DESIGNING FOR SUSTAINABILITY
Increasing Biodiversity Awareness in Coffee Consumption

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Coffee Consumption

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

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ACKNOWLEDGEMENT

Thanks to my wonderful advisor — Suguru Ishizaki, who guides and motivates me through out the process. I have learned so much not only about design, but also the ways of approaching problems and communicating ideas. I appreciate for the time, feedback and patience that you provided. I really enjoy being your student and working with you.

I would love to thank my family, my mom, dad and sister, for all the encouragement along the way and always have faith in me. Thank you Tom for being my best listener. I appreciate for all the time you spent with me to discuss my thesis and gave me valuable advices. Your supports are all in my heart.

I would also like to give thanks to my dear classmates, graduate design program 2014 for the supports and camaraderie. I will miss the days and nights that we worked and studied together at the studio. And finally, I am thankful to all of those (especially National Taiwan University Center of Biodiversity) who have participated and helped me to complete my thesis project.

CONTENT INDEX

ABSTRACT

The loss of biodiversity is an inevitable problem that we will need to face in the near future. According to recent scientific studies, at least 10,000 species are going extinct every year. This is a serious biodiversity crisis. Despite the significant effort of the scientific community to deal with climate change, biodiversity has been rather neglected.

Considering the impact on our everyday activities in the loss of biodiversity, this thesis explores ways to increase the public's awareness regarding biodiversity in their daily and ordinary activities. More specifically, this project focuses on human activities surrounding coffee consumption. Coffee is the second most traded commodity in the world, and most coffee trees are planted in biodiversity hot-spots. Hence the coffee production has a significant impact on local ecosystems.

This thesis project presents a possible solution to help biodiversity-friendly coffee shops to build their relationship with customers through shared value, and together move towards a more biodiversity-friendly coffee consumption experience. The final design centers on communicating the story of coffee and biodiversity by using the interactive table and the mobile application. It seamlessly integrates information, delivering into existing coffee experience.

The final result is summarized into five design principles. Although this thesis project focuses on increasing the awareness in coffee consumption, the design implications can be further applied to other issues surrounding coffee and other daily commodities.

INTRODUCTION

Deciding an appropriate scope was a challenge in this thesis project. In the field of Sustainability, biodiversity is one of the most important areas. The reasons for focusing on biodiversity were as followings: First, biodiversity loss is an irreversible and serious problem. Once the plant and animal species go extinct, there is no way to recover it. Recently, the rate of biodiversity loss is increasing dramatically due to human population growth and expansion to the natural environment. Although there is an increasing attention about sustainability, biodiversity has received less emphasis. Most of research has been done in the fields of conservation biology and environmental science, but not in design.

Second, biodiversity plays an important role in stabilizing the ecosystem. It has a positive impact to many other environmental issues, especially in mitigating the effect of climate change. Besides, the variation of all living organisms serves as a resource for human. Biodiversity is definitely the foundation of a healthy planet. It is a potential topic to target due to the power of possible influence. Therefore, I chose to focus on sustainable behaviors that relate to the conservation of biodiversity.

Most people pay attention to the nature environment, plants and animals, but they don't know the importance of biodiversity. It seems like a faraway threaten. One way to reduce biodiversity loss is to raise people's awareness and connect to daily life practices. It is the first step for people to learn about biodiversity, and start to behave sustainably.

Through my research, I discovered drinking coffee was a routine practice in most people's daily life. Furthermore, coffee closely related to biodiversity. It prompted me to think about incorporating biodiversity knowledge in common coffee drinking activity, and making coffee as an entry point for people to care about biodiversity.

The final solution was to create a biodiversity-friendly coffee experience in the coffee shop. By providing the interactive table and mobile application, it naturally engaged coffee drinkers to learn more about biodiversity-related information while drinking coffee in the coffee shop. The way it delivered information was different from current web-based and paper format. Through the interactive table, the information was easily accessible to coffee drinkers. Despite the final design was targeted in increasing biodiversity awareness specifically in coffee consumption, with the goal that the final design implications of this project could be applied to various areas in solving other sustainable issues.
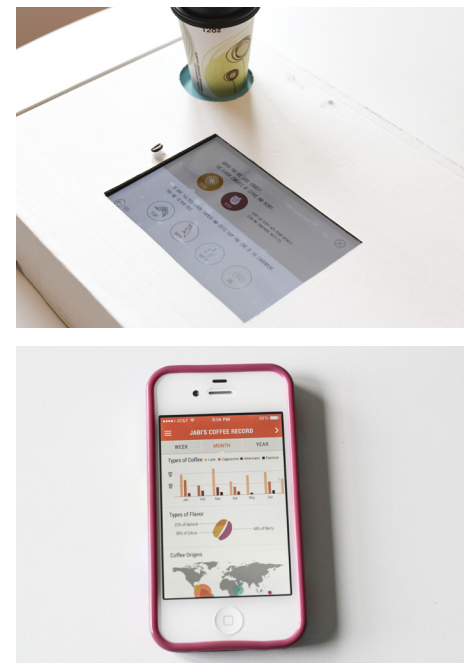

Figure 1. Interactive table and mobile application

*The IRB number of this thesis is HS13-413

RELATED WORK

I began my project by reviewing relevant literature in two major areas. The first was the overview in the area of Sustainability. The second was current research in coffee consumption and biodiversity.

SUSTAINABILITY AND PERSUASIVE TECHNOLOGY

Sustainability is a rising field in Human-Computer Interaction and Interaction Design. It includes various genres, such as persuasive technology, ambient awareness, sustainable interaction design, pervasive and participatory sensing (DiSalvo, 2010). And there are five main themes including: (1) energy consumption (2) water consumption (3) CO2 emission (4) transportation (5) waste/recycling. All the topics represent various aspects of resource consumption in human's daily life. It reveals that resource consumption related behaviors have the major impact to Sustainability.

A majority of research in Sustainability has focused on persuasive technology. The most cited paper within the corpus is BJ Fogg's paper in 1998, which articulates a framework and approach to persuasive technology (Fogg, 1998). Persuasive technology was first defined by B.J. Fogg as "an attempt to shape, reinforce, or change behaviors, feelings, or thoughts about an issue, object, or action (Fogg, 1998 ; Hronn, 2012)." According to this definition, persuasive technology uses interactive technology to change human's attitudes or behaviors (Fogg, 1998).

Intent	Function	Level of Analysis
Endogenous	Media	Individual
Exogenous	Tools	Family
Autogenous	Social Actors	Organization
		Community

Table 1. The framework of persuasive technology contains three components, intent, function and level of analysis.

(1) Intent: the intent of changing human behavior.

(2) Function: the function of persuasive technology.

(3) Level of analysis: the impact of persuasive technology.

In addition to persuasive technology, many research and projects in Sustainability have used the behavior model that Fogg proposes to change people's behavior. The behavior model (Figure 2) indicates that motivation, ability and trigger are the three elements for a behavior to occur (Fogg, 1998).

(1) Motivation: The eagerness for doing something
(2) Ability: The ability to perform the behavior
(3) Trigger: External factor to prompt certain behavior

The result helped me to realize the importance of choosing a proper scope in order to move forward since sustainability encompasses a wide range. The five major categories in Sustainability provoked me to think about other possibilities besides these themes. Another valuable thing was to understand the persuasive technology framework and behavioral model, which were used for changing behavior. It gave me a theoretical overview of the elements in persuasive technology and behavior change, which could be applied to subjects under Sustainability.

1 Raise awareness   2 Increase convenience
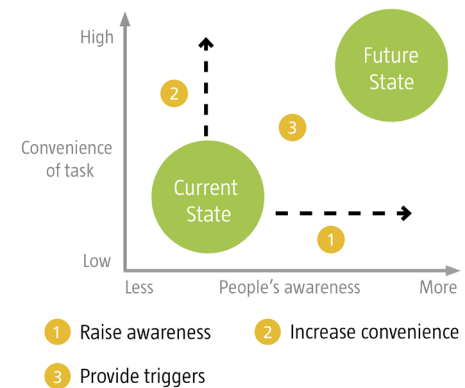
3 Provide triggers

Figure 2. The green circles represent the state of people's behavior towards sustainability. In order to motivate people to behave sustainably, there are three methods: raising awareness (motivation), increasing convenience (ability), and providing triggers (trigger).

COFFEE CONSUMPTION AND BIODIVERSITY

Researchers in conservation biology, ecology and agriculture have investigated about the impact of coffee industry to the environment, especially for biodiversity conservation. Philpott argues that most of coffee trees are planted in biodiversity hot-spots, and the main reason of the biodiversity loss is because of intensification of coffee industry (Philpott, 2008).

Because of the increasing demands in coffee, the removal of local habitat raises the concern of biodiversity loss. There are several approaches to maintain species diversity in agricultural area. Perfecto mentions some solutions such as shade coffee certification and a market-based conservation strategy. Shade coffee means the coffee is grown under the diverse and dense canopy of shade trees, which keeps part of the original plantation (Perfecto, 2005; Bhagwat 2008). Other research also indicates the importance of considering biodiversity in coffee production process. Jose A. Gobbi explains that shade coffee plantations have the potential for biodiversity conservation because the shade trees maintain the structural and floristic complexity, which serve the same function as the original forest for animals. Shade coffee not only ensures a better habitat for biodiversity, but also considering the quality of the coffee. It is a way to connect environmental and economic goals together (Mas, 2004).

In brief, the relationship between coffee and biodiversity can be summarized to three key points:

1. Eighty percent of the places that coffee trees grow are overlapped with biodiversity hot-spots. (Biodiversity hot-spot is the area with abundant species, and the amount of species is higher than other places.)

2. Five coffee production systems (Figure 3) are typically adopted: (1) traditional polyculture; (2) commercial polyculture; (3) technified shade less than 1200 m elevation; (4) technified shade greater than 1200 m elevation; and (5) unshaded monoculture. Besides planting only coffee trees, some coffee farmers keep shaded tree species with coffee trees. With the help of shade, coffee is grown under a healthier environment. It improves the coffee quality and maintains some levels of biodiversity simultaneously (Gobbi, 2000).

3. More research has noticed the important issues surrounded coffee. One of the current solutions is to support certificated coffee, such as bird-friendly and rainforest certificate, which are aware of the environment accompanied with coffee production.
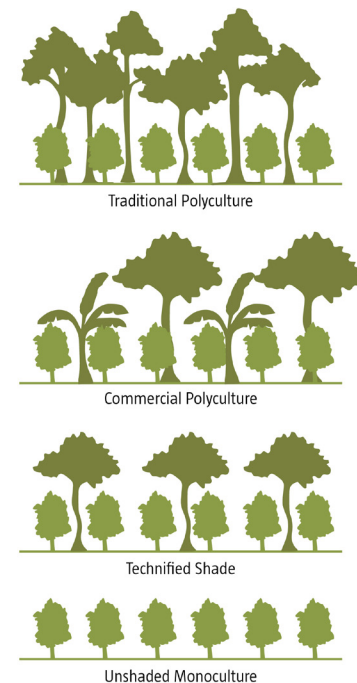
Traditional Polyculture

Commercial Polyculture

Technified Shade

Unshaded Monoculture

Figure 3. Different types of coffee production systems. *The image is modified from Gobbi, 2000.

EXPLORATORY RESEARCH

The objective in the exploratory research is to learn the broad rage of work in biodiversity related behaviors. The research activities in this stage were to understand 1. People's daily resource consumption, 2. Current relation between coffee industry and biodiversity, 3. People's attitude towards biodiversity. The results directed me to possible design directions.

DAILY RESOURCE CONSUMPTION

Considering the relation between human's life and biodiversity, biodiversity provides service and resource for all the human beings. Among all the behaviors in daily life, resources consumption has the largest influence to biodiversity. To narrow down the scope of this project, behaviors that relate to resource consumption were a good starting point. Resource consumption encompasses a wide range of things, such as food, waste, water, energy and etc. The challenge for approaching the problem was to target the specific resource consumption behavior. In this research, retrospective interview and diary study were performed to help me determine on coffee consumption.

1. Retrospective Interview
The retrospective interview was conducted with four participants to understand their resource consumption of a day. They were requested to recall, for example, their activities, food they ate, things they used and threw yesterday, and then talking about their daily consumption in general.

The following seven points summarize the key learning from the retrospective interviews:

1. Food (food compose, food package and food containers, etc) was identified the largest consumption. Paper (printer paper, post-it, cardboard) was the second.

2. In the food category, interviewees mentioned coffee and tea were the top two consumptions in their daily life.

3. People's daily consumption was shaped based on the behavior pattern they have built in the past.

4. Recycling was the most common sustainable behavior that people did in their daily life practice.

5. People were willing to take biodiversity-friendly actions. But when there were obstacles/barriers in the environment, it stopped them taking sustainable actions.

6. Making sustainable actions easy to do was important. The overall environment was not supportive for biodiversity-friendly actions to happen.

Food consumption plays a major role in people's everyday consumption. However, in the literature review of Sustainable HCI, eighty percent of the research has been done in the fields of waste, water and energy. Food consumption was a less explored area compared with those categories. The result from retrospective interview and literature review both revealed that food was an area that could be explored more.

2. Diary Study

Four participants (all students from Carnegie Mellon University) joined the diary study. Participants were asked to record their food consumption of a day. The primary goal of the diary study was to learn more details about people's food consumption experience, including food that people ate and the context. Thus, participants were asked to keep track of their food, places and daily schedule. They were also asked to take photographs when possible. The four items below summarize the key findings from diary study:

1. Participants had a wide range of food they eat, but coffee was the most common food habit that every participant had.

2. The most confusing food container was the coffee cup. Three out of four participants didn't know how to deal with it.

3. Food-related sustainable behavior was affected by the environment where people situated.

4. Participants chose food according to their established routine from the past.

I realized coffee consumption was an interesting area in dealing with biodiversity issue. Because drinking coffee is an established habit. The solution might be able to apply to other daily routines as well. Besides, the coffee production system had a huge impact to biodiversity in those coffee origins. These findings guided me in the direction of coffee consumption.
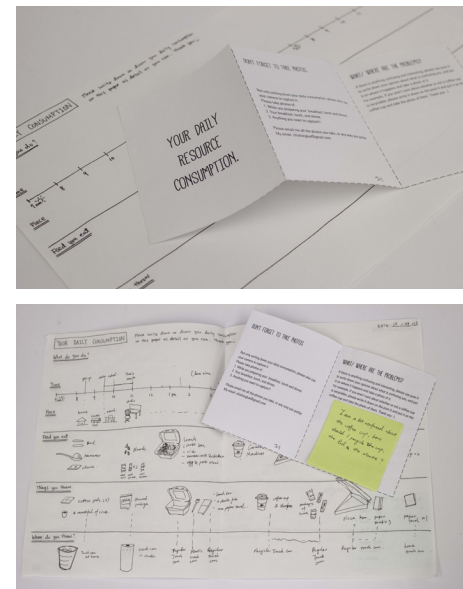

Figure 4. Participants could record their schedule, food they ate, things they threw and places they went of the day on the diary. Post-it was also provided for participants to write down any special note of their food consumption.
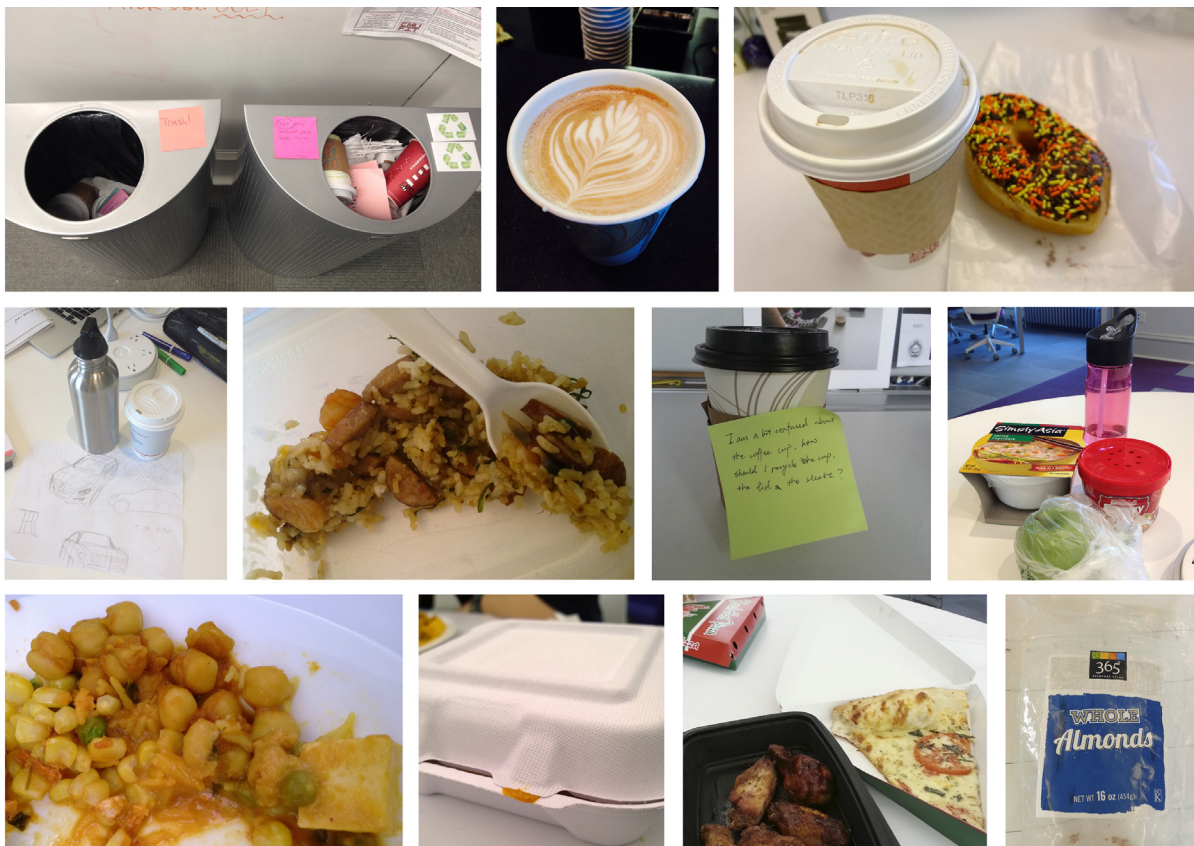
Figure 5. The photos that participants took related to their food consumption.

CURRENT STATE OF COFFEE INDUSTRY

In the previous literature review about coffee and biodiversity, I learned the knowledge from academic perspective. The fact is that biodiversity isn't totally conflict with coffee production, but what are the solutions in coffee industry now? It is also essential to understand the current state of coffee industry.

Traditional coffee production is to plant coffee under the shade of local plantations. Although the demand for coffee is increasing, the coffee prices reach to the lowest in 100 years. It results from the expansion of coffee farms and removal of original plant species in order to satisfy the market need. Therefore, coffee industry plays a very critical role in dealing with the biodiversity issue.

By interviewing three coffee experts and observing two coffee shops (Figure 6), I was able to get a brief picture of the coffee supply chain. The result supported me to identify where were the most effective and accessible points in the coffee supply chain, and what were the current solutions for biodiversity crisis.

Some facts about the current coffee industry are elaborated here in the sequence of lacking the background story of coffee, complicated coffee supply chain, and absence of connection between coffee and biodiversity.

Figure 6. Shadow the coffee drinker and observe his coffee shop experience.

The history of coffee drinking can be traced back to hundreds of years ago. The coffee supply chain is complicated, and the background story, such as coffee origin and production, is not transparent or accessible to most of customers. The current problem is that it's very hard for consumers to link the cup of coffee with its background story.

Coffee supply chain involves many stakeholders. In brief, it encompasses coffee farmers, coffee hunters, local organizations, exporters, importers, roasters, coffee bean buyers, coffee shops and finally customers. Coffee farmers have the most direct impact to local environment and biodiversity. Some of the coffee shops or roasters build their connection with coffee farmers directly, and provide educational knowledge of planting high quality and sustainable coffee to them.

More and more coffee shops pay attention to issues surrounding coffee. One of the solutions is to provide biodiversity-friendly coffee to customers. Additionally, making the information transparent to coffee drinkers is valuable for them to appreciate the cup of coffee they drink. But the current challenge is that the information is not easy to access. Most of the information is delivered online or in paper format. It requires extra effort for coffee drinkers to actively search for the information related to coffee and biodiversity.

Coffee Shop Observation

To understand the current medium that coffee shops use to deliver the information.

Figure 7.a. Information was provided in the menu at the counter.

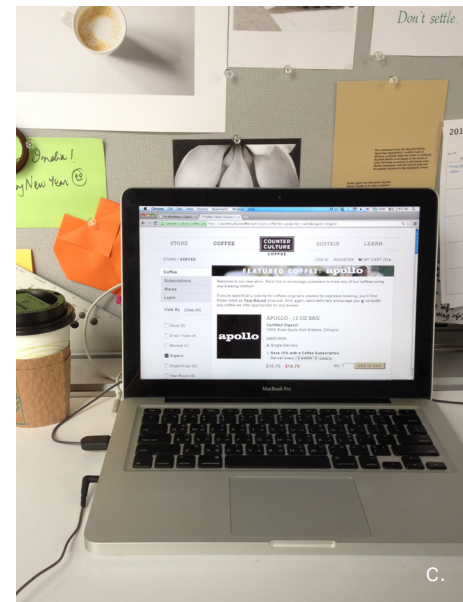Figure 7.b. More detailed information lived in the brochure in the coffee shop.

Figure 7.c. Internet stored the most holistic and complete coffee information. But it required coffee drinkers to actively search for the information.

In the coffee supply chain, farmers and customers are the most critical stakeholders, but they are the most disconnected by the opaqueness from layers of distribution in between. The absence of connection is an opportunity for coffee shops to bridge the gap. Considering the influence and accessibility, I decided to focus on coffee shops and customers at the end of the supply chain to achieve a bottom-up effect to impact coffee farms, and benefit the environment and biodiversity conservation ultimately.
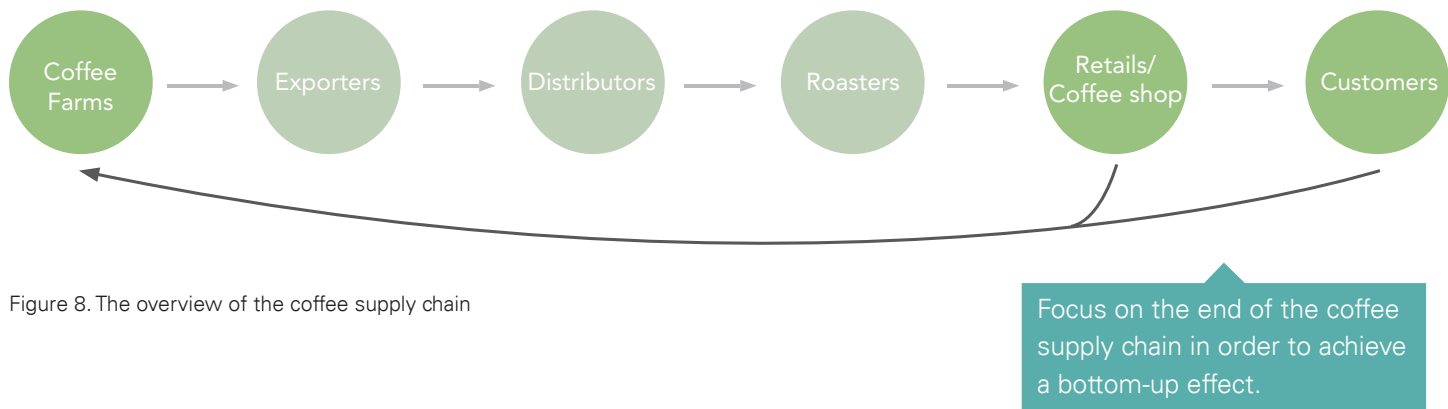

Figure 8. The overview of the coffee supply chain

Focus on the end of the coffee supply chain in order to achieve a bottom-up effect.

ATTITUDE TOWARDS BIODIVERSITY

After identifying the opportunity areas in coffee supply chain, the next step was to understand the customer's part. Five people were interviewed about their attitudes and actions towards biodiversity.

The following three findings described the five interviewees' attitudes toward biodiversity:

1. People are aware of the importance of biodiversity, and they show empathy of caring animal and plant species. The connection between coffee and biodiversity is however missed so little action is taken.

2. Although people care about biodiversity, it is a far away happening issue across the world. They don't know what actions are available to mitigate biodiversity loss in their daily life. Besides, people are curious about how do their behaviors effect the environment.

3. People are willing to know more about biodiversity-related coffee knowledge only if the information is easy to access.

The two big green circles in Figure 9 illustrate two group of people, who are my target groups in this thesis project. The goals of the final design are to
1. Increase their awareness about biodiversity, and 2. Motivate them to take actions towards a more biodiversity-friendly direction.

More action

Less awareness — More awareness
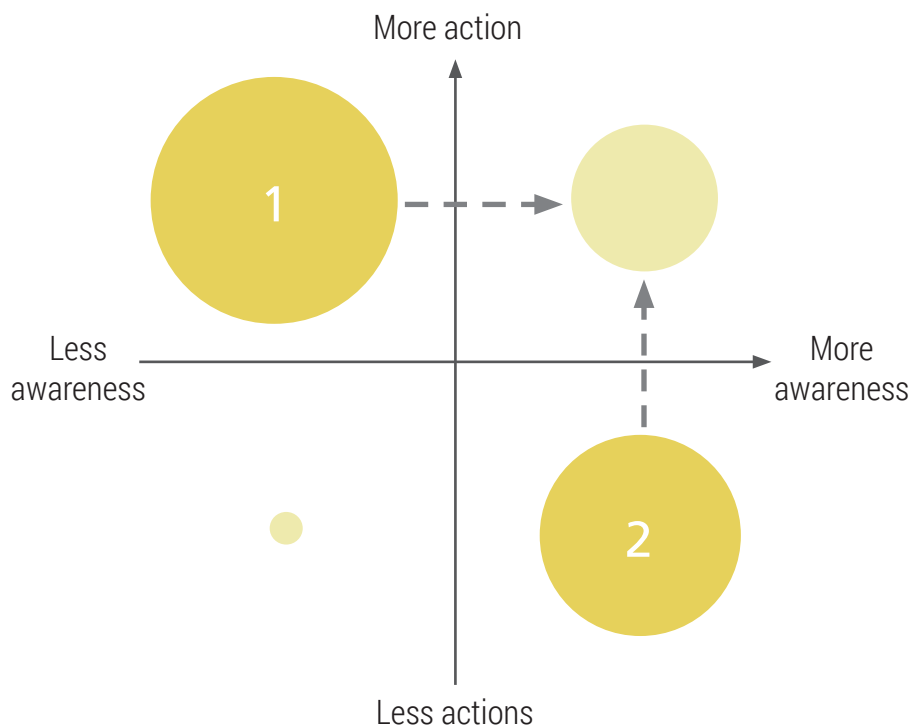
Less actions

1

2

Figure 9. This Figure represents the overview of people's awareness and actions in biodiversity. Most people are in area 1 and 2. For people in area 1, the decision of choosing biodiversity-friendly coffee shops often lies on convenience. The effort of serving biodiversity-friendly coffee is not necessarily recognized by the customers. For people in area 2, they understand the importance of biodiversity, but they don't know how to initiate changes in their daily life. It is hard to make the link between coffee and biodiversity because of the layered distribution structure in the coffee supply chain.
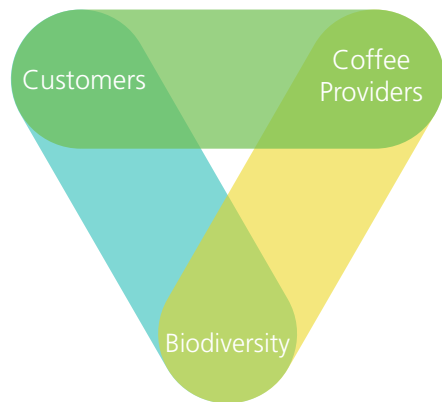
Figure 10. Considering for a biodiversity-friendly coffee experience, customers and coffee providers are the two main stakeholders in this thesis project.

In Figure 10, it summarizes the relationship among the customers (coffee drinkers), coffee providers (coffee shops) and biodiversity.

Biodiversity and Coffee Providers: Conservation Biology and Agriculture have done the research about the coffee production and biodiversity. Their research focus is to investigate a more environmentally friendly way to plant coffee.

Biodiversity and Customers: Everyone's daily life has more or less impact on biodiversity. Many current biodiversity solutions focus on how people can bring positive impact to the environment.

Customers and Coffee Providers: This is my focus area and it has the most potential for further development because less work has been done in this area. In order for sustainable actions to happen, it really requires the shared responsibility between customers and the coffee providers (coffee shops).

"It is the shared responsibility between customers and us [coffee shop]. We try our best to create a convenient environment. But at the end of the day, sustainability is all about personal responsibility."   *Coffee shop manager*

DESIGN DIRECTIONS

To achieve a biodiversity-friendly coffee consumption experience, it requires the shared responsibility between coffee shops and coffee drinkers. My problem statement is to help the coffee shop that has already provided biodiversity-friendly coffee build the relationship with customers and raise biodiversity awareness in addition.

Synthesizing from previous research, I identified three design directions that could fulfill the goal of increasing biodiversity awareness in daily life practices:

1. Embed the biodiversity-related coffee story in current coffee experience to help people learn more about biodiversity and appreciate the cup of coffee they are drinking now.

2. Use coffee as an entry point for people to think and care about biodiversity.

3. Stirring curiosity among people by initiating the conversations about biodiversity in the public space.

4. Provide benefits for both coffee shops and coffee drinkers.

GENERATIVE RESEARCH

After completing the exploratory phase of the project, I conducted two workshops to explore user experience on coffee consumption: 1. coffee experience workshop, and 2. co-design workshop. The goal of the workshop was to develop my deeper understanding about people's coffee consumption experience, and use the knowledge to generate potential design solutions that will help increase the awareness of biodiversity through activities surrounding coffee consumption.

COFFEE EXPERIENCE WORKSHOP

In order to discover the potential area for biodiversity-friendly interventions to happen, it was important to know more about the coffee consumption that people practice nowadays. The coffee experience workshop was designed to help me understand people's coffee experience in the coffee shop, and their motivations of drinking coffee. It was held in Carnegie Mellon University and 6 participants in total.

The workshop had three activities. For the first activity, participants were asked to map out their coffee experience. Afterwards, they were told to reflect on their coffee journey and write down their opinions on post-it, indicating where they have done a good job in biodiversity, and where were the barriers related to biodiversity in the journey. The last activity was to come up the solutions that could prompt themselves to be more sustainable according to the coffee journey they created.

Figure 11.a. A set of cards for participants to map their coffee journey.

Figure 11.b. Drawing and mapping out their coffee journey.

Figure 11.c. The example of the coffee journey map that a participant created. The blue post-it indicated the person's sustainable behaviors. The pink post-it represented where they could improve on sustainability. The grey post-it showed the possible solutions.

Figure 11.d. One of the solutions was to have clear indication on the recyclable coffee cup.
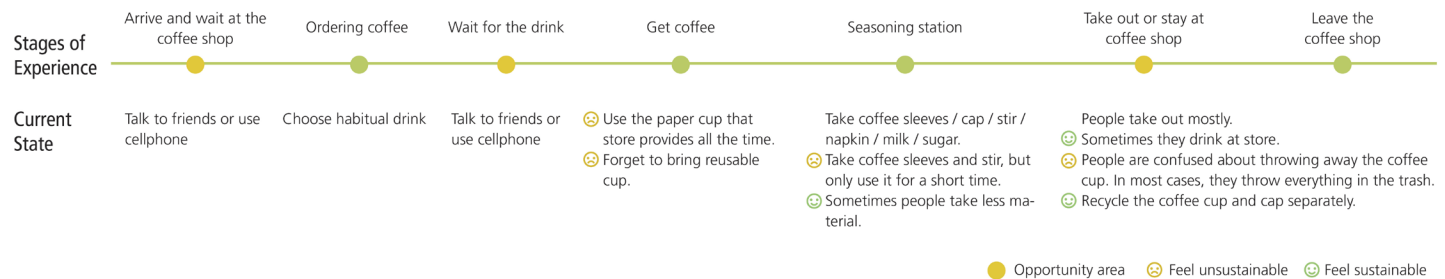
Coffee Experience Journey

Stages of Experience

| Arrive and wait at the coffee shop | Ordering coffee | Wait for the drink | Get coffee | Seasoning station | Take out or stay at coffee shop | Leave the coffee shop |

Current State

Talk to friends or use cellphone	Choose habitual drink	Talk to friends or use cellphone	☹ Use the paper cup that store provides all the time. ☹ Forget to bring reusable cup.	Take coffee sleeves / cap / stir / napkin / milk / sugar. ☹ Take coffee sleeves and stir, but only use it for a short time. ☺ Sometimes people take less material.		People take out mostly. ☺ Sometimes they drink at store. ☹ People are confused about throwing away the coffee cup. In most cases, they throw everything in the trash. ☺ Recycle the coffee cup and cap separately.

🟡 Opportunity area   ☹ Feel unsustainable   ☺ Feel sustainable

Figure 12. The summary of participant's coffee experience journey.

Two major findings from coffee experience workshop are to identify design opportunities and to understand current coffee consumption practice.

First, in Figure 12, the three yellow circles were identified as the three design opportunities in the coffee consumption experience. While waiting in line, waiting for coffee and after getting coffee, those were the timings that coffee drinkers could learn information without feeling disturbed.

Second finding was to understand the current sustainable practices in the coffee consumption experience. By asking participants to point out their biodiversity-friendly behavior in the journey, I found the sustainable practices that they did currently. Most of the ideas were about recycling material, such as coffee cups and sleeves. It wasn't obvious for my participants to think of choosing biodiversity-friendly coffee as an option towards sustainability.

Besides the workshop, online research was also conducted to know more about people's motivations of drinking coffee in general. It was important to keep those motivations in mind while designing the final concept. Motivations consist of several aspects, and I categorized them into five:

1. Social activity: Drinking coffee is a social event.

2. Craftsmanship: People look for the craftsmanship of the coffee experience, including the production phases in plant/harvest/roast coffee bean to final brewing the coffee.

3. Ritual activity: Drinking coffee is a ritual practice in people's daily life. It is highly personalized according to each person's daily life pattern.

4. The senses of the coffee: People enjoy the smell, the taste, the warm feeling in hands and the experience provided by coffee.

5. Physical need: Drinking coffee is a way to refresh mind and switch mood.

The final solution should cater to people's motivations of drinking coffee, and not interrupt or contradict their existing coffee experience.

Figure 13: Motivations of drinking coffee from online research.

CO-DESIGN WORKSHOP

As I reported in the previous section, the coffee experience workshop suggested that participants couldn't make the connection between coffee and biodiversity. This finding led me to conduct another workshop to know how people envision the biodiversity-friendly coffee consumption experience if they realized that coffee production has a huge impact on biodiversity. I collaborated with National Taiwan University Biodiversity Center to hold this workshop. Eight coffee drinkers participated the co-design workshop.

The co-design workshop included two parts. The first part introduced the information of coffee and biodiversity, which encompassed the following topics.

1. The importance of biodiversity
2. The relation between coffee and biodiversity
3. Current state of coffee industry and biodiversity
4. The problem statement: How to trigger coffee drinkers/lovers to understand the value of biodiversity? And motivate them to behave in a more biodiversity-friendly direction?

The second part of the workshop, participants were asked to brainstorm visions according to the problem statement. And then they formed groups in two and designed the solutions for a biodiversity-friendly coffee experience. The purpose was to deliver the biodiversity-related information to participants, and encourage them to come up with ideas after learning the knowledge.

Figure 14. The flyer for coffee and biodiversity co-design workshop.

Figure 15. Activities in the workshop.

Figure 16. The first activity was to invited participants to map out their coffee consumption journey. By doing this, they had a more concrete picture of their experience.

Figure 17. Participants wrote down their visions for a biodiversity-friendly coffee supply chain on post-its. They used affinity diagram to group the visions into seven themes.

According to the seven themes, they chose one theme they were interested, and collaborated with other people to think about possible solutions to achieve the vision.
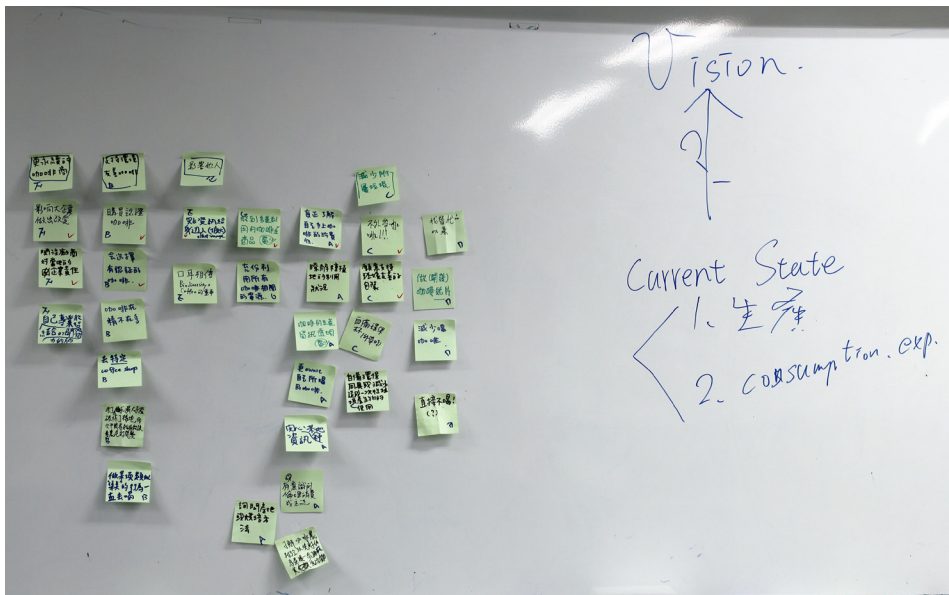
Figure 18. Then they shared their ideas with other people. In this photo, her concept was about improving the information transparency in the coffee supply chain.

Figure 19. In the end, they shared their ideas with other people and voted for the concepts based on potential and feasibility to decide which one should be developed further.
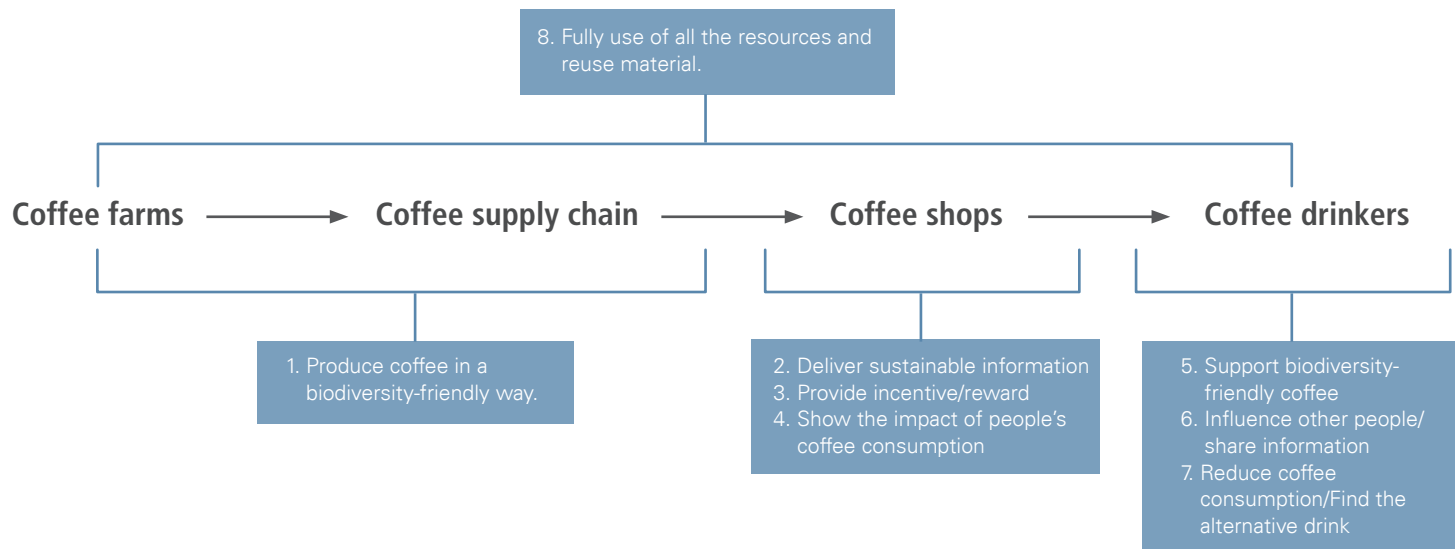
```
                    ┌──────────────────────────────┐
                    │ 8. Fully use of all the       │
                    │    resources and reuse        │
                    │    material.                  │
                    └──────────────────────────────┘
```

Coffee farms ⟶ **Coffee supply chain** ⟶ **Coffee shops** ⟶ **Coffee drinkers**

1. Produce coffee in a biodiversity-friendly way.

2. Deliver sustainable information
3. Provide incentive/reward
4. Show the impact of people's coffee consumption

5. Support biodiversity-friendly coffee
6. Influence other people/ share information
7. Reduce coffee consumption/Find the alternative drink

Figure 20. The seven visions that participants came up.

Co-design Workshop Synthesis

The co-designed workshop was successful based on the feedback that I received from the participants. On the one hand, participants were interested to know more about coffee and biodiversity. On the other hand, they said they would be more aware of the coffee they drink in the future. From here, the feedback provided valuable insight that information delivery was an effective way to increase people's awareness in biodiversity.

CONCEPT SPEED-DATING

Looking back with all the findings that I got previously, I listed down several questions to help me brainstorm ideas. For example, how to make people aware of biodiversity while drinking coffee? What if the biodiversity-related information is more accessible and engaging for coffee drinkers/lovers? And how to help the coffee shop build and maintain their relationship with customers?

Overall, eighteen ideas were generated, categorized and narrowed down to final four concepts. I showed these four concepts to five participants by using storyboards. After briefly describing each concept, participants gave their feedback and picked their favorite one. Based on their responses, I asked follow-up questions to understand more about participants' demands and desired experiences that they wanted to have.
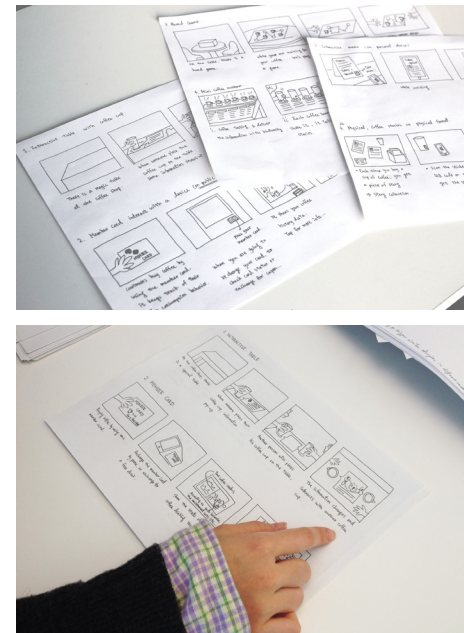

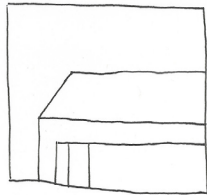Figure 21. Demonstrating the concept storyboards to participants.

Figure 22. Some ideas that participants came up during the workshops.

Figure 23. Brainstorm ideas based on the insights from exploratory research and workshops.
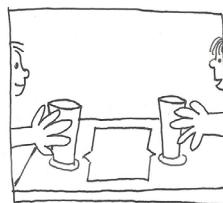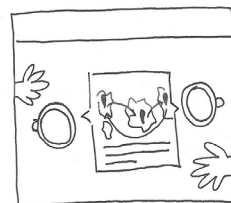
Concept Storyboards

At the coffee shop, there is a special table.

When someone places their coffee cup, information pop-up.

Another person also places his coffee cup on the table,

The information changes and interacts with another coffee cup.

An interactive table provides information about the cup of coffee in your hands when placing it on the table. It is designed for different situations. Customers can play it alone or with their friends.

2. MEMBER CARD.

Buying coffee by using the member card
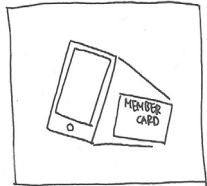
Recharge the member card by phone, or exchange for

Show the stats of your coffee drinking record

There is a big screen, showing accumulated data from all

Member card keeps track of customer's coffee drinking behavior, and provides the accumulated data in the mobile device. Biodiversity-related coffee information is presented on the kiosk when user refills their card.

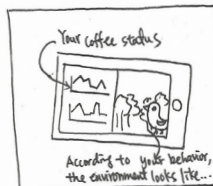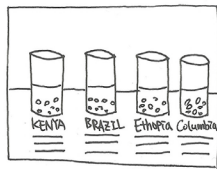## 3. MINI COFFEE MUSEUM.

Inside the coffee shop, there is a mini coffee museum to exhibit information about coffee & the nature environment.

It exhibits the back-end information of the coffee beans they choose, and their efforts for the quality coffee.
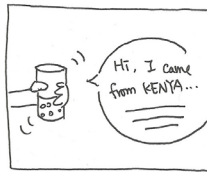
When you shake the can, it tells the story to you.

Or maybe a big interactive screen to display information related to the coffee you buy.

A special area exhibits the coffee and biodiversity story in the coffee shop.

4. BOARD GAME
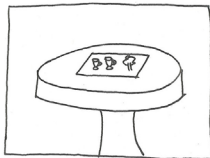
A board game on the table inside coffee shop.

change the combination of the variables.

To see whose coffee land is more sustainable, or coffee consumption choices is more biodiversity-friendly.

And display the information about the coffee that coffee shop provides. (Behind-scene story).

An educational board game that coffee drinkers can play at store while waiting and enjoying the coffee.

In the end, I pulled out all the insights that I got from the concept speed-dating sessions, and used affinity diagram to categorize them. The following points are the summaries of the feedback for each concept.

1. Interactive Table
- Four out of five participants liked this concept the most.
- It directly connected biodiversity information and the cup of coffee.
- It was naturally engaging, and nurtured conversations between customers.

" The interactive table is a surprise in the coffee shop, and the interaction is subtle."

2. Member Card
- It lacked of motivation for people to check the status on the card, and only attracted people who have already interested in sustainability.
- It was powerful to build long-term relationship and change people's behavior by showing the accumulated data.

" The way of presenting the information on the big screen was like advertisements. I just want to skip the information."

3. Mini Coffee Museum
- Using audio to tell the coffee story needed time commitment.
- Having physical exhibition for people to interact with was interesting.
- It needed to think about how to drop people in the exhibition.

" How to attract people who don't really care about sustainability to the exhibition?"

4. Board Game
- Playing a board game in the coffee shop really required time.
- It only attracted a specific group of people.
- The format of board game was nice. Users could explore and figure out the information by themselves in a fun way.

" People need to spend time on this. In most of the situation they might not want to play a game. But it is nice to have something that people can try and play."

Final Concept—Interactive Table

Based on the result from concept speed dating, I chose the interactive table as the main concept. Interactive table had the strength in delivering instant information at the time. Additionally, to make the experience more complete and have long-term influence, I incorporated merits from the member card concept to provide accumulated consumption data by using mobile application.

There is an interactive table in this sustainable coffee shop.

When placing the cup of coffee on the table, you wake up the interactive table.

The area under the cup lights up, if you touch the area...

The information pops up, which is related to story of this cup of coffee and biodiversity.

The information is related to the specific coffee that customers buy. If they don't know each other, information shows individually.

If you go to the coffee shop with friends, the information are shared. It compares the difference and similarity.

Interactive table knows people's relationship by evaluating the distance and interaction between coffee cups.

The table recognizes coffee member card as well. It presents the accumulated data of your coffee drinking behavior and links with biodiversity.
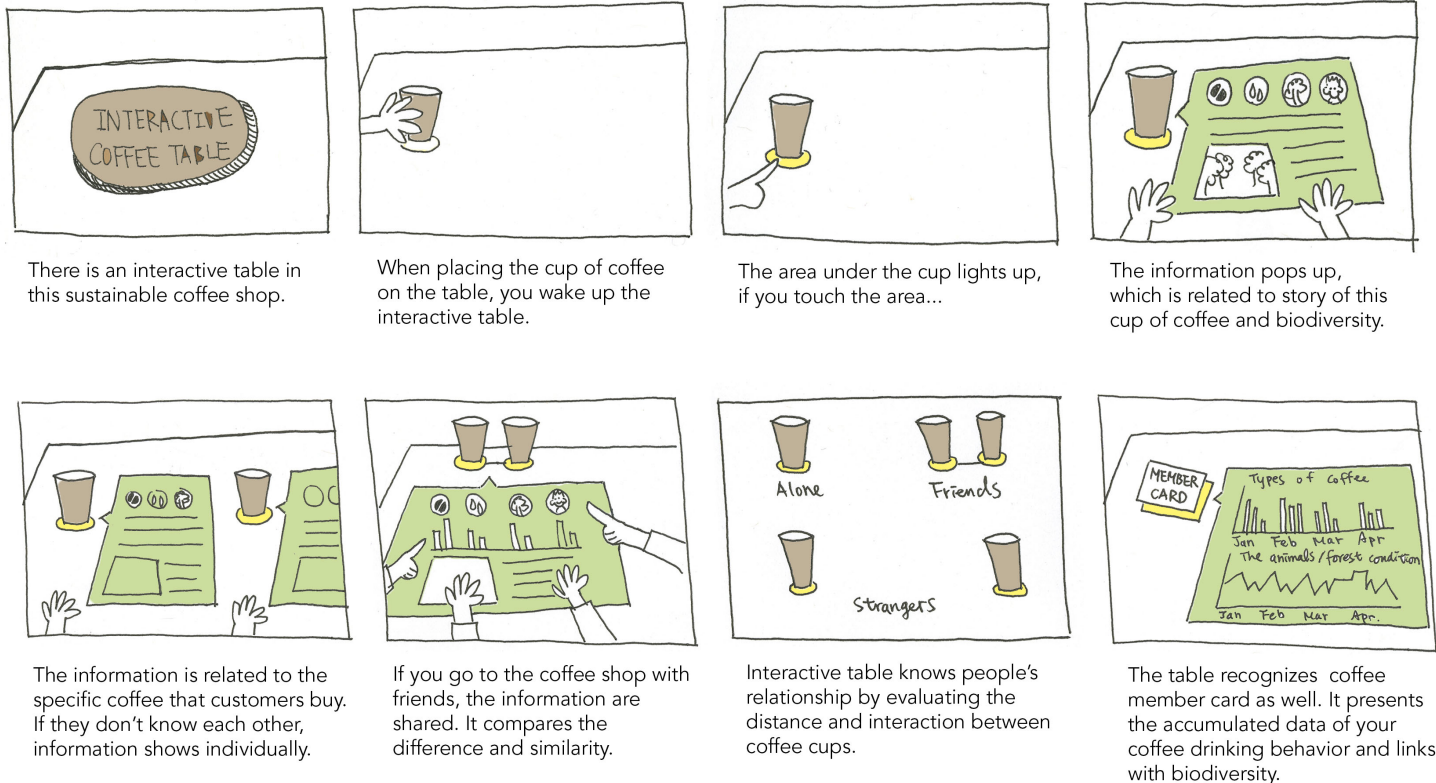
Figure 24: The storyboard of the final concept — interactive coffee table.

DESIGN ITERATIONS

After deciding the final direction, I created different types of prototypes, from low-fidelity to high-fidelity. The feedback from iterative process really supported me to design the details of the final solution.

PAPER PROTOTYPE

The goals for the paper prototype were to learn: 1. The priority of the information showed on the table. 2. Preferred ways of presenting the information. 3. Interaction among people. The paper prototype was tested with four coffee drinkers.

Two situations were introduced to participants when testing the paper prototype. One was going to the coffee shop alone, the other one was having coffee with friends. I was curious about whether or not people changed their information preference according to different situations.

Besides researching coffee drinkers' demands, I did online research to find out what is the information provided by the coffee shops now. The information included the name of the coffee, the flavor of the coffee, farmers/producers' information, harvest time, the coffee bean journey, the craftsmanship of the coffee, sustainable information related to the coffee, coffee story and local environment information. Each category was written in a piece of paper, and participants could rank the information category from what they wanted to know the most to the least interested. In order to know about the preferred ways of presenting information, the four paper prototypes were showed different ways of delivering biodiversity information to participants.
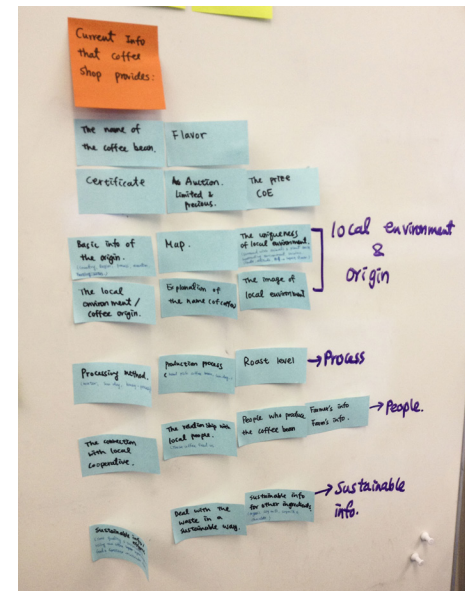

Figure 25. The information that coffee shops provide currently.

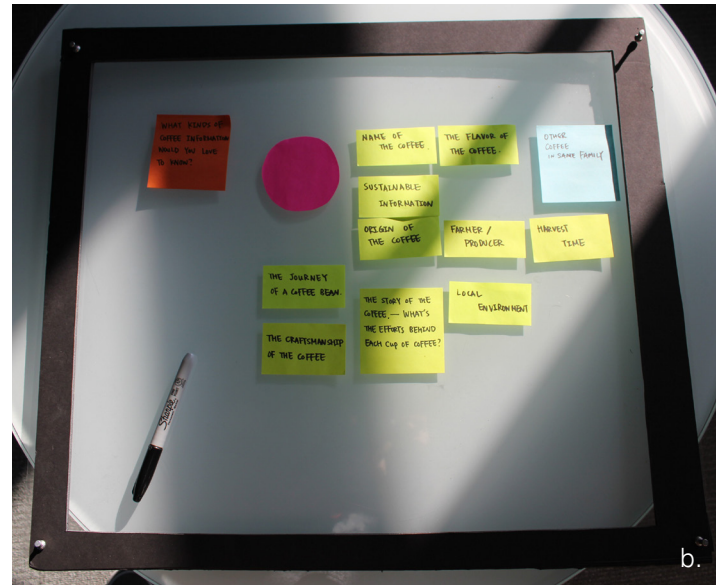Figure 26.a. Participants were prioritizing the information they wanted to know.

Figure 26.b. The information on the top, according to their prioritizing, is the one in which the participant is most interested while the bottom is the least.

The information on the interactive table could be delivered in four different ways.

Figure 27.a. Showed all the information at once.

Figure 27.b. Showed the categories first, and users could choose their interested category to receive more information.

Figure 27.c. Showed one question at one time, and used questions to prompt people to learn more information.

Figure 27.d. Showed all the questions at once, and used interactive data visualization to present the information so that people could play with the information.

Feedback of paper prototyping test was categorized in three main topics, information priority, preferred ways of presenting information, and interaction among people.

Information priority

- Overall, participants were interested in learning biodiversity-related coffee information, but it was not their first priority.

- Basic coffee information, such as coffee origins and flavor, was the information that most participants were interested and wanted to know first.

- People have the same information preference when they are alone or with their friends. But they mentioned the content should adjust to meet various situations.

- The content needed to deliver the uniqueness and specialty of the cup of coffee.

Preferred ways of presenting the information

- Use question to trigger people's interests and provide information at the same time.

- Provide accumulated data to show people's coffee consumption pattern.

- Provide rewards and feedback.

- Present the information in a fun, informative and engaging way.

Interaction among people

- Most of participants liked to sit on the same side to play and read the information together.

- Comparison and collaboration were the two preferred interactions when playing the interactive table with others.

DIGITAL PROTOTYPE

Reflecting on the previous results, most of the participants would like to receive the information through answering questions. I made a digital prototype for interactive table, and it was tested with four participants, including three coffee drinkers and one coffee shop manager.

In the beginning, I gave participants a cup of coffee, and asked them to place on the interactive table. And then the information showed on the interactive table immediately.

In the digital prototype, the first question was about the flavor of the coffee. It served as an introductory question to link the cup of coffee with customers. They needed to paid more attention to the coffee in order to answer the question. After that, the interactive table started to deliver biodiversity-related questions for users to play.

The biodiversity-related information was categorized into four areas, plants, animals, water and soil. Users could choose their interested topic and learn more information through answering questions. Each question accompanied with a proper amount of biodiversity information (For detailed information and examples please see the Appendix).

Figure 28. Using iPad to simulate the interactive table.

Figure 29.a, 29.b. The interactive table experience was simulated by embedding iPad in a white box for users to interact.

Figure 29.c. Each participant had a cup of coffee. As long as they placed their coffee on the prototype, it turned on. Participants could start to answer and play the interactive table. They were told that the information on the interactive table was related to the cup of coffee in their hands. I demonstrated the digital prototype first, then inviting participants to explore the interactive table by themselves.

Feedback of the Digital Prototype

Overall, coffee drinkers enjoyed the playing and learning experience provided by the interactive table. All the participants mentioned that they learned something new by using the interactive table prototype. They liked the introductory question starting from asking the flavor of their coffee. It aroused their curiosity about the cup of coffee that they had. For the mobile application, users felt connected to the coffee shop more by viewing their accumulated behavior data and their impact of biodiversity-friendly coffee consumption.

From the coffee shop side, making the information accessible and transparent to customers were valuable. The solution definitely could generate more benefits for the coffee shop, such as emotional connection and economic gain. To deepen the connection between the coffee shop and customers, it was also important to include the human/community information. If the final design could address other important issues at the same time, such as fair trade, it would be even more helpful for customers to understand the efforts that coffee shop made in various aspects. Furthermore, the coffee shop manager talked about providing external links for customers, so they had the ability to explore and learn more information by themselves.

Quotes from coffee drinkers:

" *I like this idea. I have never thought about the connection between coffee and biodiversity. Now I learned a new thing."*

" *I would love to see the comparison and difference between my coffee and my friend's coffee. It motivated me to learn more."*

Quotes from coffee shop manager:

" *The more information you provided to customers, the more they appreciate the coffee in their hands."*

DESIGN REQUIREMENTS

According to the feedback, I synthesized the result to eight design requirements. The details of the final solutions was designed by using these eight requirements:

1. Deliver coffee and biodiversity information in-situ.
   It is easier for users to make the connection when immersing in the context.

2. Start delivering the information from what people are interested in.
   It is necessary to attract people's attentions first and deliver inforrmation later.

3. Use questions to trigger the learning of biodiversity-related coffee knowledge.
   Questions can raise people's curiosity to learn the information.

4. Provide the information gradually.
   Showing too much information at once overwhelms users.

5. Convey positive information.
   Conveying positive information increases awareness without making people feel guilt or having negative emotion about their behaviors.

6. Include the possibility for social interaction.
   Social interaction is a way to encourage people to learn and try new things.

7. Show the impact of people's actions.
   People are curious and willing to know how much difference they can influence the environment based on their behavior.

8. Provide rewards and feedback.
   Rewards and feedback serve as triggers to motivate certain behaviors.

FINAL CONCEPT

BIODIVERSITY-FRIENDLY COFFEE EXPERIENCE

The final design is to provide a biodiversity-friendly coffee experience. It seamlessly integrates information, delivering into existing coffee experience. Biodiversity-related information is presented in two types of formats:

1. A mobile application, which provides information with flexibility and accessibility. Coffee drinkers can view the information anywhere anytime. It shows customers the accumulated data of their behavior pattern and the positive impact of their sustainable coffee consumption.

2. An interactive coffee table in the coffee shop, it provides biodiversity-related coffee information to customers. They can learn the knowledge through playing with the interactive table. It creates an integrated coffee experience for people to connect the cup of coffee in their hands with the context story.

SCENARIO

The final design lives in a coffee shop and provides the information to help customers make the connection with biodiversity while drinking coffee. The process of customers who go through a coffee consumption experience in the coffee shop shows three design opportunities for interaction.

Enter the shop → ● Wait in line → Make an order → ● Wait for the coffee → ● Get and enjoy the coffee → Leave the shop

Mobile Application   Mobile Application   Interactive Table

Figure 30. In the process of getting coffee at a coffee shop, the final solution was introduced in the timings of the coffee experience journey.
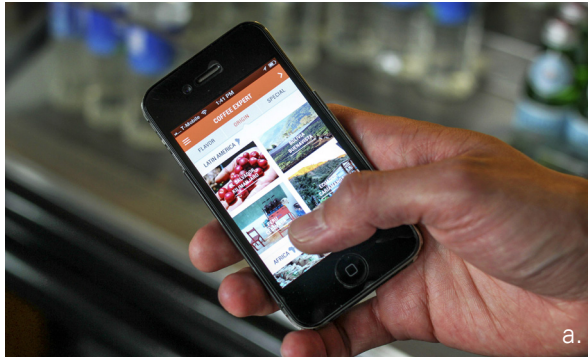
1. Mobile Application

Figure 31.a. Providing the information on mobile device allows customers to get information prior to order coffee.
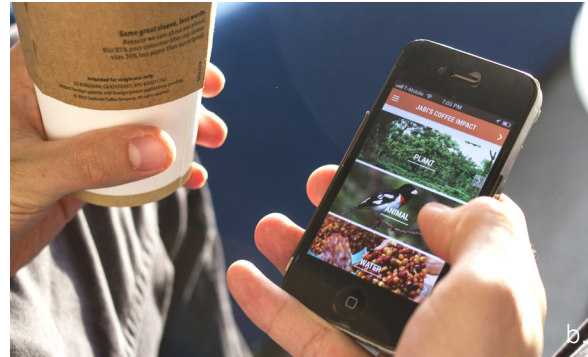

Figure 31.b. It presents the story of how their personal coffee consumption causes positive impact to the local environment by supporting biodiversity-friendly coffee.

Figure 31.c. The application keeps track of people's coffee consumption every time. The accumulated data serves as the long-term feedback to reveal their coffee consumption pattern.
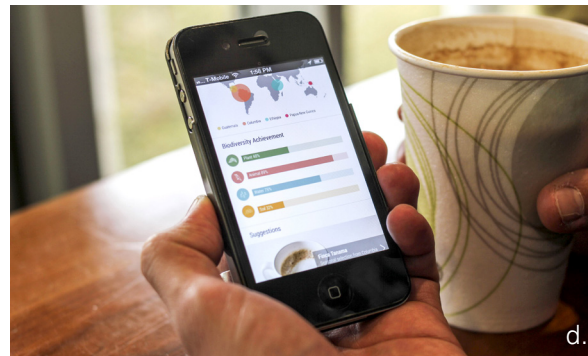

Figure 31.d. The application connects to the interactive table to record coffee drinkers' achievements of learning biodiversity-related coffee knowledge.

2. Interactive Table — Self-learning

Figure 32.a. Going to the coffee shop alone.
When placing the coffee on the interactive table, it provides information related to the customer's coffee.

Figure 32.b. Information starts from the topic in which people are most interested, such as coffee flavor or origins.

Figure 32.c. After answering the introductory question, biodiversity-related knowledge is introduced.
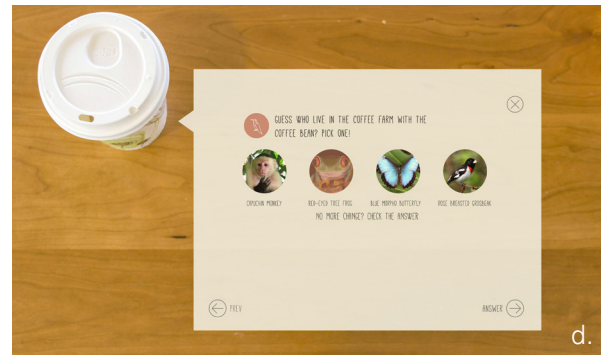

Figure 32.d. Coffee drinkers can play and learn more about biodiversity by answering a series of questions.

3. Interactive Table — Social Interaction

Figure 33.a. Going to the coffee shop with a friend. The interactive table presents the shared information.

Figure 33.b. They can play the interactive table together and answer questions collaboratively.

Figure 33.c. Playing with other people opens up different ways of interaction. By comparing the information, it prompts coffee drinkers to learn more.
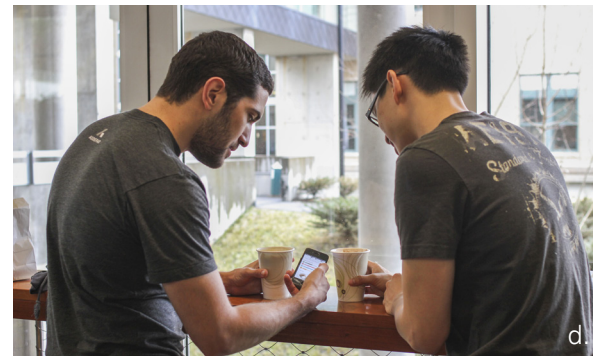

Figure 33.d. Start a conversation of coffee and biodiversity in the coffee shop.

VALUE FLOW

The value flow graph (Figure 34) demonstrates the systematic view of the final design. For coffee shops who provided biodiversity-friendly coffee to customers, if they made biodiversity information accessible to coffee drinkers, customers may appreciate their effort and value more. With the increased biodiversity awareness in the public, which produced a positive impact to the environment in the end. And if more and more customers supported the coffee shop, it helped the coffee shop to maintain their business. Because of the rising interest in biodiversity-friendly coffee, it created another positive impact on the coffee farmers, which motivated them to plant coffee in a more biodiversity-friendly way. The final design needed not only to sustain the environment, but also the business simultaneously.
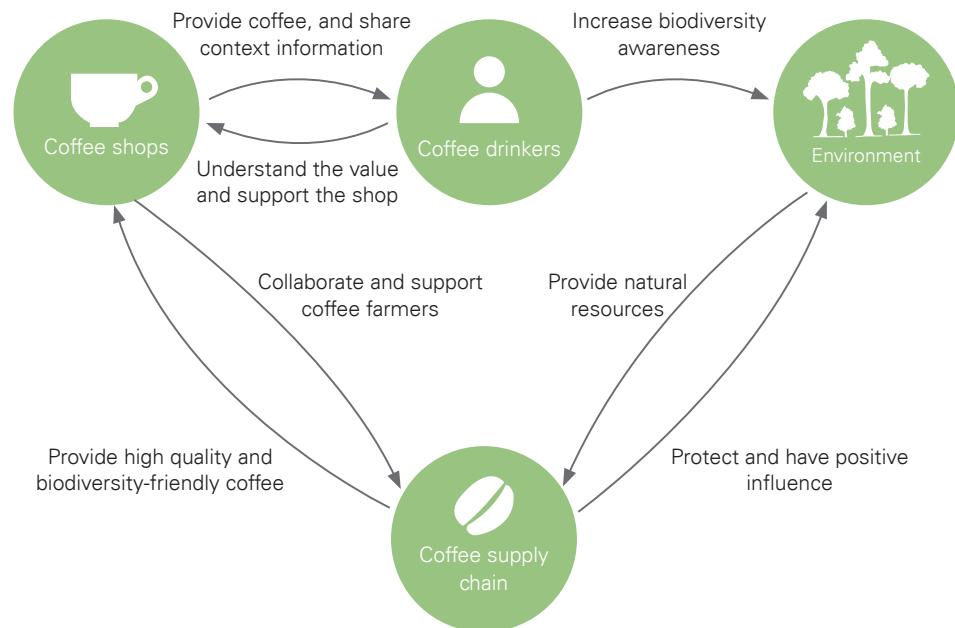

Figure 34. The value flow of the final solution. It illustrates the exchanged value among the key stakeholders in the whole system.

CONCLUSIONS

Most of people don't actively search for the information related to biodiversity and sustainability partly due to limited exposure and low accessibility to the information source. This however implies the huge potential for growth considering the uncharted audience. In this thesis project, I have explored the possibilities to increase the awareness into daily practices. I believe that this project is a successful demonstration to solve biodiversity problems by focusing on a specific daily life routine — coffee consumption.

Coffee drinkers are willing to learn more about coffee and biodiversity, and they can also push the industry to produce a positive impact to local environment. But they lack the supportive environment to learn the information conveniently.

I proposed a solution with the help of the interactive table and mobile application to complement the coffee consumption experience. The final concept is not only about communicating the biodiversity information, but it is also about the experience. The interactive table delivers the information in handy, and raising people's biodiversity awareness in advance at the coffee shop. The mobile application connects all the previous coffee experiences together. Through out the design process, the insights that I identified in the research phases guided me to the final design. And the feedback that I received in prototyping test showed users favored for the final solution. It successfully incorporates the information in current coffee experience, and nurtures the possibility for social interaction in learning biodiversity knowledge.

DESIGN IMPLICATIONS

The project tackled biodiversity problem in coffee consumption specifically. But the final result of this thesis project can extend beyond the initial goals. Through out the whole project, the overall findings were synthesized to the design implications. These five design implications could be further applied to influence other areas in the future.

1. Deliver the information within the context

2. Help people to make connection and feel the impact of the commodity

3. Encourage social interaction while providing the information

4. Provide an engaging and informative experience

5. Show behavior pattern and serve it as a long-term feedback

FUTURE WORK

This project has presented a holistic and concrete example of providing a biodiversity-friendly coffee experience in the coffee shop. This thesis project was designed for the real context and tested with several target users. However, when conducting this project, the scope and time frame were limited. There are more explorations that can be done in the future. To further build on my thesis, there are two directions that can be considered.

For the future development of this thesis project
- Conduct prototyping test in the real space.
- Carry out prototyping test with more participants for a longer time frame.
- Explore more about possible social interactions.

For future implementation
- Expand the design requirements to other coffee issues.
- Implement the design implications to other commodities.
- Evaluate the long-term influence on behavior change.

AFTERTHOUGHT

Reflecting back, it was a long and fruitful journey. I was ambitious about this thesis project in the beginning, expecting the final result could have some positive impact to the world. I don't know how much does it change the world but what I am certain about is it definitely changed some part of me. The process of doing the thesis is a way of understanding myself. It helped me to realize how I pursue knowledge and create things.

In the whole process, the biggest challenge for me was to define the scope. Finding the potential area to focus is important for the limitation on time and resources. The beginning part of the research was where I had struggled the most. If I knew coffee was the potential area in the staring point, I would spend more time and effort in learning about coffee industry and people's coffee experience. But the interesting part was that, if I hadn't been through that winding path, I didn't have the chance to discover coffee was the treasure land. Looking back to the process, everything I did is like a dot, and doing thesis was like connecting all the dots.

Spending almost 10 months and being around in such a resourceful environment, I really appreciate for this opportunity to do this thesis. I always wish to do a project that I can combine my background in biology with my skills in Interaction Design. For me, biology is about seeking the truth and understanding the facts in the nature. And interaction design is about shaping human behavior and providing a better solution in people's life. This thesis project realizes my dream.

REFERENCES

Bhagwat, Shonil A., et al. "Agroforestry: a refuge for tropical biodiversity?." *Trends in ecology & evolution* 23.5 (2008): 261-267.

Broms, Loove, et al. "Coffee maker patterns and the design of energy feedback artefacts." *Proceedings of the 8th ACM Conference on Designing Interactive Systems.* ACM, 2010.

Caudill, S. Amanda, Philippe Vaast, and Thomas P. Husband. "Assessment of small mammal diversity In coffee agroforestry in the Western Ghats, India." *Agroforestry Systems* 88.1 (2014): 173-186.

Davis, Janet. "Early experiences with participatory design of ambient persuasive technology." *CHI EA 2009* (2009).

DiSalvo, Carl, Phoebe Sengers, and Hrönn Brynjarsdóttir. "Mapping the landscape of sustainable HCI." *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems.* ACM, 2010.

Fogg, Brian J. "Persuasive computers: perspectives and research directions." *Proceedings of the SIGCHI conference on Human factors in computing systems. ACM Press/Addison-Wesley Publishing Co.,* 1998.

Fogg B. "A behavior Model for Persuasive Design." *Persuasive '09* .ACM 2009.

Froehlich, Jon, Leah Findlater, and James Landay. "The design of eco-feedback technology." *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 2010.

Gobbi, José A. "Is biodiversity-friendly coffee financially viable? An analysis of five different coffee production systems in western El Salvador." *Ecological Economics* 33.2 (2000): 267-281.

Hronn Brynjarsdottir , Maria Håkansson , James Pierce , Eric Baumer , Carl DiSalvo , Phoebe Sengers. "Sustainably unpersuaded: how persuasion narrows our vision of sustainability." *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems,* May 05-10, 2012

Mas, Alexandre H., and Thomas V. Dietsch. "Linking shade coffee certification to biodiversity conservation: butterflies and birds in Chiapas, Mexico." *Ecological Applications* 14.3 (2004): 642-654.

Perfecto, Ivette, et al. "Biodiversity, yield, and shade coffee certification." *Ecological Economics* 54.4 (2005): 435-446.

Philpott, Stacy M., et al. "Biodiversity loss in Latin American coffee landscapes: review of the evidence on ants, birds, and trees." *Conservation Biology* 22.5 (2008): 1093-1105.

APPENDIX

INTERACTIVE TABLE EXAMPLES — SELF-LEARNING

There are four categories, plant, animal, water and soil. Each category has a series of questions that users can play and learn biodiversity-related coffee information. The following shows three examples from three different categories — animal, water and plant.
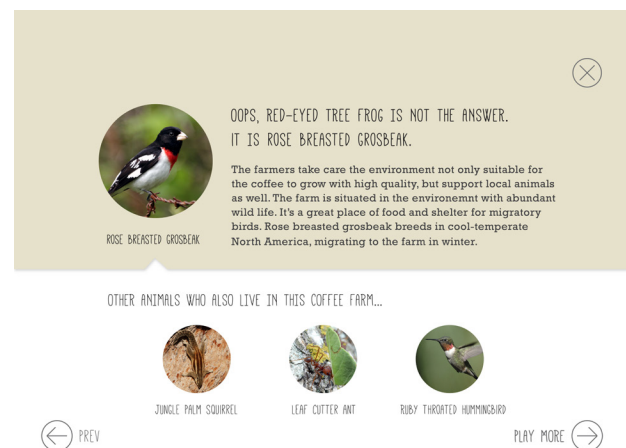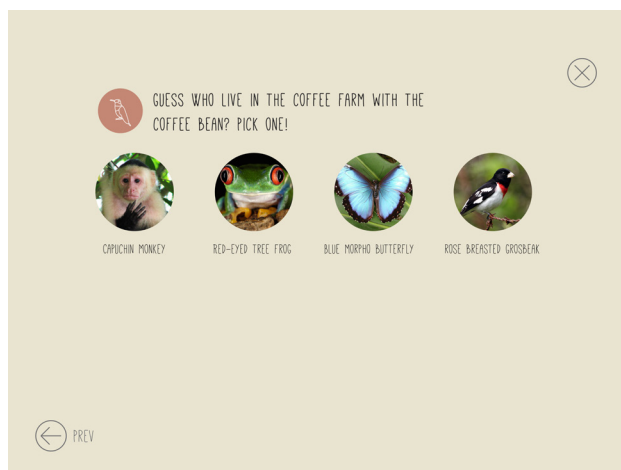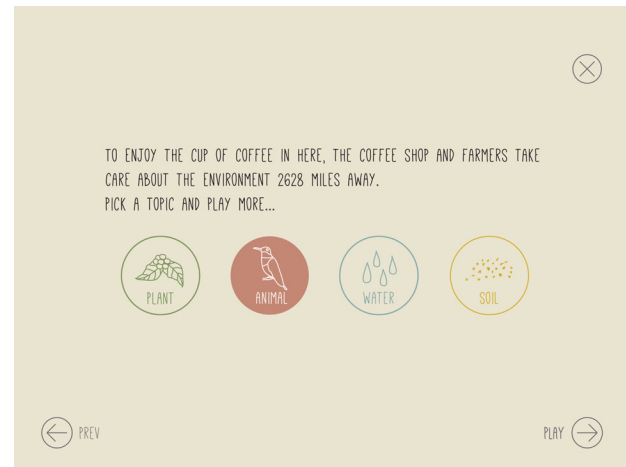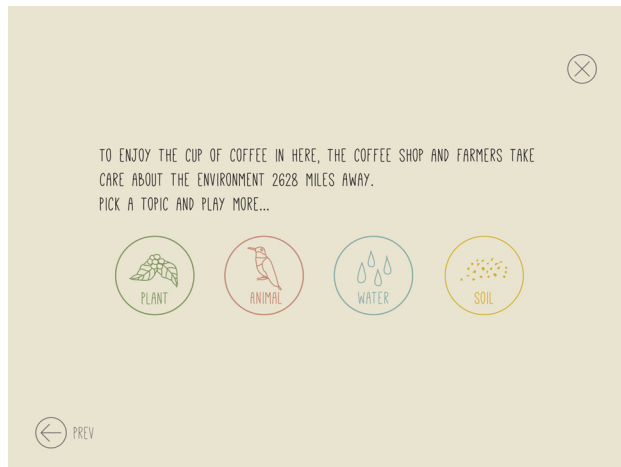
Panel 1 (top left):

TO ENJOY THE CUP OF COFFEE IN HERE, THE COFFEE SHOP AND FARMERS TAKE CARE ABOUT THE ENVIRONMENT 2628 MILES AWAY.
PICK A TOPIC AND PLAY MORE...

PLANT   ANIMAL   WATER   SOIL

PREV   PLAY

Panel 2 (top right):

HOW MUCH WATER DOES THIS COFFEE NEED FROM PRODUCTION TO REACH TO YOUR HANDS NOW?   = 1 GALLON

PREV   ANSWER

Panel 3 (bottom left):

HOW MUCH WATER DOES THIS COFFEE NEED FROM PRODUCTION TO REACH TO YOUR HANDS NOW?   = 1 GALLON

PREV   ANSWER

Panel 4 (bottom right):

THE WHOLE PROCESS NEEDS MORE WATER THAN YOU THINK. IT TAKES 37 GALLONS TO PRODUCE ONE CUP OF COFFEE.

Don't worry. All water used during the production and processing is filtered before it is released into nature again. And it will be reused for other purposes. There is no use of chemicals. The farmers do their best to protect the natural environment.

PREV   PLAY MORE

TO ENJOY THE CUP OF COFFEE IN HERE, THE COFFEE SHOP AND FARMERS TAKE
CARE ABOUT THE ENVIRONMENT 2628 MILES AWAY.
PICK A TOPIC AND PLAY MORE...

PLANT   ANIMAL   WATER   SOIL

CAN YOU IMAGINE MY LIVING ENVIRONMENT?
PLANT YOUR COFFEE FARM AND CHOOSE THE PLANT.
YOU CAN PICK MORE THAN ONE.

COFFEE TREES   CROP TREES   LOCAL TREES

CAN YOU IMAGINE MY LIVING ENVIRONMENT?
PLANT YOUR COFFEE FARM AND CHOOSE THE PLANT.
YOU CAN PICK MORE THAN ONE.

COFFEE TREES   CROP TREES   LOCAL TREES

YES! YOU ARE RIGHT!
YOUR COFFEE IS GROWN UNDER THE CANOPY OF LOCAL TREES.

This kind of agricultural system is called rustic shade-grown
coffee. It is a perfect environment for producing high quality
coffee and taking care of local animals and plants. This coffee
has organic shade-grown certification.

Lean more about shade-grown coffee:
http://en.wikipedia.org/wiki/Shade-grown_coffee

INTERACTIVE TABLE EXAMPLES — SOCIAL INTERACTION

The interactive table also enables coffee drinkers to play it with other people. It demonstrates the comparison between different cups of coffee.


Two cups of coffee came from different origins. The interactive table triggers people to learn biodiversity information by presenting the difference.
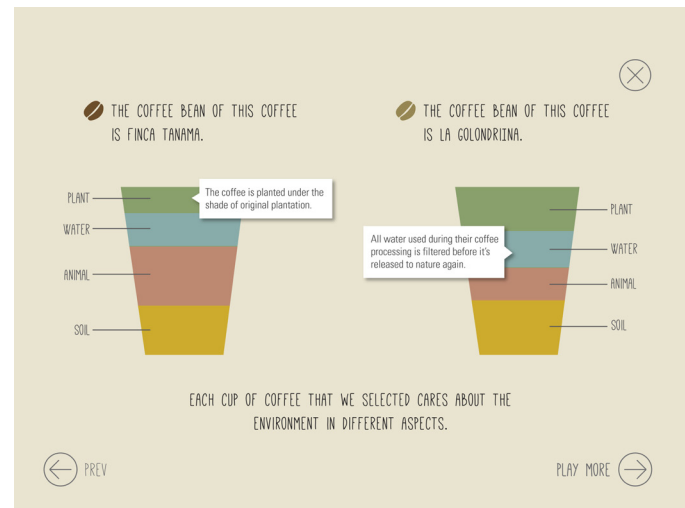

Instead of showing the disadvantages, it shows the positive information of each cup of coffee, such as how the cup of coffee does a good job in biodiversity with different perspectives.

MOBILE APPLICATION

The mobile application contains three parts, coffee expert, coffee impact and accumulated coffee record.
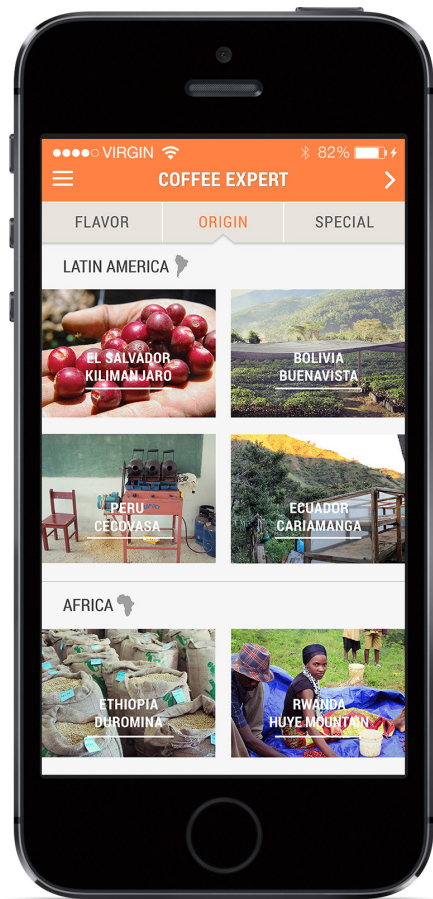

Coffee expert helps coffee drinkers to learn more about the biodiversity-related information of the coffee bean that coffee shop provides.
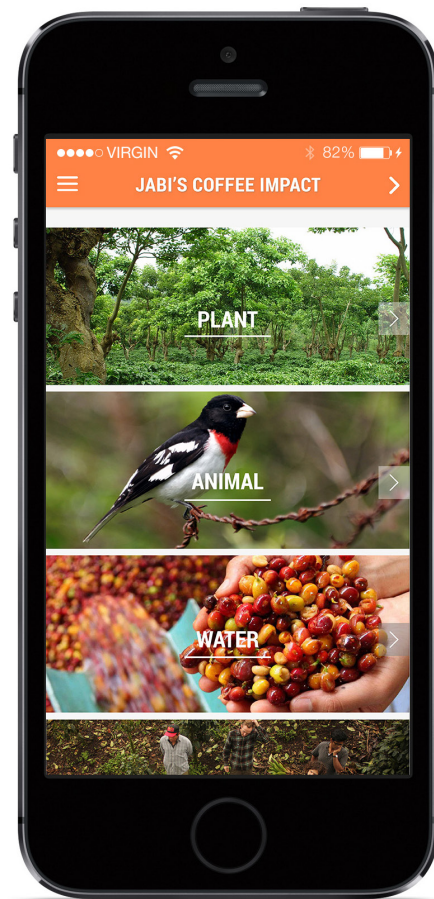
Personal coffee impact shows the positive influence of coffee drinker's biodiversity-friendly consumption to the environment.

Left phone screen:

●●●●○ VIRGIN 📶 ⚡ 82% 🔋

JABI'S COFFEE RECORD

| WEEK | MONTH | YEAR |

Types of Coffee ■ Latte ■ Cappuccino ■ Americano ■ Expresso

Jan   Feb   Mar   Apr   May   Jun

Types of Flavor

22% of Apricot
30% of Citrus
48% of Berry

Coffee Origins

● Guatemala ● Columbia ● Ethiopia ● Papua New Guinea

Right phone screen:

●●●●○ VIRGIN ⚡ 82%

● Guatemala ● Columbia ● Ethiopia ● Papua New Guinea

Biodiversity Achievement

Plant 48%
Animal 89%
Water 75%
Soil 32%

Suggestions

Finca Tanama
Seasonal selection from Columbia
Flavors of citrus and red berries

Accumulated coffee record keeps track of coffee drinker's coffee drinking behavior as the long-term feedback for them to reflect on their coffee consumption.
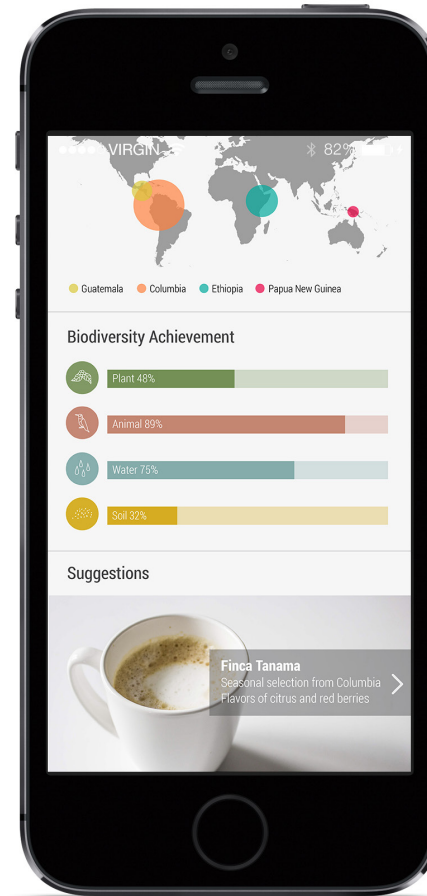
And it also links with the interactive table to record the status of how much information that people have learned.