. Kaufman's Special Topics: Persuasive Design in HCI, Fall 2021), I created a simple model to help me better understand the insights and narrow down the problem space of the thesis (Fig. 18).

**Dietary transitions often accompany life transitions. The motivations for positive dietary transitions are usually caused by moments of realization and moments of crises:**

Moments of realization happen along with gradual and long-term life transitions, such as getting into college, adopting a pet, or dating someone new.

Moments of crisis mean the type of transitions in food practices caused by specific events that usually trigger unpleasant emotions, such as watching a documentary or reading a book that brings awareness of food sustainability.



**Fig. 18** My model of dietary transition

**Behavioral changes in diet can lead to new awareness change, or a shifting sense of identity, regarding food practices which can further induce new behaviors.**

A behavioral change can start without environmental-related motivations, but perspectives on food sustainability can change as the behavior changes. For example, one participant started a more plant-based diet to reduce her anxiety. As she learned to cook differently for health reasons, she learned about environmental impact. This route can be a non-aggressive way to raise awareness of sustainability.

***"I cook more after becoming a vegetarian, and it made me appreciate vegetables a lot more."***

***— from a vegetarian participant***

**Multiple motivations can go behind a single food choice or dietary type, including health conditions, animal rights, fitness goals, and environmental impacts.**

These motivations make changes in food practices complicated but provide opportunities for leverage points. There is no "one size fits all" solution, but multiple leverage points can be involved in one intervention.

## Existing Challenges in Sustainable Diet Transition

**Short-term food choices are easier to change, but long-term dietary habits are more important for individuals' sustainable transition.**

Single meals can not reflect an individual's overall environmental impacts from diets. When considering choices of a single meal, participants usually consider flavor, expiration situation, convenience, cost (time/price), cooking and dining environment, etc. Consideration of ecological impacts is not a priority.

**Concrete knowledge of food sustainability is mostly restricted to the stage on or after purchase.**

Most participants' responses described food overpackaging, landfills, waste from expired food, and noncomposable products as negative environmental impacts when answering the question "How do you think this meal can potentially impact the ecological environment?" Even though some responses mentioned meat or dairy products and food miles, they often came with defense for individual impact or doubt (eg. "I, alone, probably won't make much impact" and "Not sure though").

***"The food didn't go to landfill so I consider it a win."***

***"My coffee filter is compostable, so this is pretty zero waste."***

***— from diary study responses***

**Under most retailing environments, people are not supported in making rational decisions due to the lack of transparency and trustworthy information.**

The original forms of food materials and their production conditions, especially animal products, are hidden. Descriptions and images on food packages can be inaccurate intentionally. Food labeling exacerbates the situation because it does not reflect the whole picture of nutritional values in food. These learnings correlates to what I learned in the literature review: food consumption is heavily impacted by environmental cues and habits (Londakova et al., 2021).

***"You need to know where your food comes from to reduce meat consumption."***

***— from a flexitarian participant***



**Successfully shifting dietary habits to more sustainable practices requires ongoing effort and difficult decision-making.**

At the moment of decision making, most participants automatically prioritize immediate pleasures, such as taste, price, and convenience, over long-term benefits, such as environmental impacts and health.

Sustainable food practices have larger barriers for consumers, especially for those with busy lifestyles. Switching food practices require lifestyle and identity change in that people need to learn cooking skills, change where they purchase food and seek knowledge on food sustainability.

***“You can switch up your cosmetics, shampoo, soap, and all those sorts of things in name of sustainability, but switching up food becomes difficult because of availability and taste.”***

***— from a flexitarian participant***

Contradictory to the health concerns many people have towards a more plant-based diet, many challenges vegetarians or vegans face are social issues. It’s difficult to balance social obligations with a plant-based diet.

***“It’s most challenging to stick to a plant-based diet in social situations. Sometimes my friends want to eat at a restaurant where all I can eat is a side dish.”***

***— from a vegetarian participant***

**Additional Themes to Inform Opportunities**

- Lack of cooking skills can be a constraint for dietary transition. However, obtaining cooking skills brings a sense of achievement, which is a pleasant experience to activate system 2 thinking on food sustainability.
- Cooking is a critical part of maintaining a healthy and sustainable diet, because restaurants do not consider health as a priority of their intentions.
- Cultivating empathy for animals and nature can be a major motivating factor in changing food behaviors.
- Referencing food behaviors from a variety of cultures can help educate people on food sustainability.

## Design Implications

Through the primary and secondary exploratory research, I discovered common frustrations, misunderstandings, behavioral patterns, and potential opportunities in sustainable food transition. Some discoveries challenged my assumptions about my audience. Originally, I assumed that investigating life transitions associated with dietary transitions would help me identify patterns in motivations of sustainable life transitions. However, I found out that it may not be a good rationale to categorize audiences because food choices are related to too many factors and values. The research also narrowed down the targeted group and problem space for the project.

### Who are the users?

#### Potential Flexitarians

Potential flexitarians can be an ideal audience group. According to Sanchez-Sabate and Sabaté (2019), **flexitarians are “those not ready to give up meat, but who have, or are willing to consider reducing meat consumption”** (p. 2). I further categorized them into two groups: potential flexitarians, who are willing to consider reducing meat consumption but have not taken action, and committed flexitarians, who have reduced meat consumption. For the thesis, **the goal is to help potential flexitarians become committed flexitarians.**

Instead of dividing user groups based on the traditional dietary types, flexitarian provides a more inclusive framing because the term allows users to be more flexible with their diets. It is critical for the design **not to make people feel guilty about what they eat and not to associate eating meat with negative emotions.** Reinforcing values that are strongly associated with the traditional dietary types may not cultivate the right mentality for users. Plus, the flexitarian group is a larger group, but a rarely studied one, compared to vegetarian and vegan (Sanchez-Sabate & Sabaté, 2019, pp.1-2).

### What to teach about?

#### Climate Footprint

Since the understanding of food sustainability mostly resides in the stages on or after purchase, such as food packaging, recycling, and composting, it is important for the design to educate users on knowledge of food production in earlier stages. Climate footprint is a **relatively standard measure that can reflect the environmental impacts of food production processes** because it is a comprehensive measure of human activities' impact on climate. The calculation includes important greenhouse gas emissions typically from food production that is not calculated by carbon footprint, such as emissions from animals' digestive systems.

By providing climate footprints information, the design can **teach users to compare footprints between various food items, understand the overall footprint from diets, and make tradeoffs to reduce footprints.** Therefore, climate footprint became the target point of my interventions.

# GENERATIVE RESEARCH

## Approach

For the generative research, I aimed to identify scenarios or critical points to intervene in decision-making throughout people's food experiences and generate and evaluate potential concepts for intervention. I conducted generative design activities with six participants. I devised two methods in each individual session: card sorting and concept speed dating.

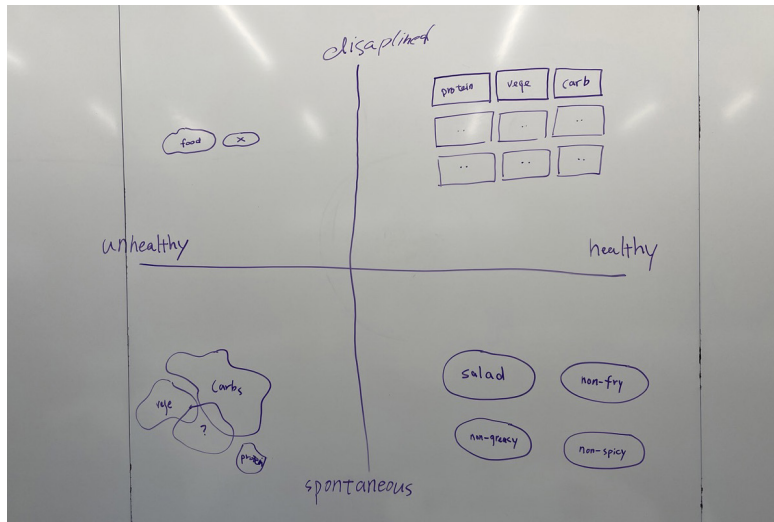
At this stage, the goal of my design intervention was not to create initial motivation to change food choices but to **generate long-term behavioral change in dietary choices**. Therefore, I slightly narrowed down the target audience: people who believe in anthropogenic impact on climate and environment and are interested in learning about food sustainability. Before conducting the research with each participant, I gathered information to ensure the participants had sustainable awareness to some extent.

### Part 1: Card sorting

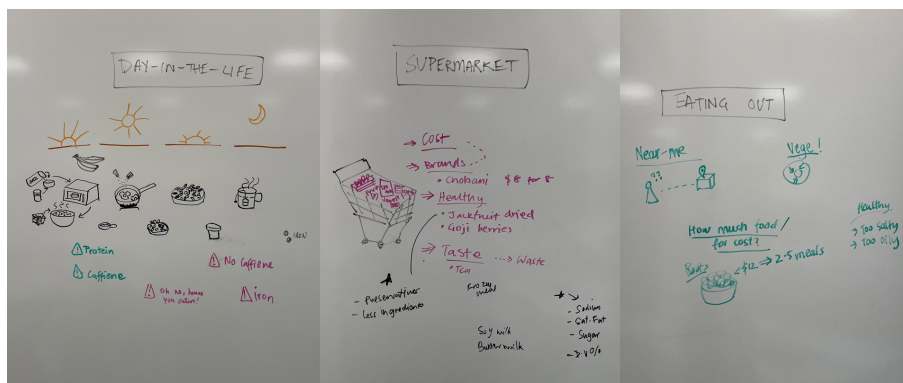
The goal for the first part of generative research was to:

- **Learn about participants' thoughts and emotions during current points of decision throughout their food experience**
- **Identify target scenarios and critical points for design intervention in participants**
- **Enable participants to generate their ideal food maps/ journeys and intervention ideas**

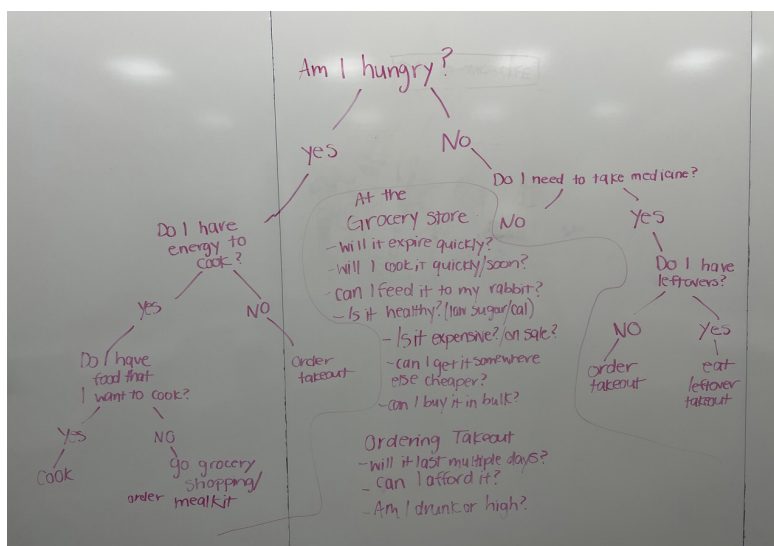
First, participants created models of their food experience based on decision-making moments. I prepared notes for participants to be as detailed as possible in their models and guided them to think about sustainability elements.



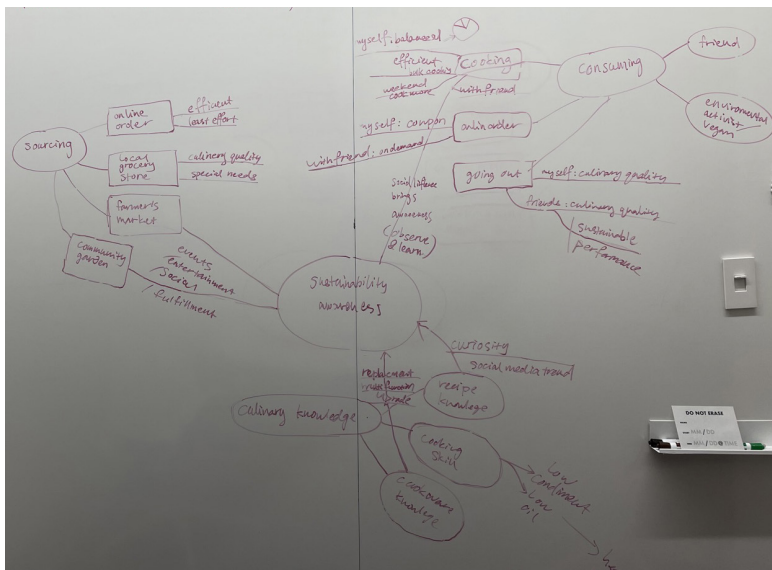
**Fig. 19** P1 created her model with two axes: healthy or unhealthy, disciplined or spontaneous. Each shape represents the meaning of the type of dietary choices in each quadrant.



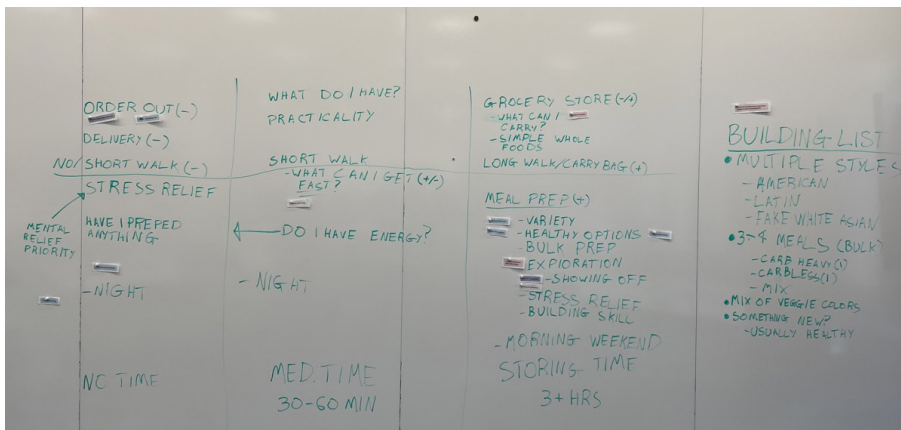
**Fig. 20** P2 generated models based on different daily life scenarios: food choices in a day in her life, in a supermarket, and when eating out.



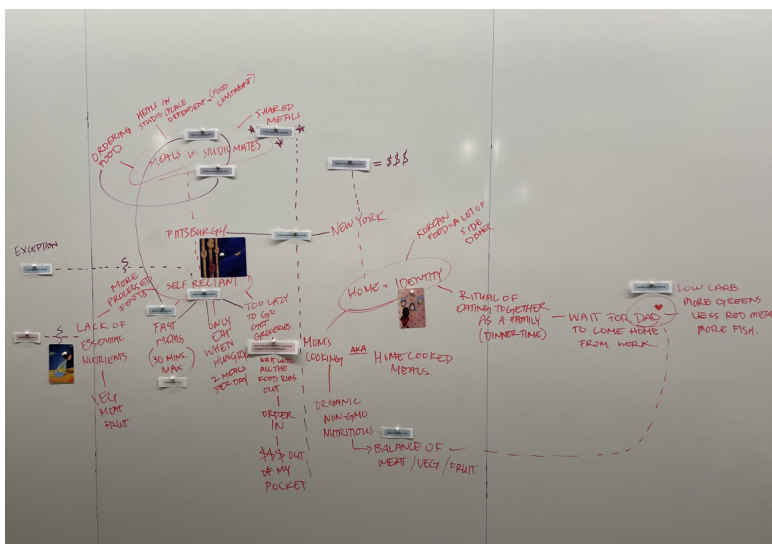
**Fig. 21** P3's model was a decision tree that included her considerations in food decision-making.



**Fig. 22** P4 categorized her food experience into three stages: sourcing (raw materials), consuming (cooked food), and culinary knowledge. She went through details of different situations in each category.



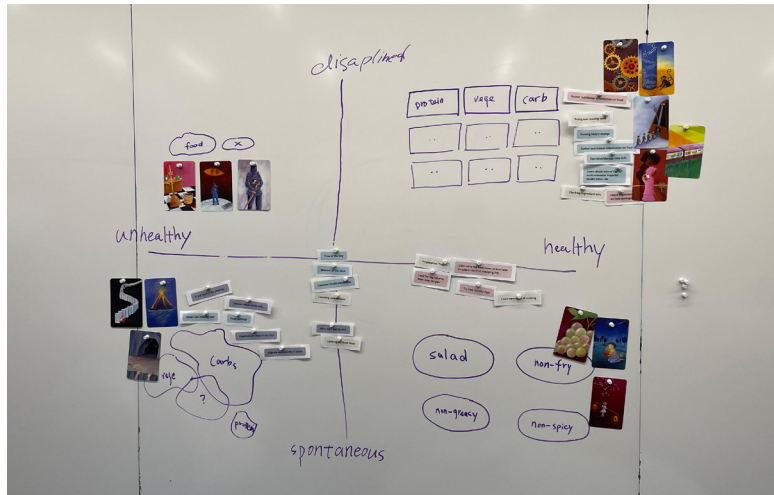
**Fig. 23** P5 divides his food choices into three main contexts. Each context involves food decision-making factors such as time cost, distance, time of the day/week, etc.



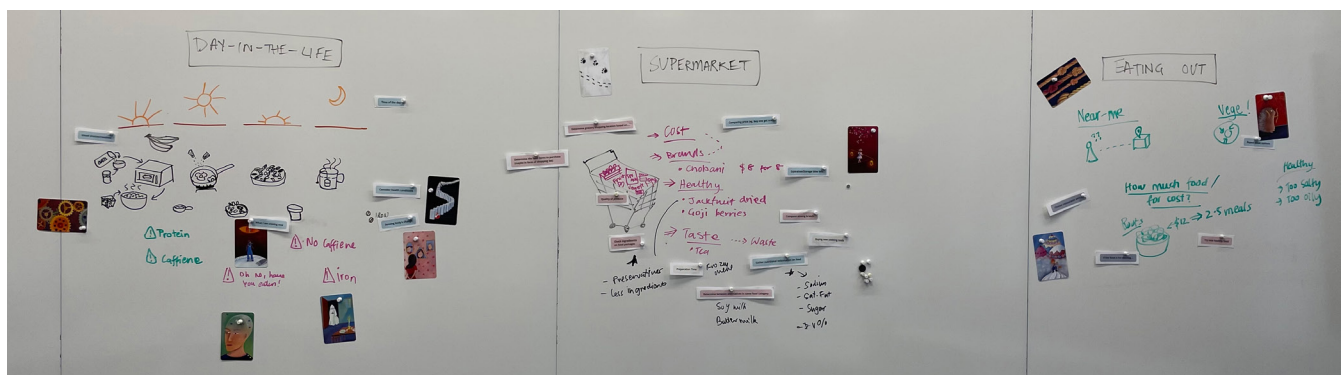
**Fig. 24** P6 built her model based on geographical locations and their impacts on her lifestyle and food choices.



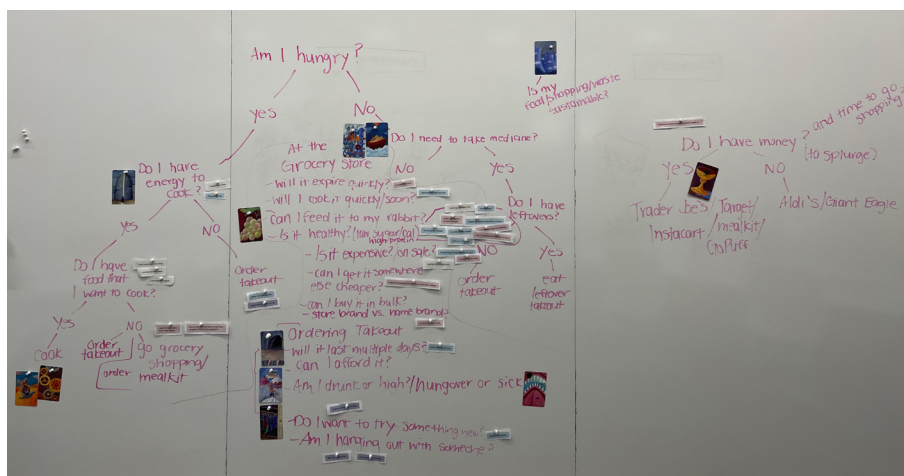
Secondly, participants matched intentionally abstract artistic visual representations to their models. I chose the Dixit card deck due to their dreamlike and metaphorical illustrations which are designed to support subjective emotional interpretation. Participants were able to express their thoughts and emotions and interpret them through the metaphors and feelings from the illustrations. Then, they explained how they understood the illustrations and why they matched them to the elements in the models.



**Fig. 25** P1's model with cards



**Fig. 26** P2's model with cards



**Fig. 27** P3's model with cards



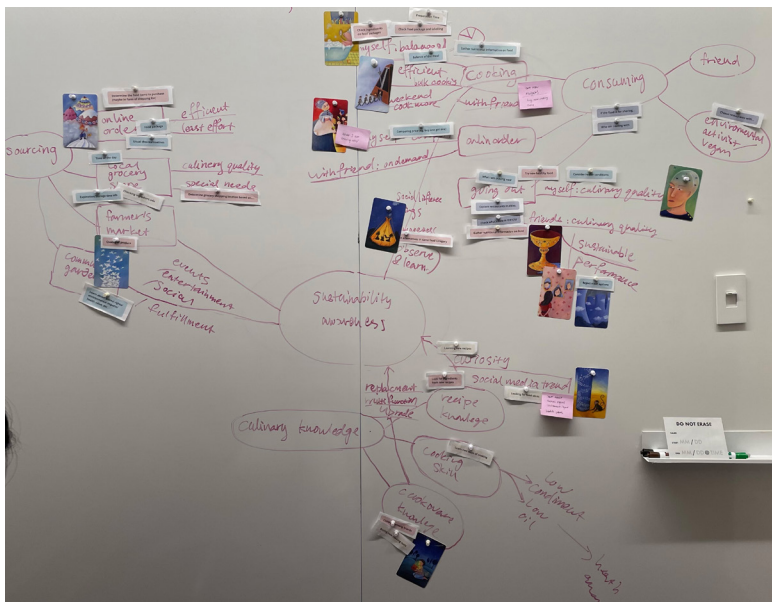


Fig. 28 P4's model with cards

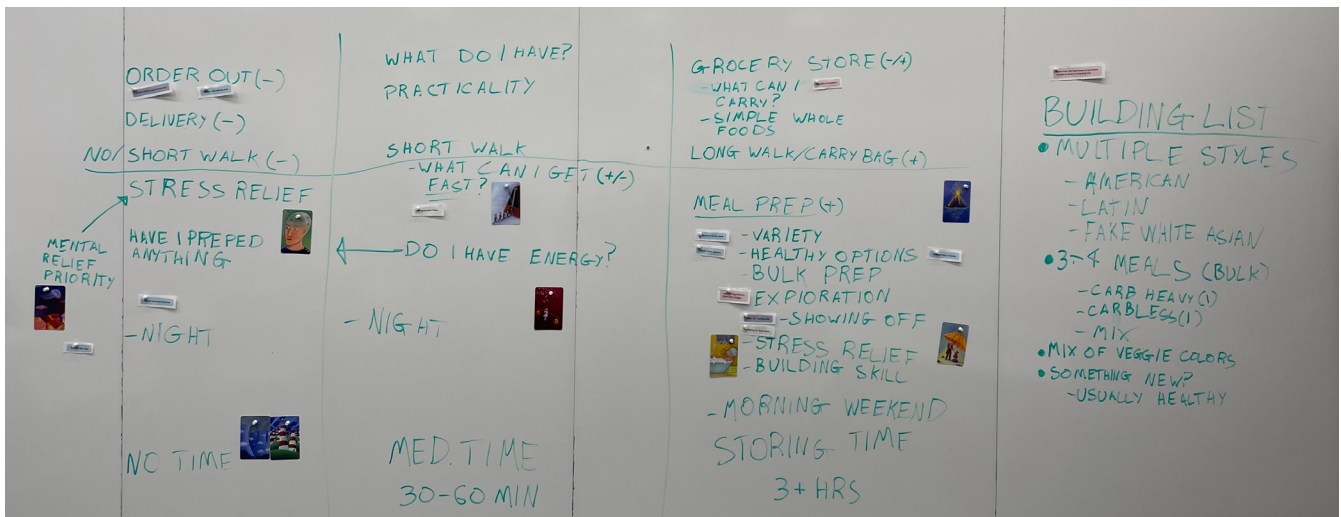


Fig. 29 P5's model with cards



Fig. 30 P6's model with cards

## Part 2: Concept speed dating

My goal for the second part of generative research was to:

- **Evaluate early concepts for design interventions through participants' preferences and reasons**
- **Identify design implications and potential design interventions**
- **During the concept speed dating activity, I walked them through the storyboards that illustrated the high-level scenarios, mediums, and functions of 3 initial concepts. Participants shared their initial thoughts, their preferences, and other feedback**

## Synthesis

Common Patterns from the card-sorting activities include:

**Participants understand that their food choices will generate positive outcomes if they make long-term efforts (Fig. 31-1).**



**Fig. 31-1** Both cards represented long journeys for some participants. They used them to describe that the positive effects of diet take a long time.

**However, many participants found food preparation and grocery shopping tedious. It is a disciplined and repetitive process. In addition, they feel overwhelmed that they need to consider too much information for health purposes (Fig. 31-2).**



**Fig. 31-2** Participants used "monkey reading the numbers," "disciplined" and "keep machine working" to describe tedious routine things they need to do to prepare meals and eat healthily.

**Social situations are opportunities for participants to learn food sustainability knowledge, as they perceive gathering as playful, growth, and celebration (Fig. 31-3).**



**Fig. 31-3** Participants used these cards for scenarios of hanging out with friends because they expressed "playful," "happy," and a "sense of ritual."

**However, participants have fewer considerations on health and sustainability in social situations (Fig. 31-4).**



**Fig. 31-4** For most participants, these cards conveyed the "cascading effect" and dark sides of craving junk food.

**Participants mostly do not think about sustainability at the moment of decision making, because sustainable awareness comes with reflection and negative emotions (Fig. 31-5).**



**Fig. 31-5** These cards are mostly for self-reflection on sustainability and environmental impacts from food industry.

## Design Principles

Combined with learnings from the literature and artifact review, the generative research informed the following design principles that guided me through the prototyping and testing phases:

### Active Participation

Participatory experience is critical for users to engage in learning new knowledge and obtain long-term habits. Ideally, the design should provide an innovative and in-depth experience that allows users to learn food sustainability through practice.

### Personalization

There is a wide range of preferences and restrictions in dietary choices. The reasons and motivations behind each are also different. The design should provide a personalized experience and a sense of inclusivity for all users.

### Low Effort

Even people who are aware of their unhealthy diets or even under health risks may be only willing to make dietary changes that require minimal effort. Making changes to diet might be complicated because of enjoyment associated with food, or lack of knowledge or resources. Therefore, the design should require minimal effort from users since sustainability is a less immediate concern for many audiences.

IDEATION

## Concept 1: Secret Recipe

### What it is

Concept 1 provides a fun and alternative way for friends and family groups to gather together (Fig. 32-1). Secret Recipe facilitates the planning and gathering process by accommodating group members' dietary needs with recipes and keeping them a secret until they gather. Throughout the experience, the app takes chances to provide information on the climate footprint of food ingredients and promotes conversation about food sustainability among group members.

### Persuasion technique

This concept utilizes the persuasive technique called obfuscating, which means stealthily introducing persuasive content in an intervention. On the surface, the app introduces collective cooking as a new way of group gathering. The key feature is that it educates users the information on food sustainability when they are potentially under the corresponding scenarios.

### How it works

1. Personalize recipes: A group of friends enters their information on their dietary preferences and restrictions. The app provides a few recipes for a group of friends (Fig. 32-2).

2. Distribute ingredients: Before the gathering, the app mixes and assigns different ingredients to each group member to bring to the gathering so that no one in the group recognizes the dishes. The system provides information on climate footprint and potential alternatives with lower environmental impact (Fig. 32-3).

3. Gather & cook: On the gathering day, everyone brings their ingredients, takes a guess of what meals are going to be, and unlocks the recipes together (Fig. 32-4).

4. Celebrate: Finally, the app captures the group's memory with photos and messages. It will eventually form a memory scrapbook for all the gatherings (Fig. 32-5).

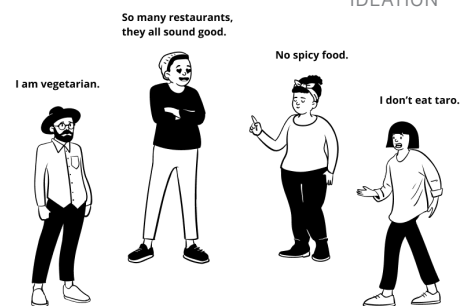


Fig. 32-1 Concept 1: Secret Recipe

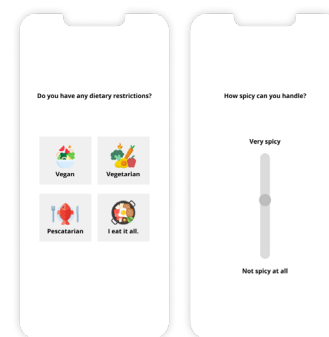


Fig. 32-2 Personalize recipes  
image from Flaticon.com

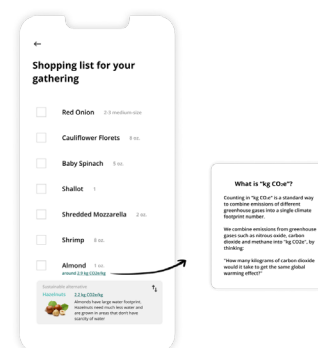


Fig. 32-3 Distribute ingredients

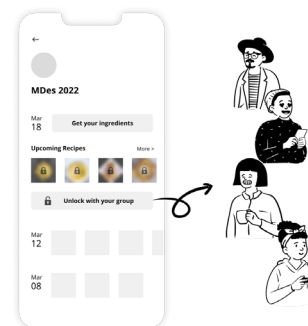


Fig. 32-4 Gather & cook



Fig. 32-5 Celebrate

## Concept 2: Board Game

## What it is

Concept 2 utilizes the form of a board game to educate players on the concept of carbon efficiency, and compare climate footprints between different food items.

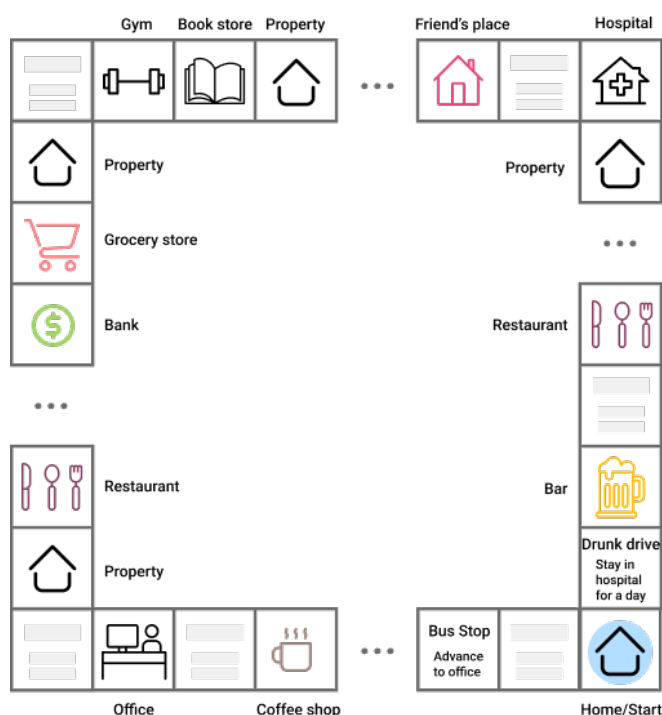
## Persuasion technique

The game leverages the persuasion technique called intermixing, which means balancing the proportion of "on-topic" and "off-topic" content in an intervention. The main theme of the game is to promote a healthy and positive lifestyle. This game mixes climate footprint information with other daily life scenarios so that the knowledge is more approachable for players.

## How it works

The mechanism of this game is similar to Monopoly (Fig. 33-5). In each block, players can change scores on health, climate footprint, income, and intelligence based on chance cards they draw. The winner has the highest total score.

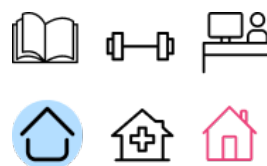
Players get to trade properties if they land on property blocks (Fig. 33-1). The game also involves other daily life scenarios (Fig. 33-2). The points when the game educates players about climate footprint information are blocks of restaurants, grocery stores, coffee shops, and bars (Fig. 33-3). The chance cards that players can draw can teach them knowledge on food sustainability, such as "brewing is not a sustainable practice" (Fig. 33-4).



**Fig. 33-5** Concept 2: Board Game



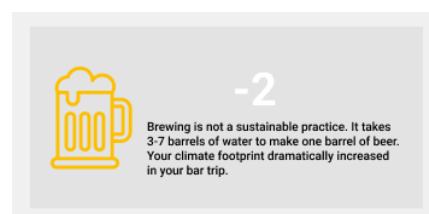
**Fig. 33-1** The property block



**Fig. 33-2** Intermixing blocks for daily life scenarios



**Fig. 33-3** Blocks for educating climate footprint information



**Fig. 33-4** Chance card example



## Concept 3: Earth Calorie

### What it is

Concept 3 is a vision of a future grocery shopping experience. In the future, we will be able to track climate footprint more accurately and comprehensively. Almost all products will have an estimated climate footprint label. Grocery stores will have Earth Calorie smart carts to guide them through their shopping experience. The term, Earth Calorie, is an analogy for climate footprint. Just like calories to humans, the aggregate of individuals' climate footprint can be a measure of the earth's health.

### How it works

When a customer place items in the cart, the cart will detect products and provide personalized information such as health benefits and how the products help them achieve their personal goals. It will also display the total price (Fig. 34-1).

When the individual footprint reaches the average, the cart will give them an alert and provide further suggestions on how to reduce earth calories if they choose to (Fig. 34-2).

As the customer walks through different sections of the grocery store, they will be able to see labels that encourage them to purchase products with a lower climate footprint (Fig. 34-3). Later, customers can view the specific knowledge or data on their personal devices. An example is the earth calorie equation of latte and tea: A three-cup latte's footprint is around the same footprint of 80 cups of tea (Fig. 34-4).

At the end of the experience, if paper receipts still exist in the future, we will be able to celebrate our small improvements in climate footprint on receipts (Fig. 34-5). Users can scan the code to view their Earth Calorie progress on their devices and how their purchases contribute to their total earth calories over time.



Fig. 34-1 Earth Calorie smart cart

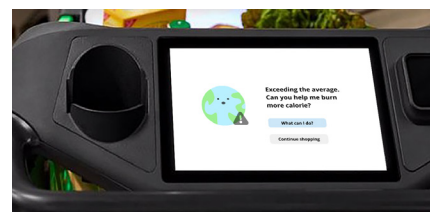


Fig. 34-2 Smart cart alert



Fig. 34-3 Label for products with lower climate footprint

### Earth Calorie equation



Fig. 34-4 Climate footprint equation

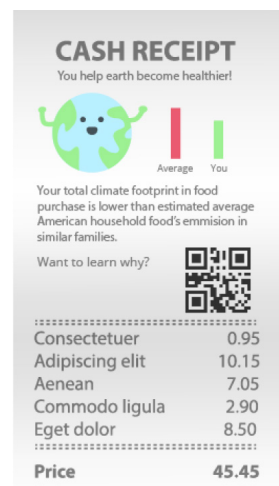


Fig. 34-5 Receipt with earth calorie



I eventually chose Concept 1, because it was most relevant in answering the research question and leveraging persuasive design techniques.

In evaluating the concepts, this concept stood out for the following reasons:

- It leverages multiple incentives, including needs for social interactions and novel experiences.
- This concept has potential to extend into other scenarios, such as experiment kitchens.
- People could see themselves using a tool like this.

# PROTOTYPE DEVELOPMENT

## Process

For the prototype development phase, I extracted the main themes of Concept 1, which are mystery, friends, and recipes. I integrated the main themes into a journey diagram to better understand the food experience and potential opportunities for persuasion messages in the journey. Then, I created wireframes based on the journey diagram to explore the design of the screens that can better facilitate the experience. At the same time, I also divided the functionalities into different sections. Lastly, I made an interactive prototype for informal evaluation and improved it into Foodie Friends based on the feedback on the workflow.

This process helped me bring the concept to life and understand the gaps to fulfill through evaluation. I learned that clear guidance, targeted disclosure and leveraging existing cues are critical for the persuasion techniques to effectively convey information on food sustainability. In addition, this process informed me with next steps to evaluate under real food environment.

# User Journey

## Onboarding



## Set dietary preferences



## Plan gathering

Create group

Create event



Recipes found & hidden

## Prepare Ingredients



## Get together & Cook

Unlock recipes



Recipes revealed

## Commemorate

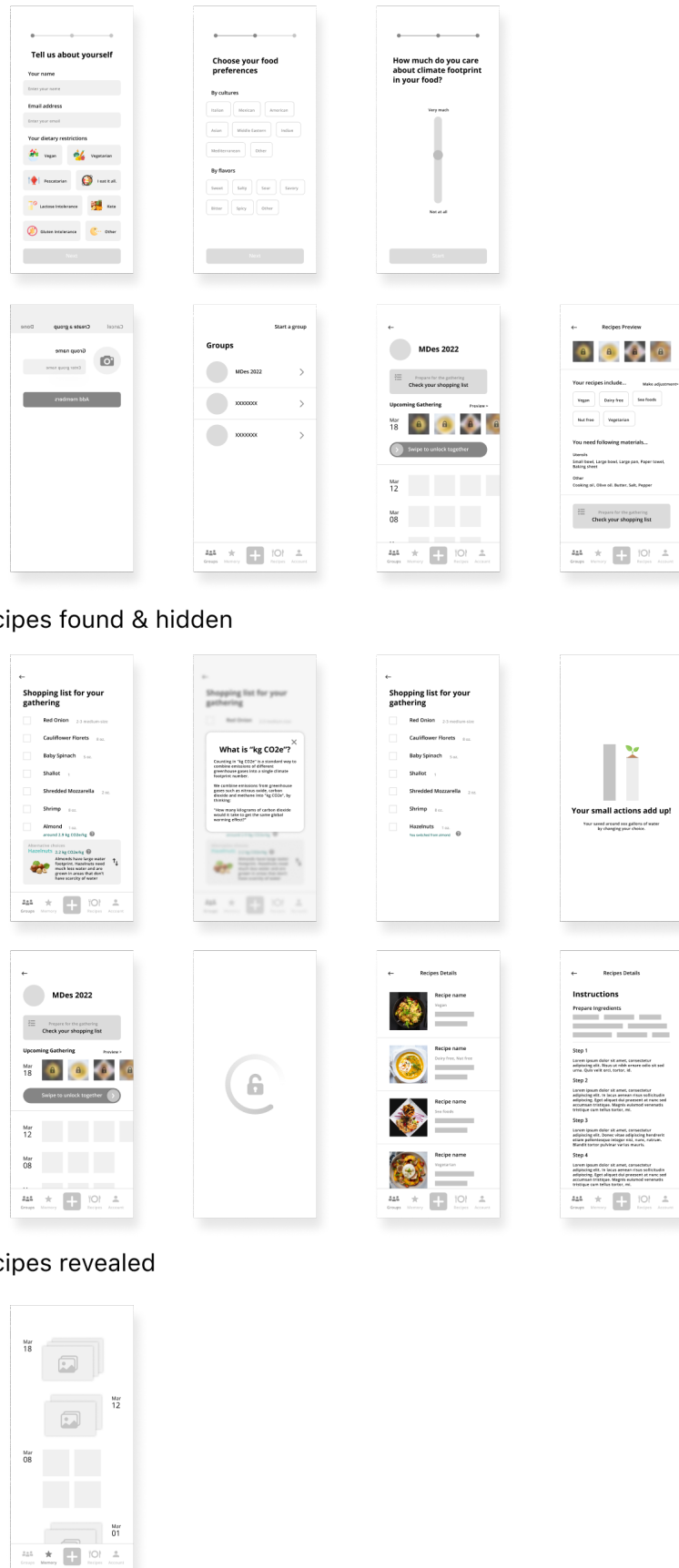


Fig. 35 Initial Journey diagram

**Tell us about yourself**

Your name  
Enter your name

Email address  
Enter your email

Your dietary restrictions

Vegan Vegetarian

Pescatarian I eat it all.

Lactose Intolerance Keto

Gluten Intolerance Other

Next

**Choose your food preferences**

By cultures

Italian Mexican American

Asian Middle Eastern Indian

Mediterranean Other

By flavors

Sweet Salty Sour Savory

Bitter Spicy Other

Next

**How much do you care about climate footprint in your food?**

Very much

Not at all

Start

**Fig. 36** Set individual preferences, image from Flaticon.com

## Set Individual Preferences

Before users start using Secret Recipe, the system asks users to provide personal information, their dietary preferences, and restrictions for better customizing recipes and experiences in the future. It also tries to learn about users' food sustainability awareness by asking users how much they care about climate footprint in their food.

## Plan Gathering

The main sections of the app include groups, memory, recipes, and account.

Users can organize gathering events in groups, refresh their memory with group photos they upload and check food they made with past recipes.

When a user starts to plan a gathering event with a group, they can create a group, add group members and initiate a gathering event. Once an event is built, the system will generate recipes that best suit the group's dietary needs based on the information they provided during the onboarding, so that everyone will have something they like on the table.

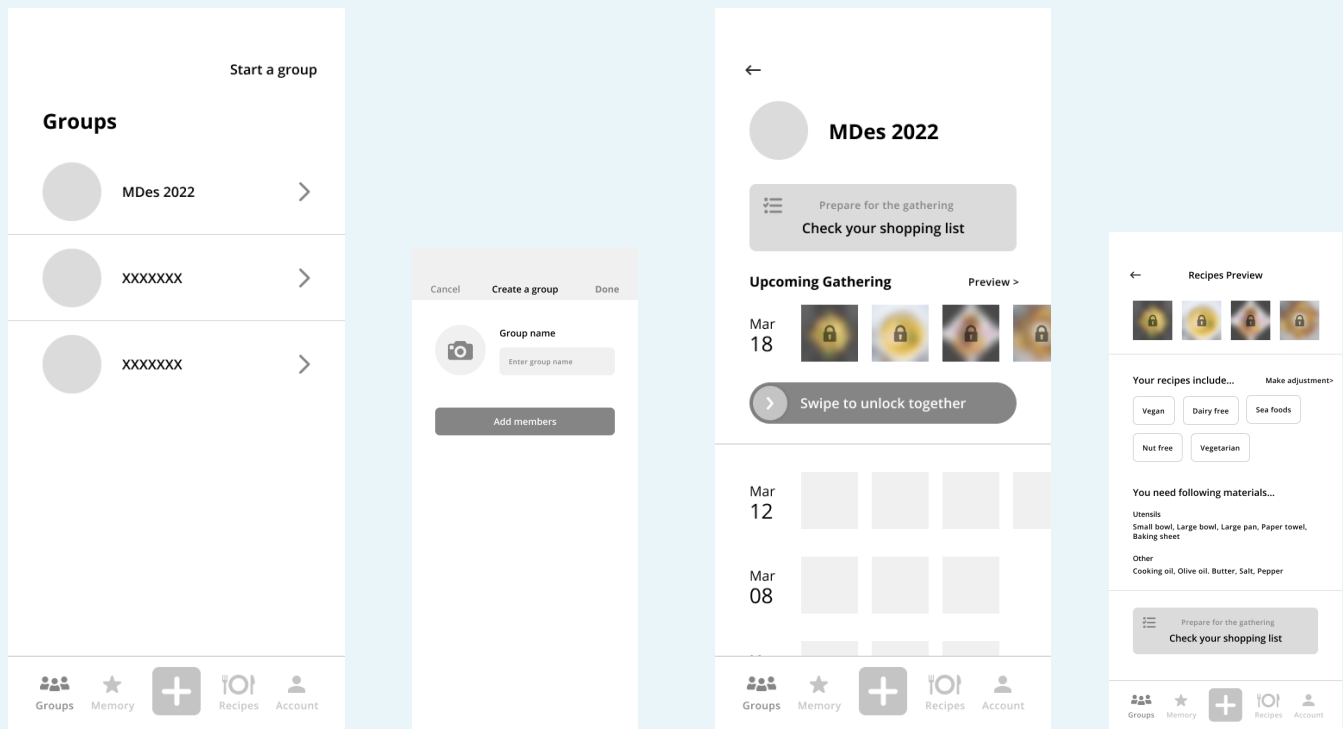


Fig. 37 Plan gathering

## Prepare Ingredients

After creating the event, each group member gets a list of ingredients to prepare for the gathering. To keep recipes mysterious, the system mixes all ingredients for all the dishes and distributes them to group members in a way that is difficult to recognize the recipes.

### Climate footprint education

The shopping list provides information on an ingredient that has a high climate footprint, allows users to learn the reason behind it, and provides a more sustainable option.

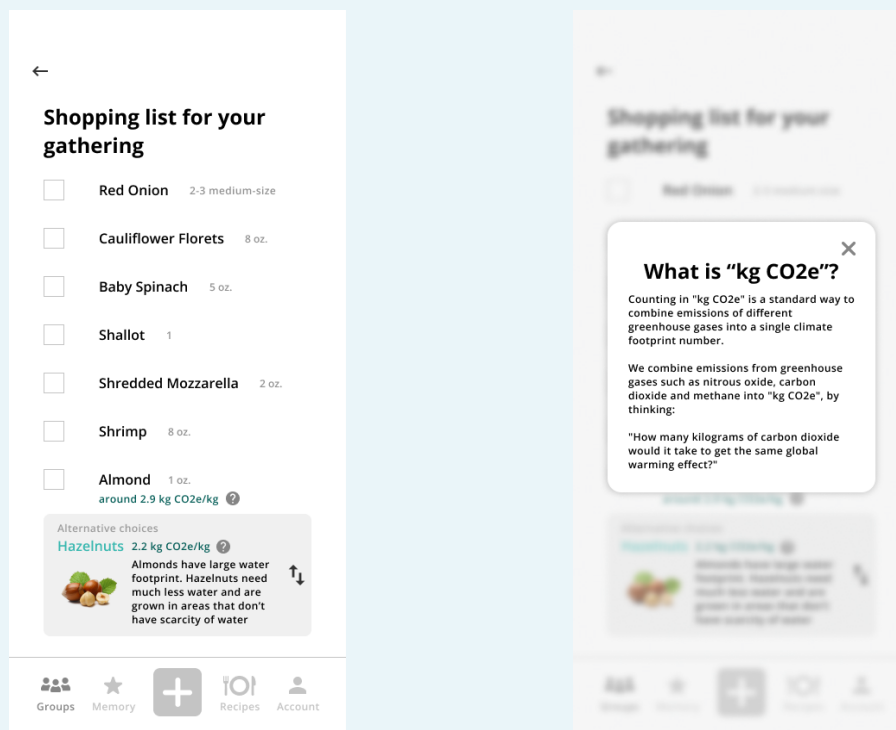
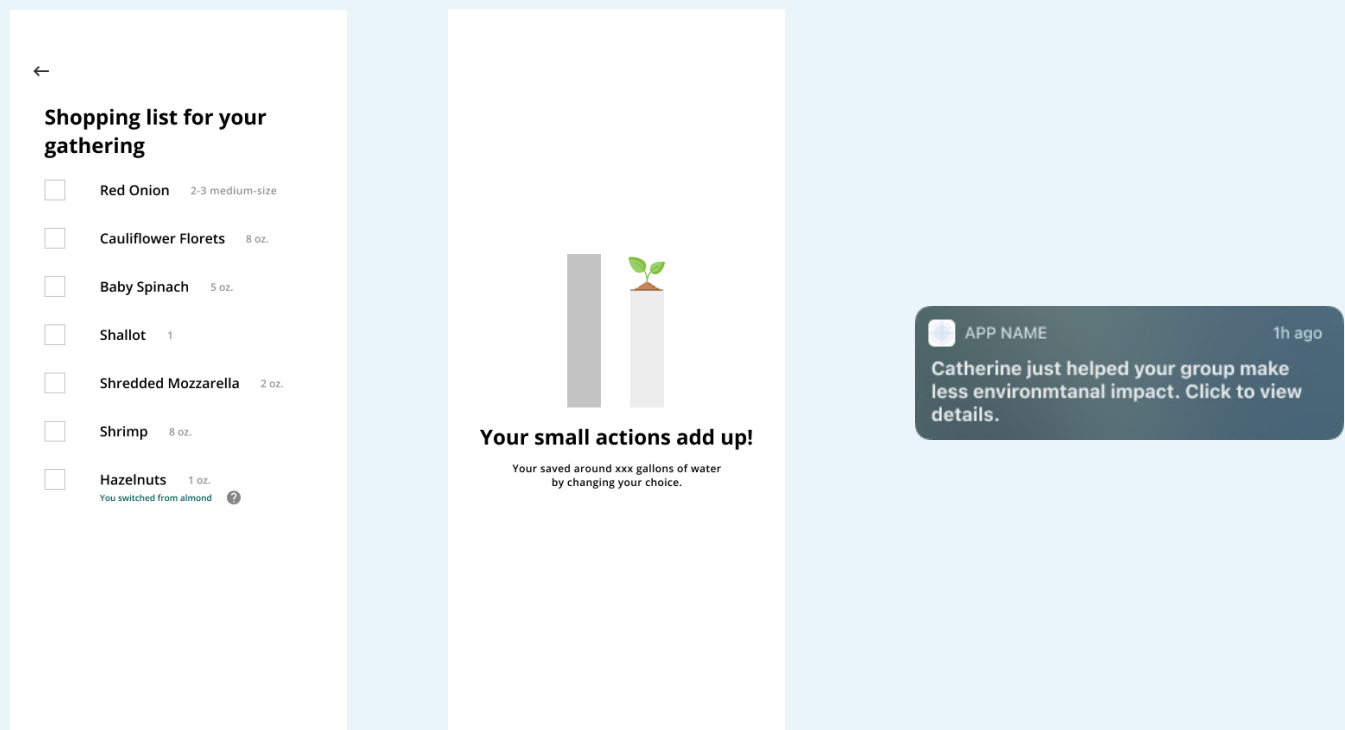


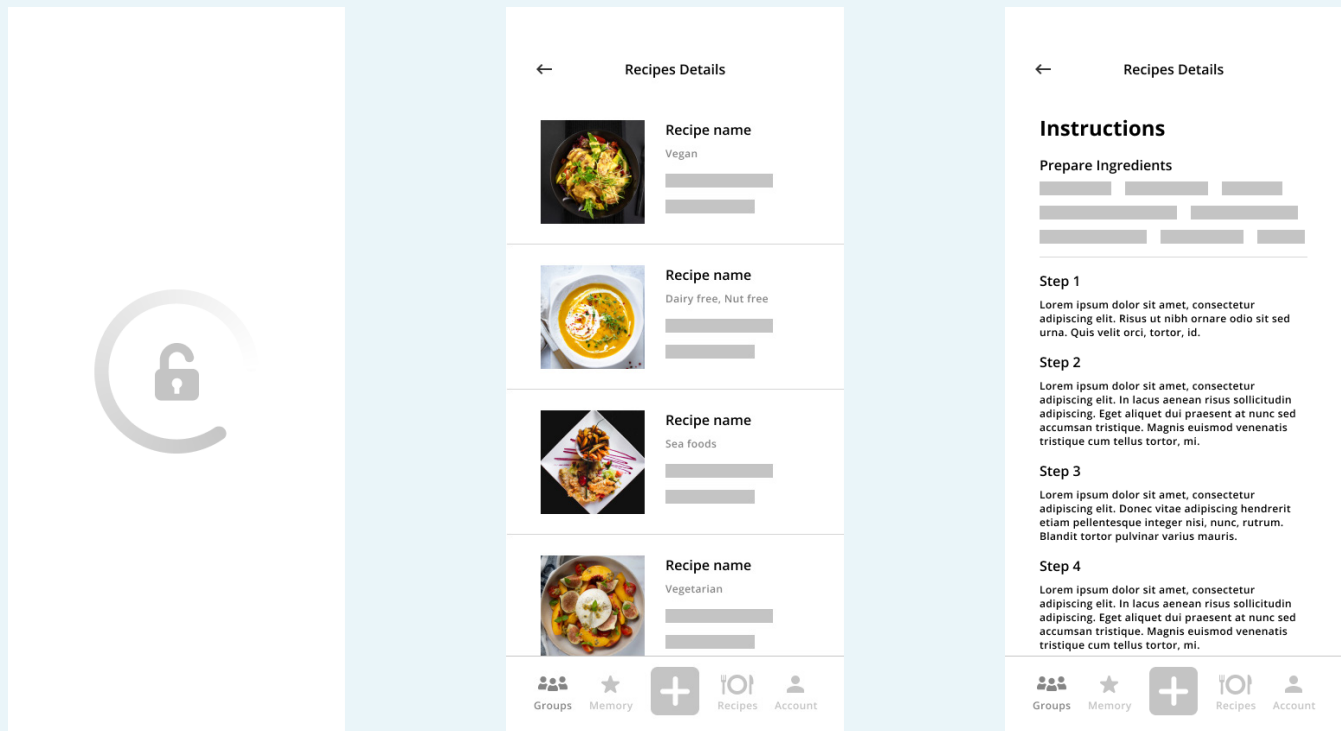
Fig. 38-1 Prepare ingredients

If the user chooses to switch an ingredient for a sustainable alternative, the system will take them to the animated screen to celebrate their action's positive environmental impact. It will also notify other members in the same group. They can click into this and give positive feedback so that the user gets positive emotional responses from the data (indirectly) and social proof. Group members will be able to view the impact only (data on carbon footprint, water, etc) but not the specific food decisions that cause this impact. By doing so, the system leaves room for the group to have conversations during the gathering since they don't know each other's ingredients in their shopping lists, eg. "Which ingredient did you switch?" "Why did this food make so much impact compared to this food?" etc.



**Fig. 38-2** Prepare ingredients  
image from Flaticon.com

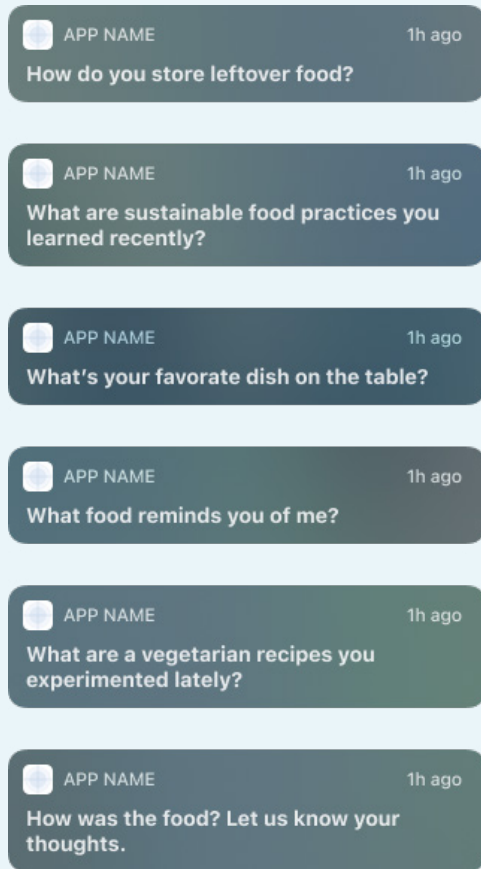




**Fig. 39-1** Get together & cook

## Get Together & Cook

When the group gets together, they unlock the recipes, and are excited to try them out. They follow the instructions, cook together and enjoy their time.



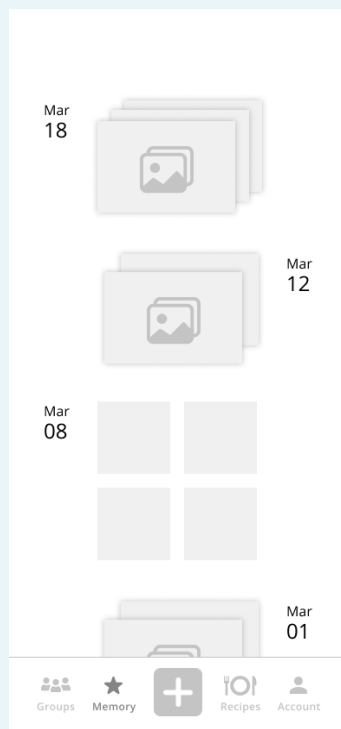
**Fig. 39-2** Get together & cook

At this stage, users get notifications that prompt them to have conversations about food, and some of the questions are related to food sustainability (Fig. 39-2). The notifications mix sustainable-related questions with other food-related questions that are not about sustainability. The intention is to intermix different questions so that users do not feel overwhelmed.

## Memory

The memory section displays past gathering photos of the food that users upload or recipe images if users don't upload photos. This feature provides a convenient way for users to distribute photos or videos, and for users to look back the experience individually.

This section serves as the last reward of celebration for users in the end of the experience to complete the loop (Clear, 2018). The positive feedback aims to attribute rewards to the whole experience of Foodie Friends, including the potential sustainable learnings.



**Fig. 40** Memory

## Evaluation

After building the prototype, I evaluated it informally with four potential users. All of them had at least basic knowledge of food sustainability, but the effort they made varied. Before evaluators started clicking through the prototype, I introduced the ideal context for each section of the app and encouraged them to think aloud as they worked through the screens. In the end, I asked each evaluator the following questions:

- What's working well? What's not working? What's missing?
- To what level do you think this experience is about sustainability? (rate on a scale of 5)
- How much do you think you know more about food's carbon footprint after experiencing this design?
- Compared to other ways of sharing meals with friends/family groups, what do you think are the pros and cons of this experience?

Through these feedback sessions, I identified the following opportunities for improvement that were incorporated into my final design.

### Clear Stage Setting

Providing context to prepare users for the food experience in Secret Recipes may be helpful. An onboarding process may be needed to articulate the mysterious elements, collective effort, and specific steps for each gathering event before users start their food experience with Secret Recipes.

### Progressive and Targeted Disclosure

Progressively revealing information on sustainability may help users understand the knowledge easily and have a better food experience, especially for users with more motivation. During evaluation, participants found food sustainability content in the app overwhelming sometimes. It may be beneficial to hide informative text on climate footprint in the main flow and provide more info for users interested in carbon efficiency.

### Effective Intervention for Conversation Flow

Three stages in the food experience may be critical for users to learn about food sustainability:

1. When users individually purchase ingredients on the shopping list, they may learn climate footprint information by practice and reflection.
2. When users receive or give affirmation for positive environmental impacts from social interaction with other group members, the positive feedback is reinforced by social proof.
3. After a group gets together, they may have a conversation on different viewpoints with group members.

Based on evaluators' feedback, I found that pushing notifications of prompts anytime during gathering events may not be effective. This is because users will not stop their current conversation flow for a push notification if they start to eat. The point to intervene naturally may be during cooking because users may already use their phones for cooking instructions and have conversations about food.

## Skewed Rating

Surprisingly, all participants rated 3 out of 5 when I asked the question: "To what level do you think this experience is about sustainability?" I had hoped for scores of two or lower, as this would indicate that the sustainability angle of the tool was sufficiently hidden within the broader, fun experience. However, during the evaluation, I condensed the gathering experience, especially the sustainable elements, and walked participants through it. Therefore, the rating may be higher than the actual scenarios.

In general, participants found it difficult to rate because they were not evaluating the prototype in the context of an actual social food experience.

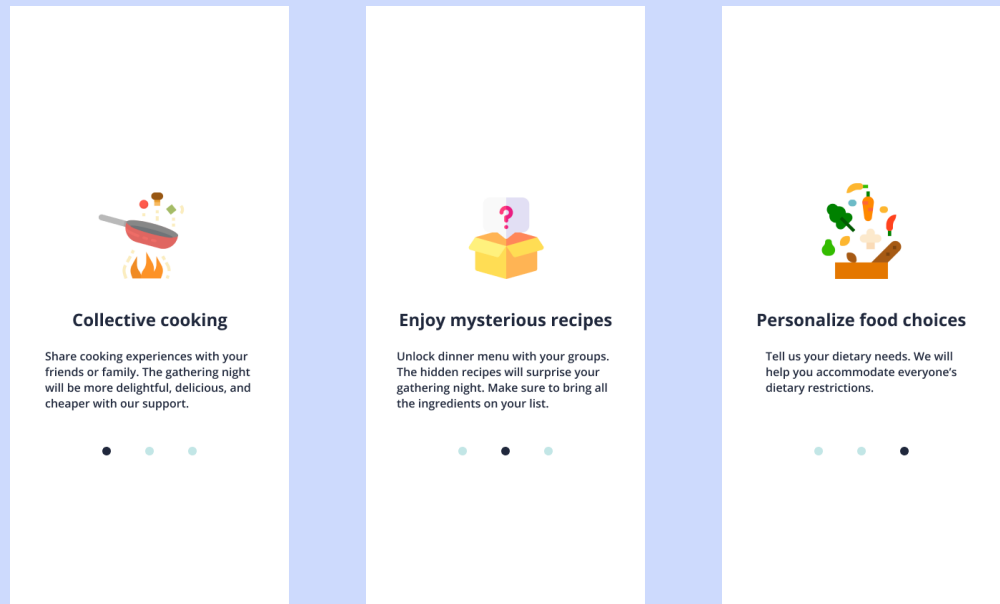
**To what level do you think this experience is about sustainability?**



**Fig. 41** Rating socre

# Foodie Friends

## Facilitating social gathering



**Fig. 42-1** Onboarding  
image from Flaticon.com

## Onboarding

When users first open Foodie Friends, onboarding screens show the three key aspects of Foodie Friends: facilitating collective cooking, providing mysterious recipes, and personalizing food choices for groups.

Foodie Friends also asks users to provide personal information, their dietary preferences, and restrictions for better customizing recipes in the future. Lastly, it tries to learn users' level of knowledge or motivation on food sustainability by asking a question related to climate footprint.

The figure displays three mobile app screens for 'Foodie Friends'.

**Screen 1: Tell us about yourself**

- Progress bar: 1 of 3 steps.
- Form fields: 'Your name' (placeholder: 'My name'), 'Email address' (placeholder: 'xxxxxx@gmail.com').
- Section: 'Your dietary restrictions'.
- Options:
  - Vegan (with leaf icon)
  - Vegetarian (with leaf and fork icon)
  - Pescatarian (with fish icon)
  - I eat it all. (with plate icon)
  - Lactose Intolerance (with glass and drop icon)
  - Keto (with fork and knife icon)
  - Gluten Intolerance (with wheat and drop icon)
  - Other (with smiley face icon)
- Next button.

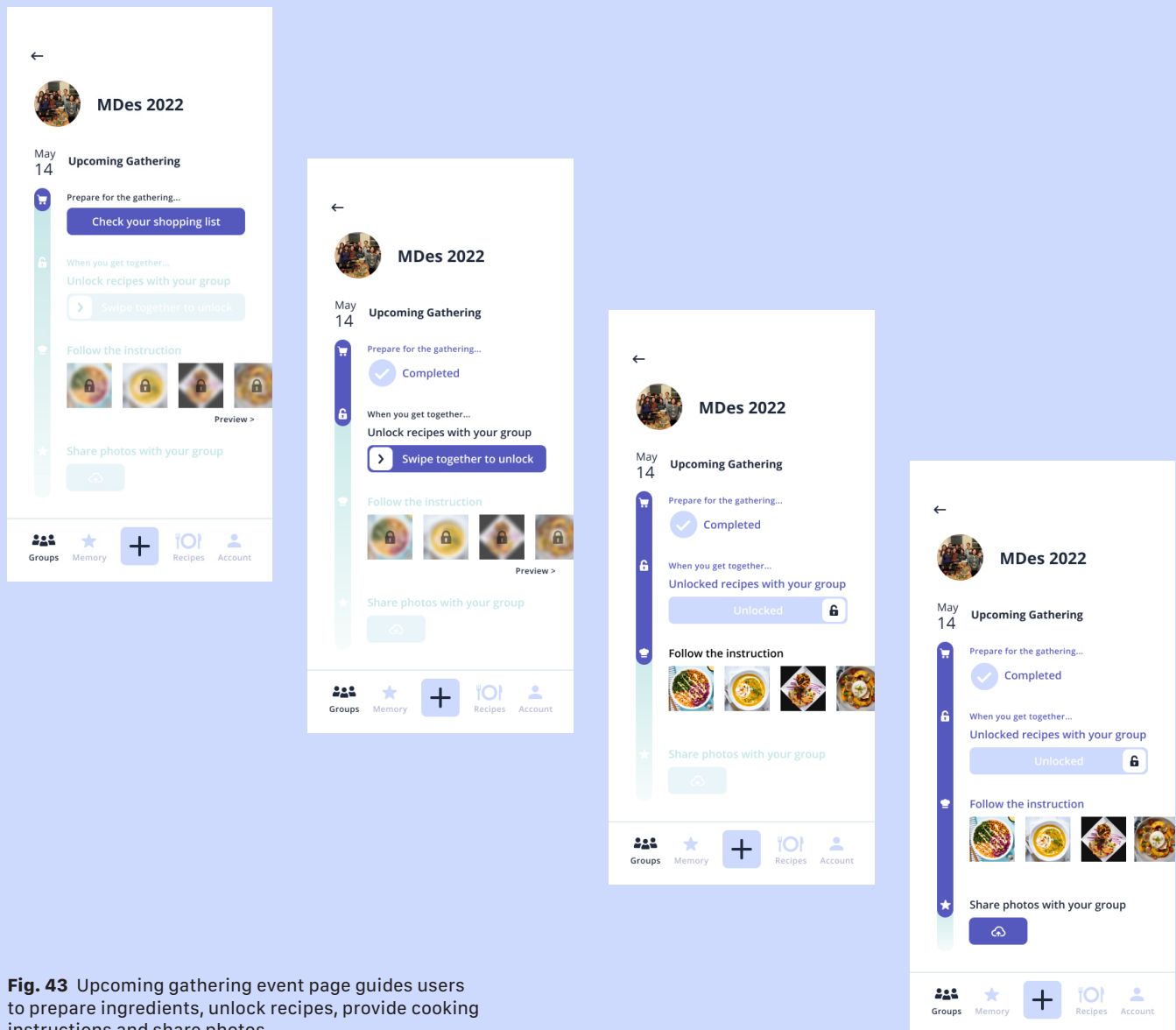
**Screen 2: Choose your food preferences**

- Progress bar: 2 of 3 steps.
- Section: 'By cultures'.
- Options: Italian, Mexican, American (selected), Asian, Middle Eastern, Indian, Mediterranean, Other.
- Section: 'By flavors'.
- Options: Sweet (selected), Salty, Sour, Savory, Bitter, Spicy, Other.
- Next button.

**Screen 3: How much do you care about climate footprint in your food?**

- Progress bar: 3 of 3 steps.
- Slider scale: 'Very much' at the top, 'Not at all' at the bottom.
- Slider handle: Positioned at the top, indicating 'Very much'.
- Start button.

**Fig. 42-2** Questions on dietary restrictions, preferences, and climate footprint image from Flaticon.com



**Fig. 43** Upcoming gathering event page guides users to prepare ingredients, unlock recipes, provide cooking instructions and share photos

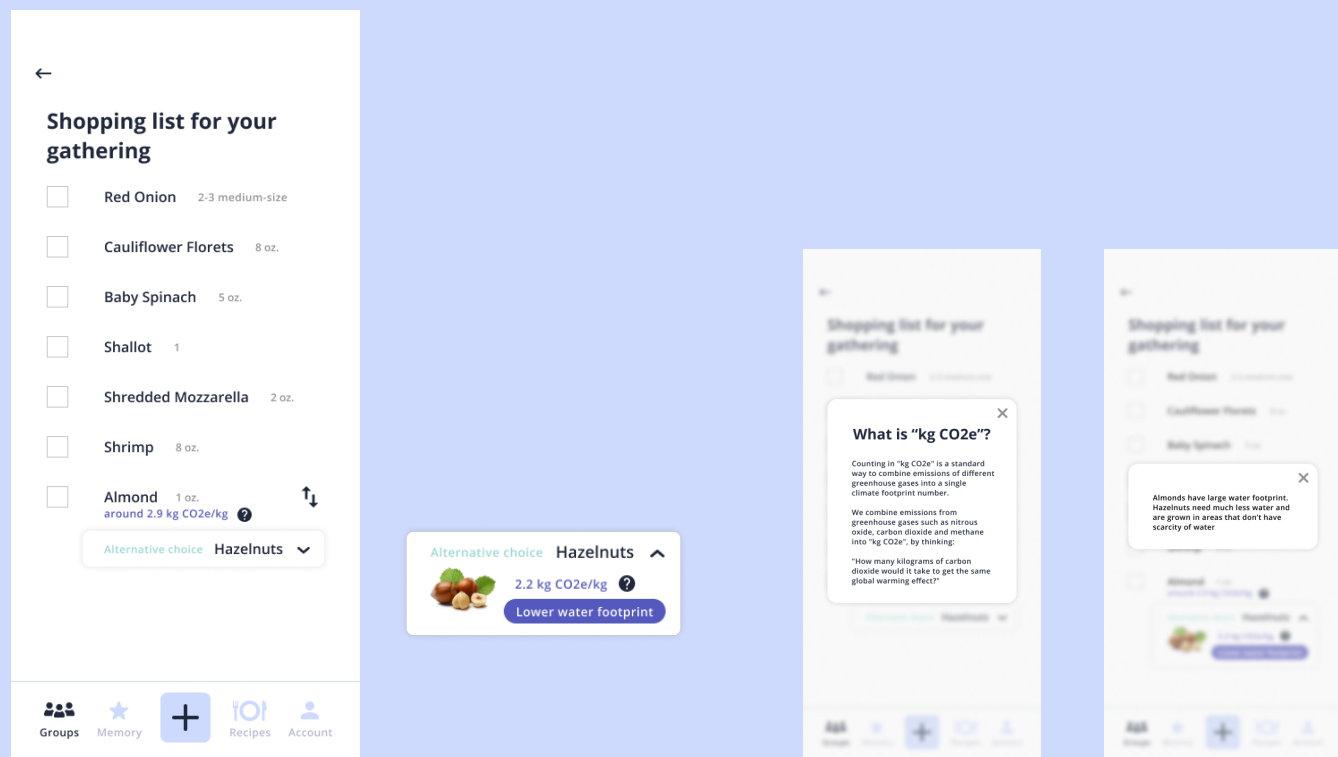
## Timeline

The group upcoming gathering event page gradually reveals step-by-step information for users based on the timeline of event progress.

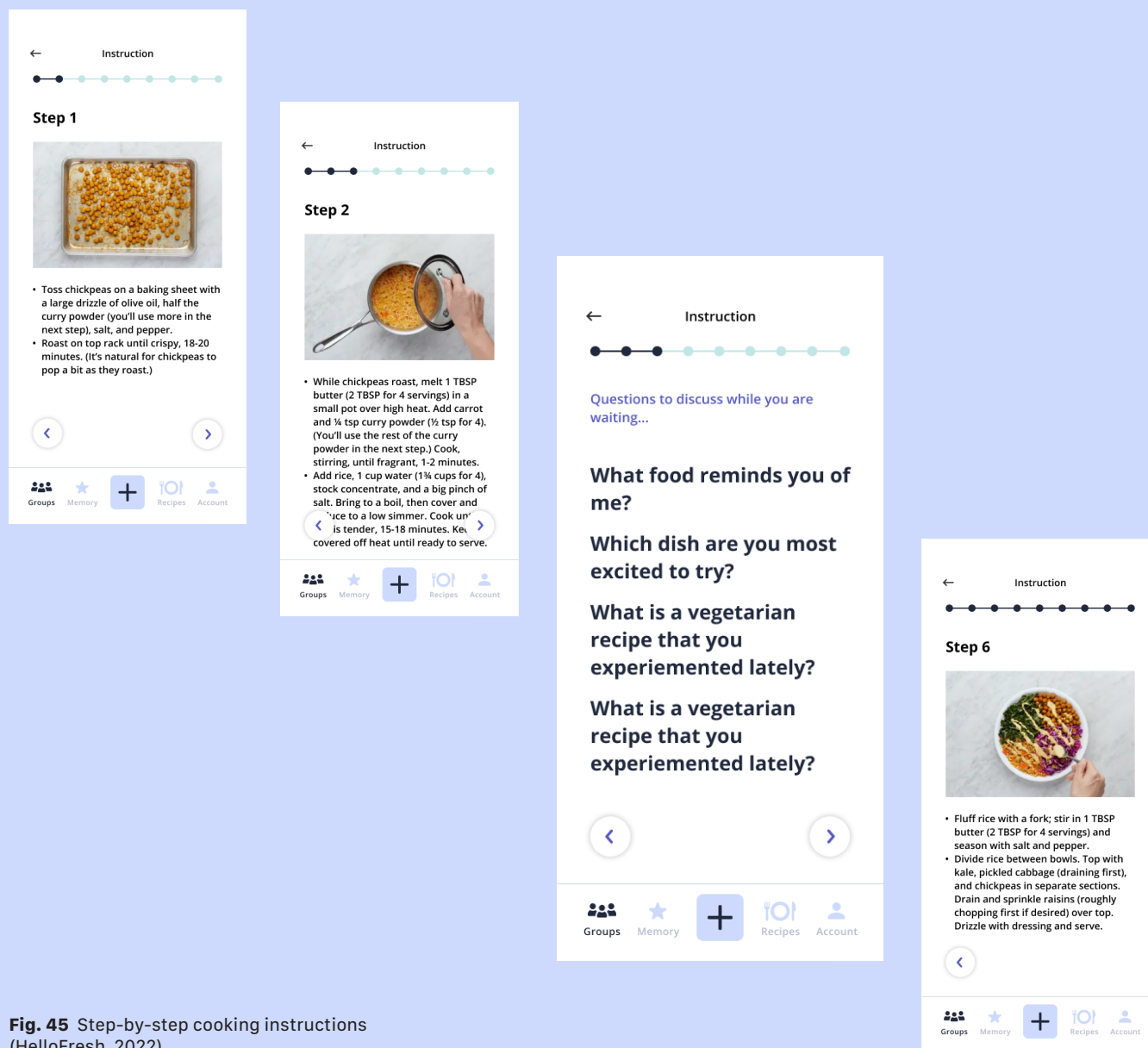


## Targeted Disclosure for Climate Footprint Information

When users individually shop for ingredients, the shopping list page presents sustainable alternative options for certain food items. While the information related to sustainability is presented subtly, users can click on the question icons to learn about what climate footprint is and why the ingredient has a higher climate footprint.



**Fig. 44** The shopping list page progressively discloses climate footprint information



**Fig. 45** Step-by-step cooking instructions (HelloFresh, 2022)

## Cooking Instructions for Intermixing

The step-by-step cooking instructions contain questions related to food for the group to discuss. Foodie Friends intermixes questions both related and not related to food sustainability in between some steps, especially the ones that take a long time to cook.

# CONCLUSION

As a designer, the goal of my research was to leverage persuasive design to enable individuals to make more sustainable food choices. In this thesis, I proposed an intervention that leverages persuasion techniques to make dietary transitions fun and easy for users.

Through contextual inquiries and diary studies, I investigated how people navigate and make decisions in the current food system. Through the literature review, I explored the frameworks and theories that designers can employ in their interventions for food sustainability. Through the artifact review, I learned the gaps between current tools and preferred states. The findings from my early research led to the generative activities and consequently helped me create three initial concepts for educating users about climate footprint in food. As a result, I designed an alternative food experience to demonstrate how people may learn about climate footprint in food through social interactions. Finally, I refined the food experience based on feedback from informal evaluation sessions.

Following the design principles of participation, personalization, and low effort, the design facilitates a fun and engaging food experience. It encourages users to participate in sustainable food decision-making and conversations with peers in a social environment. Over time, users can learn and internalize the concept of carbon efficiency in food. The design also minimizes the effort from users by providing personalized recipes that take the different dietary restrictions of a group into account.

## Key Points

**Multiple persuasion techniques can be leveraged in one single experience to multiply the potential effect.**

In the Foodie Friends experience, first, the shopping list stealthily introduces sustainable alternatives when users individually buy ingredients. Second, the potential social affirmation for positive environmental impacts leverages social proof. Third, intermixing questions of food sustainability and other food-related questions into step-by-step cooking instruction create opportunities for conversation on food sustainability. Obfuscating, social proof, and intermixing together can help users consider diverse perspectives and gradually change their attitudes.

**Thinking through users' actual scenarios is necessary for persuasive interventions to effectively alter behaviors, mindsets, or attitudes.**

Users can quickly detect the change of topic in their experience, especially those on food sustainability. If persuasive messages interrupt their original flow of actions, users may easily feel defensive about the designed experience. In order to naturally introduce persuasive messages, especially implicit messages on food sustainability, careful considerations of potential real-life events are needed.

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