Tea Frog

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INTRODUCTION

Tea Frog is a hyper-casual mobile game about a frog that runs a tea shop, produced for both iOS and Android. Players control the frog with swipes and taps in order to fulfill customer requests in a timely manner. Their goal is to go as long as they can without missing any orders, gaining more points for faster order responses.

CONTEXT OF HCI APPLICATION

Hyper-casual games are games that are meant to be played in short amounts on a mobile device. The typical user might play them on the bus to work or in the waiting room of an office. It's a light, non-mechanic-intensive game that is easy to pick up, easy to master, and low-commitment.

NEEDFINDING ANALYSIS

To conduct a needfinding analysis for this hyper-casual game application, we would first develop a set of questions to conduct a structured interview to be completed either in person or as an online survey. These questions would seek to find what our target audience or stakeholders spend their time, specifically their downtime, doing. Our guiding questions would prompt short, yet informative, responses that would give us a sense of when and where our audience may use our application. Some of our guiding questions would be:

- What does your average weekday look like (in terms of work/school/commuting/errands/activities)?
- Do you ever experience boredom in waiting periods or in time between activities?
- If you answered yes to the above question, how do you usually resolve your boredom?

We would also employ "laddering" as a method of deriving the implicit causes of our audience's behaviors, as outlined by Stanford's HCI group "Design Methods - Needfinding" document. This would involve asking *why* as a follow up question to those listed above. These *why* questions would be:

- Why do you think you feel bored at that time?
- Why do you choose to resolve your boredom in that way?

Ideally, both the *guiding* and *why* questions would reveal to us when and where our target audience might be interested in playing a hyper-casual game.

Hyper-causal games are designed to generate a lot of attention in a mobile app store, leading to many downloads. For that reason, they are often meant to appeal to a very wide audience, as wide as any individual who regularly uses a smart device. Keeping this in mind, we would want our needfinding analysis to address this large user base, so we would seek out two populations: social media users (such as Twitter users) and a more general and varied group (such as grocery shoppers). Ideally, these two populations would be made up of multiple sources. For Twitter, we would want the online survey to reach as many people as possible, and not just the individuals in one social circle. As such, it would be best for the online survey to be posted from multiple different sources, so that it could reach different groups of users. For face-to-face grocery store interviews, it would be best to survey in different areas with varying demographics, rather than at a number of stores in one region.

Altogether, the goal of this needfinding analysis for our hyper-casual game application would be to narrow down our initial target audience. It would be unnecessary to consider users in the wide audience who are seeking to limit their screen time or don’t experience boredom when they have downtime, so we would instead focus on the interests and habits of the other users in the survey. Their interests and habits would hopefully help us guide our game design and marketing strategy for the application.

MAJOR FUNCTIONAL REQUIREMENTS

Hyper-casual games require, at a high-level: a main menu for player to navigate to other menus and to the actual game, an options menu for allowing players to adjust audio/visual elements, the actual gameplay with a single mechanic, visual feedback that lets the player know what the game status is, a pause menu that allows them to adjust settings and return to the main menu mid-game, and a help/info page that gives them instructions on how to play the game, as well as report any issues they encountered to the developers. Looking at the application at a lower-level, a hyper-casual game must also satisfy a few mobile-game-specific requirements, namely: simple button controls that are easy to master, well-balanced on-screen real estate that considers different screen-size, appropriate feedback in lieu of tactile feedback from an actual button, start, pause, and interrupt gameplay smoothly, providing players with goals and rewards, and make tutorials simple so the game itself is more accessible and easy to learn.

FUNDAMENTAL INTERACTION TYPE

The player primarily interacts with the game by swiping, left, right, up and down on their screen. Players will navigate through the starting menu this way, swiping left and right to switch options, and swiping upwards to select that option. Then, within the game, players will swipe in four directions to control their frog.

We selected this because of the platform and because of Fitts' Law. Since this is a game designed to be used on mobile phones, swiping is one of the fundamental gestures used to interact with touch screens. It's low-effort, can be broadly placed (e.g., swiping from the top or bottom of the screen). We also refer to Fitts' Law, which favors radial menus for their broad widths that mean it takes less time to get to them. While this is not directly a radial menu, the ability of the user to swipe in a direction rather than seeking out a specific button will ease their load in navigating through the game. Since the goal of the game is to be very light and casual, this interaction style works well for what we're trying to achieve.

NON-WIMP INTERFACE*

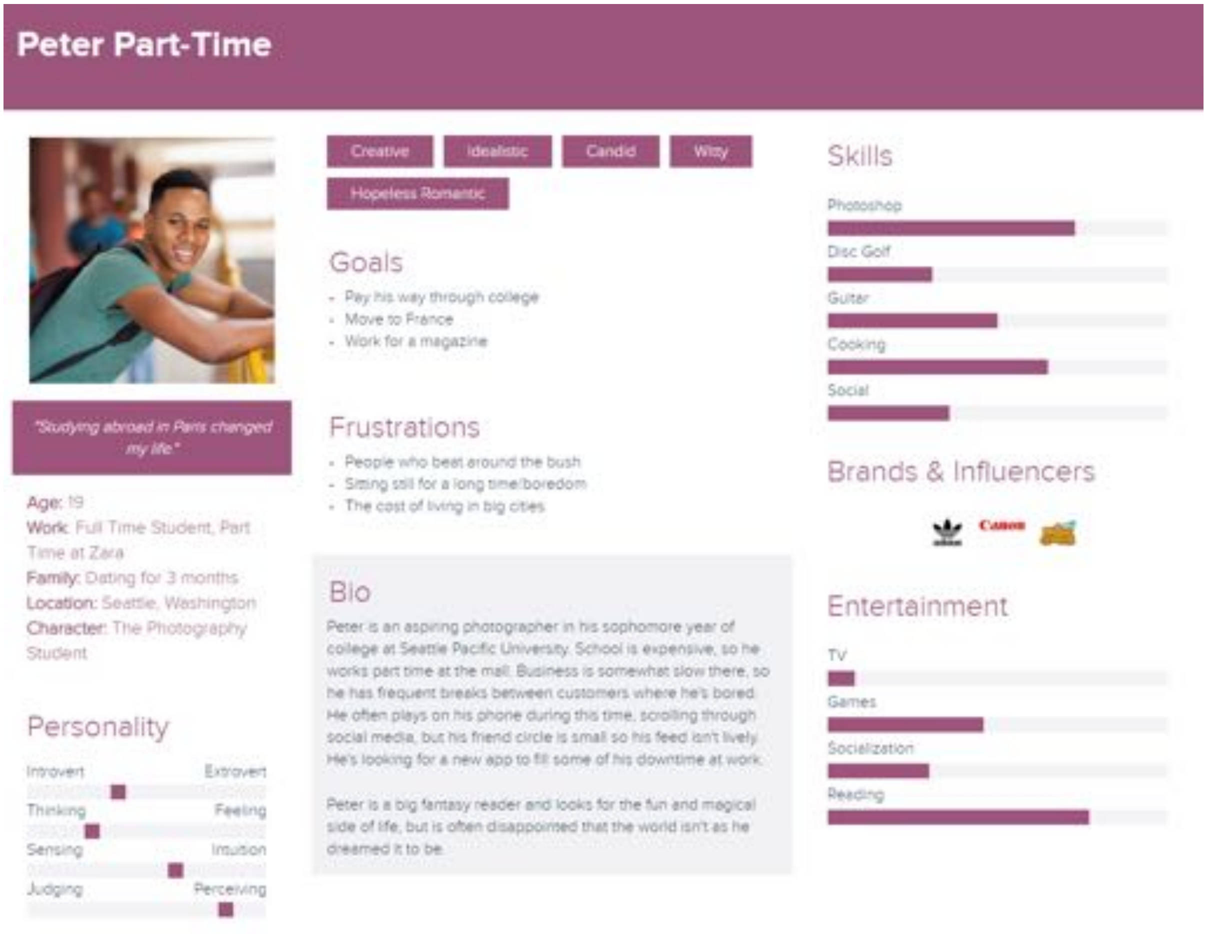
In designing our application we opted for a non-WIMP interface to create a unique experience for the user. Our post-WIMP features are primarily swiping gestures used to navigate the application, which we consider to be an instrumental interaction that allows the user to interact directly with the application, rather than navigate through buttons. Our application still features menus, but forgoing buttons and point-and-click interaction gives the user more direct control over the interface. In the game itself, the user uses up and down swipes as a means to either clear or send an order, so this instrumental interaction continues beyond the menus.

DESCRIPTION OF USER TYPES

The primary users of this application are smart-phone owners who frequently play the game. These users likely have the application on the front-page of their mobile device or elsewhere that is easily accessible. Secondary users are either those who play the game infrequently or those who watch others play the game. Infrequent players likely have the application stored in a folder on their device. Tertiary users would include developers and publishers of the application, any individual who has stakes in either of those groups or companies, developers and publishers of other applications released on the same platform, individuals who interact with primary or secondary users of the application on a regular basis (such as family members or colleagues), and individuals responsible for creating the environment in which primary or secondary users interact with the application (such as classrooms, public transportation, or waiting rooms).

PERSONAS

The personas created to guide the creation of this hyper-casual game are Peter Part-Time, a student who works a part-time job, and Sally Soccer, a stay-at-home mom with a son who plays soccer. See Figure 1 and Figure 2 for the complete profiles.



Peter Part-Time

"Studying abroad in Paris changed my life."

Age: 19
Work: Full Time Student, Part Time at Zara
Family: Dating for 3 months
Location: Seattle, Washington
Character: The Photography Student

Personality

Introvert
Extrovert
Thinking
Feeling
Sensing
Intuition
Judging
Perceiving

Creative | Idealistic | Candid | Witty | Hopeless Romantic

Goals

- Pay his way through college
- Move to France
- Work for a magazine

Frustrations

- People who beat around the bush
- Sitting still for a long time/boredom
- The cost of living in big cities

Bio

Peter is an aspiring photographer in his sophomore year of college at Seattle Pacific University. School is expensive, so he works part time at the mall. Business is somewhat slow there, so he has frequent breaks between customers where he's bored. He often plays on his phone during this time, scrolling through social media, but his friend circle is small so his feed isn't lively. He's looking for a new app to fill some of his downtime at work.

Peter is a big fantasy reader and looks for the fun and magical side of life, but is often disappointed that the world isn't as he dreamed it to be.

Skills

Brands & Influencers

Entertainment

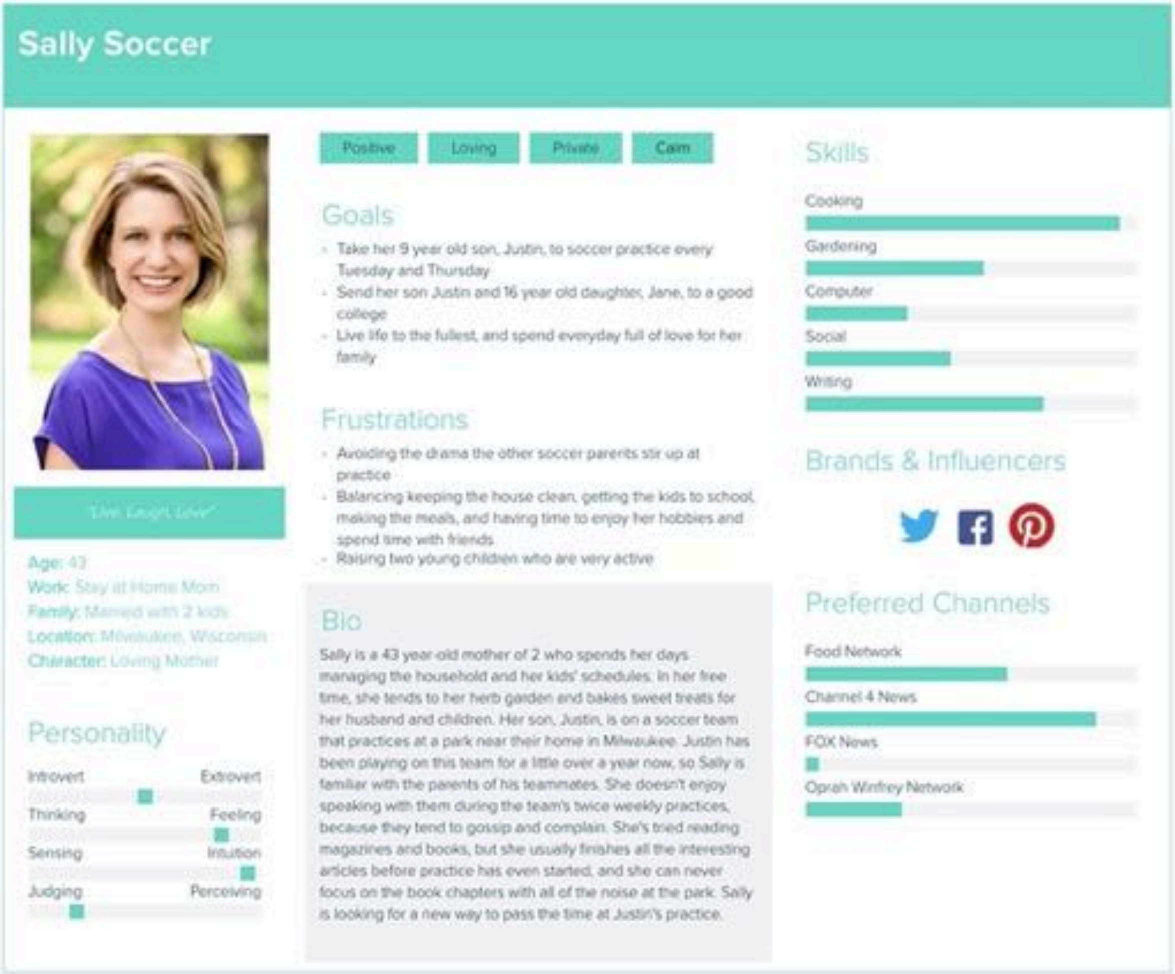
Figure 1: Peter Part-Time Persona

STORYBOARDS

We created 3 storyboards for the following tasks: Using the main menu, tapping gameplay, and feedback in the game when serving a customer.

The first interaction we storyboarded for is the main menu swiping interactions. The Menu Screen (pictured in Figure 3) is the first screen players encounter when they start the game. In keeping with our fundamental interaction type, players can either swipe left or right from the menu. If they swipe right, they'll be loaded into the game screen. If they swipe left, they'll get the instructions for the game. The decision on whether going to the right or left would start the game was based on the directionality of english speakers being used to reading from right to left, so going in this direction feels more natural.

Additionally, we chose a swipe as the interaction because of the easiness of swiping. One of our personas, Sally Soccer, is a middle-aged mom. We had her in mind in particular when deciding on swipes because since she's a little older, her eyesight isn't



Sally Soccer

Positive Loving Private Calm

Goals

- Take her 9 year old son, Justin, to soccer practice every Tuesday and Thursday
- Send her son Justin and 16 year old daughter, Jane, to a good college
- Live life to the fullest, and spend everyday full of love for her family

Frustrations

- Avoiding the drama the other soccer parents stir up at practice
- Balancing keeping the house clean, getting the kids to school, making the meals, and having time to enjoy her hobbies and spend time with friends
- Raising two young children who are very active

"Live. Laugh. Love"

Age: 43
Work: Stay at Home Mom
Family: Married with 2 kids
Location: Milwaukee, Wisconsin
Character: Loving Mother

Bio

Sally is a 43 year-old mother of 2 who spends her days managing the household and her kids' schedules. In her free time, she tends to her herb garden and bakes sweet treats for her husband and children. Her son, Justin, is on a soccer team that practices at a park near their home in Milwaukee. Justin has been playing on this team for a little over a year now, so Sally is familiar with the parents of his teammates. She doesn't enjoy speaking with them during the team's twice weekly practices, because they tend to gossip and complain. She's tried reading magazines and books, but she usually finishes all the interesting articles before practice has even started, and she can never focus on the book chapters with all of the noise at the park. Sally is looking for a new way to pass the time at Justin's practice.

Figure 2: Sally Soccer Persona

as good, and clicking tiny buttons isn't the easiest for her. We make starting the game via a swipe an easier interaction for her because the swipe has a much larger target area (e.g., anywhere on the screen) than a tap on a button would be.

Our next storyboard (Figure 4) deals with the game interaction. Players would have five buttons available to them, four of them for adding four varieties of ingredients to their cup, and the fifth to clear the cup. In thinking about the demographic for the game and other similar games (e.g., the younger audience like Peter Part-Time), a lot of them that appeal to our target audience are "tap games," so we decided to try tapping as a mechanism. Of course, this is a variation from the interaction style we described in the first storyboard, so we had to weigh the needs of Sally Soccer versus Peter Part-Time, and ultimately decided that our target audience is generally on the younger side so vision isn't our biggest concern. Additionally, there's only five buttons across, which is still a good bit larger than your average phone keyboard, so we thought that if Sally Soccer could handle a keyboard, five buttons abreast shouldn't be too difficult for her.

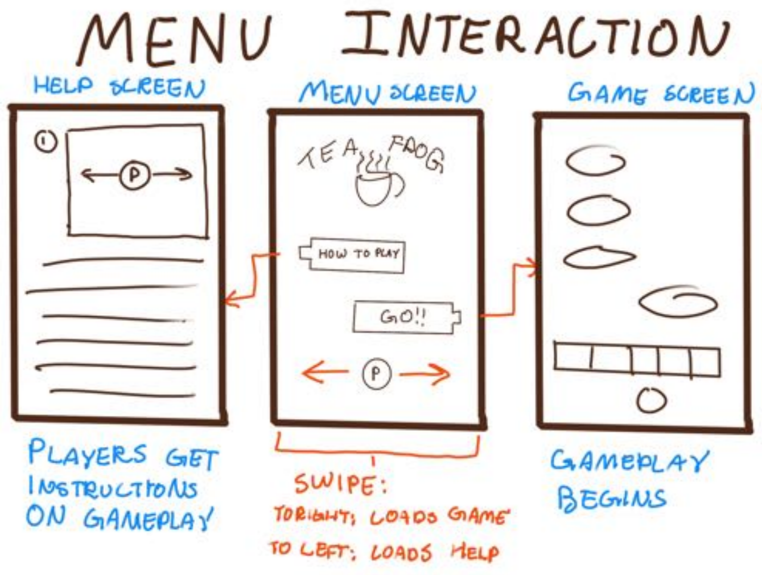


Figure 3: Menu Interaction Storyboard

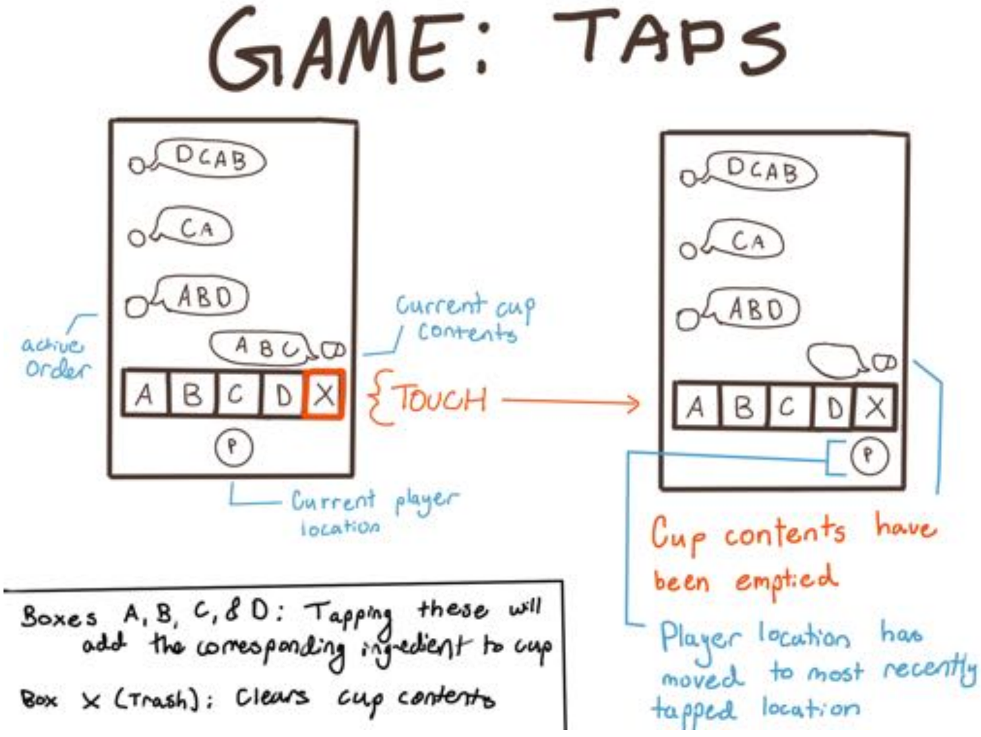
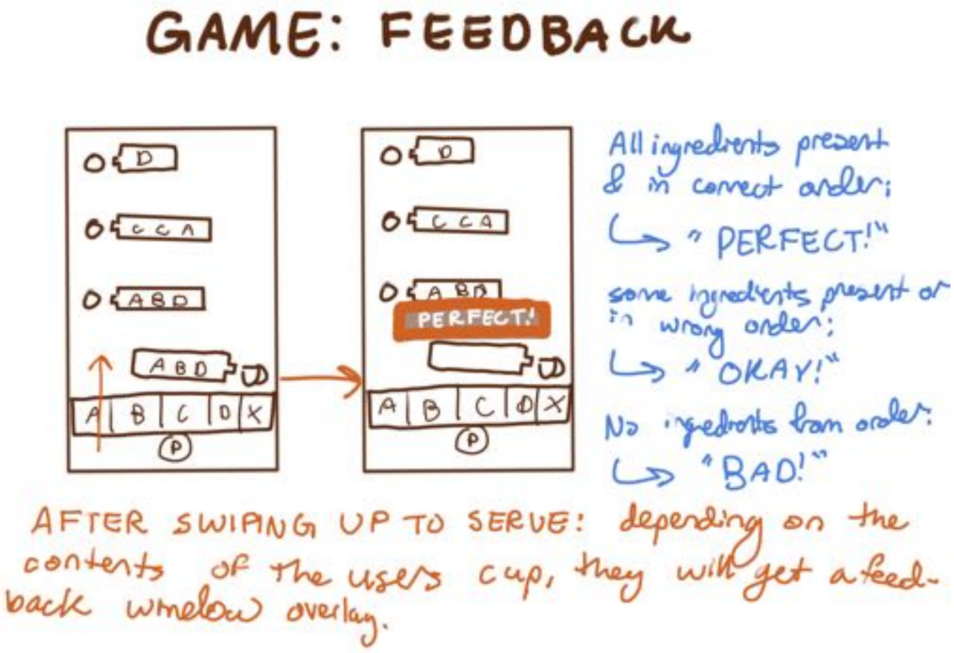

GAME: TAPS
DCAB
CA
ABD
ABC
A B C D X
P
active order
Current cup contents
TOUCH
Current player location
Cup contents have been emptied
Player location has moved to most recently tapped location
Boxes A, B, C, & D: Tapping these will add the corresponding ingredient to cup
Box X (Trash): Clears cup contents

Figure 4: Game Interaction - Tapping

Finally, in our third storyboard (Figure 5) we outline the way that users will get feedback in the game. To submit an order, they will swipe upwards on the screen. Then, depending on the contents of their cup, they will get UI feedback to let them know how they're doing. The rules for that feedback are defined in Figure 3 as well. We wanted to specifically storyboard this feature because we felt it was important to the player experience in knowing how they are doing so they can adapt their play accordingly.



All ingredients present & in correct order:
↳ "PERFECT!"
some ingredients present or in wrong order:
↳ "OKAY!"
No ingredients from order:
↳ "BAD!"

AFTER SWIPING UP TO SERVE: depending on the contents of the users cup, they will get a feed-back window overlay.

Figure 5: Game Interaction - Feedback

BIAS MITIGATION PLAN

One cognitive bias we will prepare for is the Status Quo Bias. This bias suggests that users will prefer the baseline of something they're given, and deviation from that would not be preferred. To avoid this, we will use between subjects to avoid testers getting attached to the first version they're introduced to when comparing prototypes.

Additionally, we want to avoid anchoring or suggestibility in the testers in our method of testing, so when it comes to comparing prototypes, we will create a script for the tests that we will read from and stick to it for both groups. This way, we can minimize the risk of passing on any personal preference for one prototype version over the other to the people who are evaluating it.

HCI GUIDELINES, RULES, AND STANDARDS DESCRIPTION

In our project, we will be using Nielsen's 10 Usability Heuristics, Pinelle, Wong, and Stach's 2008 Usability Heuristics for Video Games, Fitts' Law, metaphors for directionality, and minimization of cognitive load as our guidelines for completing this project. Nielsen's 10 Usability Heuristics will be our guidelines for making a functional mobile app. Pinelle, Wong, and Stach's heuristics will be our guidelines for creating a playable game. We will keep Fitts' Law in mind when designing the mechanic for the game, as hyper-casual games should be playable with one hand both holding the phone and using the thumb to interact with the application. In designing the games interface, we will use a metaphor for directionality - in the game, customer orders will be read from left to right, like in a book. Finally, our game will emphasize the idea that the developers should minimize the cognitive load on the user to prevent them from multitasking - as is the nature of hyper-casual games, our game will give the player a simple task to complete with a single motion to achieve this low-cognitive load.

POTENTIAL PROTOTYPE CONCEPTS

For our potential prototype concepts, we developed both a horizontal one (Figure 6) and two variations of vertical ones (Figure 7) to try to imagine what will be most comfortable for the players in terms of gameplay layout and how they will hold their phone.

Starting with the horizontal layout, we planned out what the game could look like. We knew we wanted the player (frog) to be at one end of the screen and the orders to approach from the other, so we put the player and their buttons at the bottom of the screen. Assuming the player would hold their phone with two hands (this is how we would if the game was laid out like this), then the interactive areas would be closest to the players thumbs, keeping the interaction close by.

Then, players would approach and fill in a line occupying the top two thirds of the screen. The player's current order would be in the middle, so it wasn't hidden by their thumbs when they play.

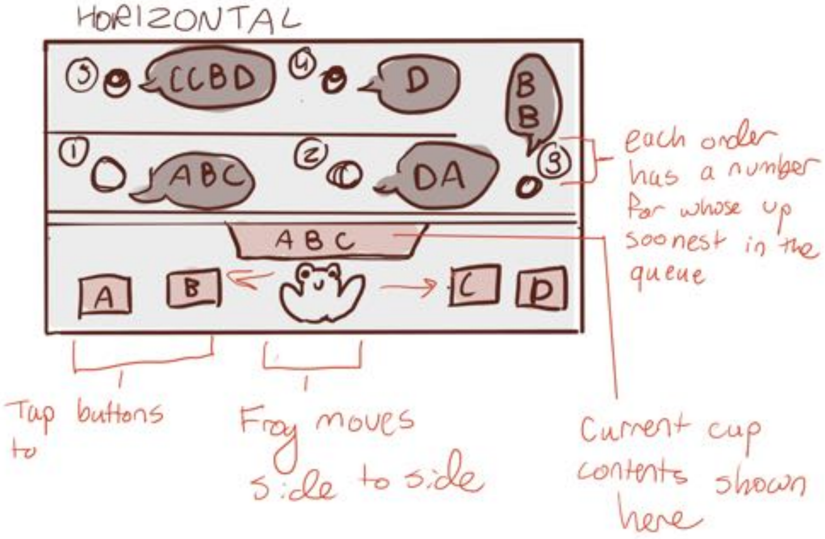

HORIZONTAL
5
CCBD
4
D
BB
1
ABC
2
DA
3
ABC
A
B
C
D
each order has a number for whose up soonest in the queue
Tap buttons to
Frog moves side to side
Current cup contents shown here

Figure 6: Horizontal Concept

For the next concept, we wanted to envision what a vertical layout could look like. This was our ascending layout (Figure 6, right). The five buttons players would be at the top, and the orders would approach from the bottom up.

We also wanted to imagine the inverse of this where the buttons were at the bottom and orders came from the top down to the bottom. We wanted to observe how many hands the players would use for these prototypes, but drawing from our own experience we felt that the users would be more likely to play the vertical prototypes one handed.

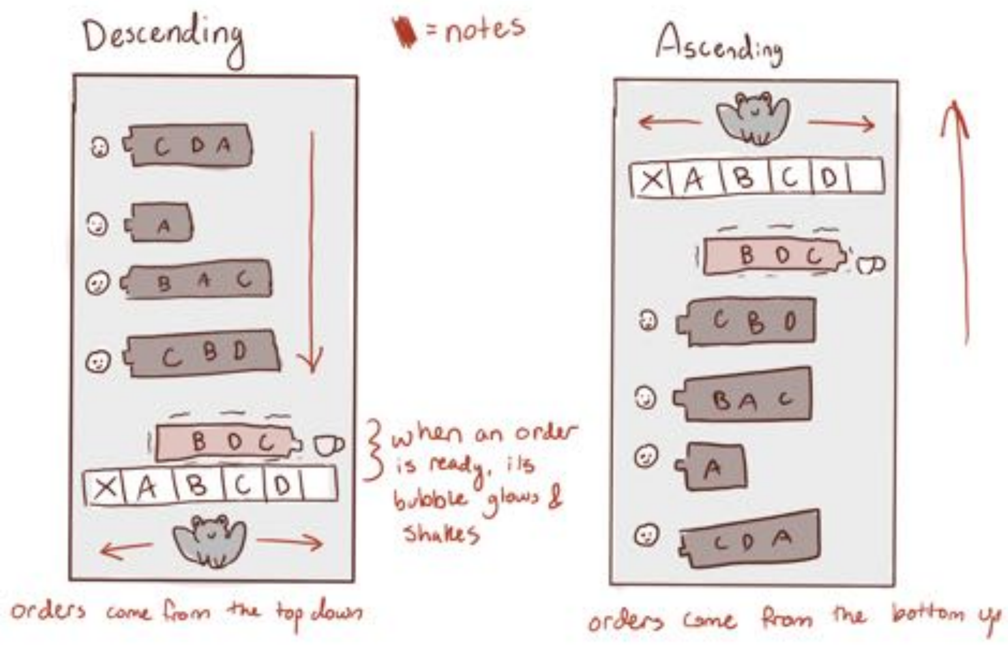

Descending
= notes
Ascending
C D A
A
B A C
C B D
B D C
X A B C D
when an order is ready, its bubble glows & shakes
C B D
B A C
A
C D A
orders come from the top down
orders come from the bottom up

Figure 7: Vertical Concepts

PARALLEL RAPID PROTOTYPING TECHNIQUES

The two prototypes implemented were the portrait-oriented “descending” (Prototype V1) and “ascending” (Prototype V2) concepts. We chose the portrait orientation over the landscape orientation due to our goal of emphasizing ease of use in this application. A study by mobile device expert Steven Hoober revealed that only 15% of study participants used their mobile device with two hands. With that in mind, we opted for a “single-handed” design, so users are able to hold their phone in one hand and use that same hand to interact with the game.

In the production of these prototypes, we were able to test not only the directionality of the gameplay, but different interaction types. In the “descending” prototype, users tapped the ingredients to add them to the order, and swiped up to send the order. In the “ascending” prototype, users swiped the character left and right, swiped down to add the ingredient they were positioned over to the order, and double tapped anywhere on the screen to send the order. That way, we could test different mechanics for playing the game while experimenting with different layouts.

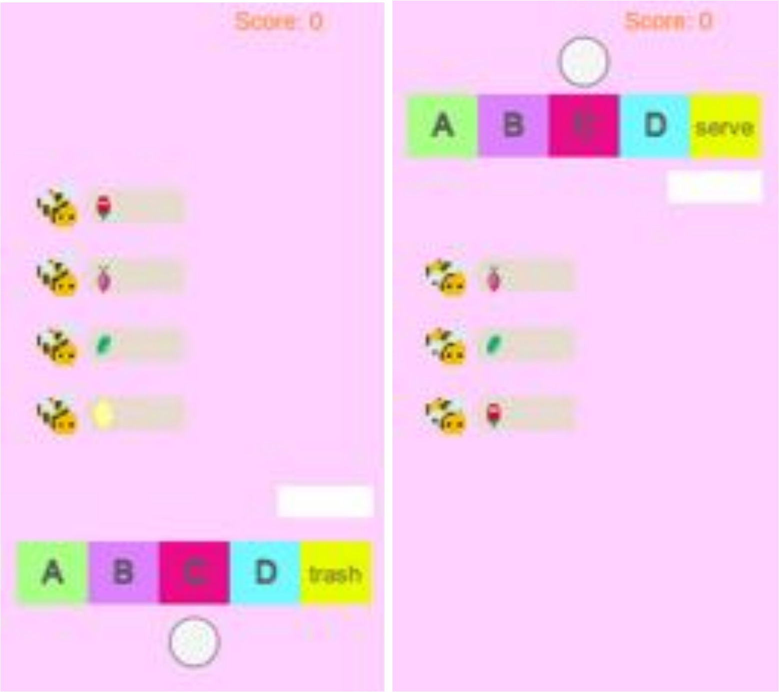


Figure 8: Prototype V1 (Left) and Prototype V2 (Right)

QUASI-EXPERIMENTAL RESEARCH

For our research, we were comparing between the two different prototypes (Figure 8) that we created. Our goal and research question would be to determine which of the two layouts would provide users with the best gameplay experience. Thus, these prototypes were our independent variables, and the experience the players had with them would be our dependent variables. Before we conducted our experiment, we also wanted to operationally define some of the terms that we used. Primarily, ask users to rate how much fun they had, but that's a pretty broad term. For fun, we define it as the level of engagement, which is ideally high and consistent (maintaining the concept of flow in video games, where the difficulty is proportionate to the users skills and their skills and the difficulty grows generally proportionately).

We would be comparing the two vertical prototypes. We hypothesized that the descending ordered one would be most successful with users. One reason for this was that its layout mimicked a texting conversation. The newest content would be closest to the bottom, and the users area of control was displayed on the right side like it would be if they were sending a text. Additionally, the mechanics felt a little more straightforward in that prototype.

When collecting participants we decided to use between subjects, so with 10 testers, we would have five people test each condition. When collecting participants, they were primarily college students while a couple of them were professors who had familiarity with video games. We felt this group was a pretty good sampling of our target audience as we had a range of ages, genders, and video game experience. As for the groups, we wanted to have as close to random assignment as we could. Thus, participants were alternatingly assigned to a condition, so the first person we tested was given version one (V1) of the prototype, and the next person was given version two (V2), and the next person after that V1, and alternating from there.

When testing, the users would be given the prototype to play on a phone, and walked through our playtest script. The script began with an explanation of the playtest and let the users know that we just wanted to observe them using the game. Then, we gave them verbal instructions on how to play, and let them know they could ask for them to be repeated at any time. Then, we asked them to begin playing and recorded our observations as they played. After playing the game 2-3 times, we asked them several questions.

Initially, we asked for them to describe their overall impressions of the prototype. Then, we asked what assumptions they made about the game and what didn’t meet their expectations. We asked this question in particular because we wanted to get impressions on the way they thought the UI was meant to be used and what impression it gave them. Then, because we were trying to decide between two prototypes with their own strengths and weaknesses, we wanted to collect as much qualitative data as we could to best make a decision. We asked three quantitative questions.

First, we had users rate on a scale of 1 to 10 how fun the game was, with 1 being not all and 10 being very much so. Fun was explained as in our operational definitions. Then, we asked them to rate on a scale of 1 to 10 how difficult the game was to learn, with 1 being not at all difficult and 10 being extremely difficult. Finally, we asked them to rate on a scale of 1 to 10 their overall experience in the game, with 1 being very negative and 10 being very positive.

Since we were using between subjects, one thing we were worried about was users having different standards for the scales (as much as we tried to define them) and having the same experience but rating them pretty differently. We helped control for this by also taking users' comments when they would rate something and have them elaborate on their rating to help us establish confidence in their number. This did end up being useful, as we had one user who rated things very strongly (trending towards extremes on the scale) but when asking for elaboration on their answers, they changed their answer by a little.

We were also wary of potential bias in this, and did our best not to ask leading questions and rather answer user questions with a question of our own to get them to think more out loud and elaborate more.

When testing was complete and their answers recorded, we would thank them for their time and let them go so we could debrief. We aren't including the exact observation notes for each test for conciseness, but the overall impressions and data from the different versions is recorded below:

Overall Observations

When it came to V1 of the prototype, some common points of feedback were that they liked the tapping mechanic for ingredients and that the character moved with the taps for feedback. Users of both the V1 and V2 prototypes thought that it was challenging to learn at first, but once they got the hang of it, gameplay became very simple.

Prototype Version	Avg. Fun Rating	Avg. Difficulty Rating	Avg. Overall Rating	Total (fun + overall - difficulty)
V1 (Descending)	6.5	1.75	6.9	11.65
V2 (Ascending)	6.5	4.5	7	9

Table 1: Experiment Data

Additionally, users of both versions felt that the flow was not very well planned--the start of the game was too slow and took too long to become challenging.

For V2 users, they felt that the swiping mechanic was too slow especially when orders sped up more as the game went on. It would take them several swipes to get to the ingredient they were trying to navigate to, and users reported that it ended up feeling cumbersome more than convenient.

An overall consensus was that the game needed more instructions and better pacing. Based on the data, people found V2 much more difficult to learn, but felt pretty even-keel about how fun they both were and had pretty equal overall impressions. Thus, because V1 seemed a lot less difficult for users to pick up, it is the one we proceeded with.

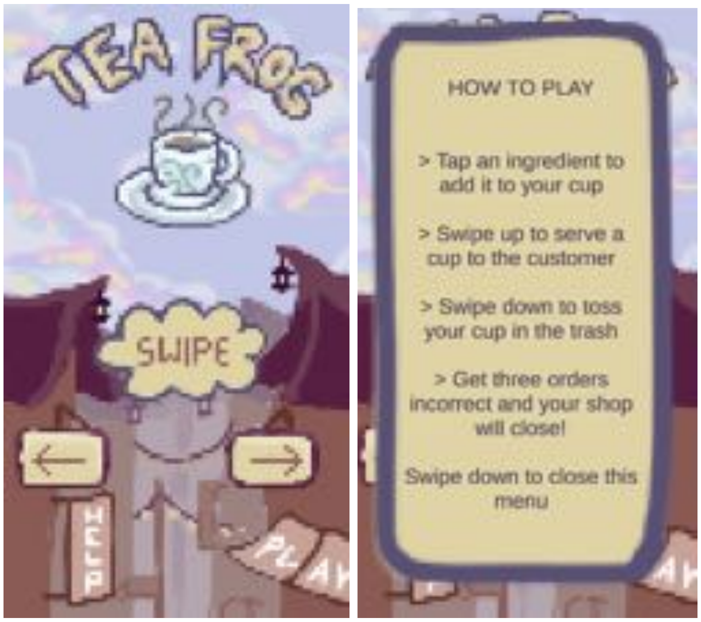
EXPERIMENT LESSON LEARNED

From our quasi-experimental research, we learned a bit more about what hypercasual game users are looking for. For one, the “ascending” prototype (which used mainly swipes instead of taps) proved to be more difficult for users to learn, as the mechanics were less intuitive. In comparison, users who tested the “descending” prototype were able to learn how to play the game much quicker and with less difficulty. Our take away from this is that the mechanics we implemented in the “descending” prototype will provide users with a better experience, so those will be the ones we implement in the interactive prototype. Our research also helped us to understand the importance of feedback in this game. We did not implement the feedback described in our storyboards for the parallel prototyping, but all of the users who tested our game made some note about desiring more feedback from the game. This tells us that we were correct to consider feedback as one of the three major requirements we will implement in the full application prototype.

INTERACTIVE PROTOTYPE WITH 3 MAJOR REQUIREMENTS

The interactive prototype for TeaFrog features three components we considered crucial for a hyper-casual game on a mobile device - a menu, complete with instructions on how to play the game, the game play itself, and feedback within the game that keeps the user updated on the current game status. Our prototype was built in the game engine Unity3D, with assets imported from Adobe Procreate and Adobe Photoshop. It consists of two separate “scenes” - the menu, where users can navigate to the game instructions or the game itself, and the game, where users can play the game and return to the menu. The functionality in the game is derived from a number of scripts, or code files, each with a unique purpose and responsibility. The primary scripts are the Customer - which manages each customer’s order and derives a score based on what the player serves them, the CustomerSpawner - which creates customer, the PlayerController - which responds to the user’s taps and swipes to control the game, and the GameManager - which starts and ends the game. A number of assets, including other scripts, are compiled by Unity3D to create a fully functional mobile game, which can be tested and played with a touchscreen device. For the purposes of this project, Unity Remote 5, an app available for iOS and Android devices, was used to test the game.

The menu of our prototype application has two options: view the instructions or play the game. The menu acts as a starting point for when the application is launched, and lets the user learn how to play before they start the game. When it comes to mobile games, hyper-casual or otherwise, users will be familiar with a menu, and can expect to find out more about how to play the game somewhere through the menu.



HOW TO PLAY

> Tap an ingredient to add it to your cup

> Swipe up to serve a cup to the customer

> Swipe down to toss your cup in the trash

> Get three orders incorrect and your shop will close!

Swipe down to close this menu

Figure 9: Tea Frog Menu

The game itself features an animated frog character that serves customers that come into their tea shop. Customers spawn at a rate that increases throughout the game, and each has a randomly selected order between 1 and 4 ingredients long. Players are meant to tap the ingredients from the bottom of the screen to match the requested order, and then swipe up to send the order. The game gets increasingly more difficult as time progresses, and the player must keep up with the requested orders to continue playing. If the player serves an incorrect order or doesn't serve the customer fast enough, they lose a life. The game ends when the player loses three lives. The player's ultimate goal is to stay in the game as long as possible to achieve a high-score.

We are considering feedback a major functional requirement because both Jakob Neilsen's 10 Usability Heuristics and Pinelle, Wong, and Stach's 2008 Usability Heuristics for Video Games emphasize "visibility of system/game status" and "providing consistent responses to the users actions." The feedback in TeaFrog comes in the form of a small dialogue above the player's order window that will say 'Perfect!', 'Great!', 'Good!', or ':(', depending on the order the player served. This allows the player to see that the game is, in fact, responding to their specific actions, and that they are playing correctly or incorrectly.

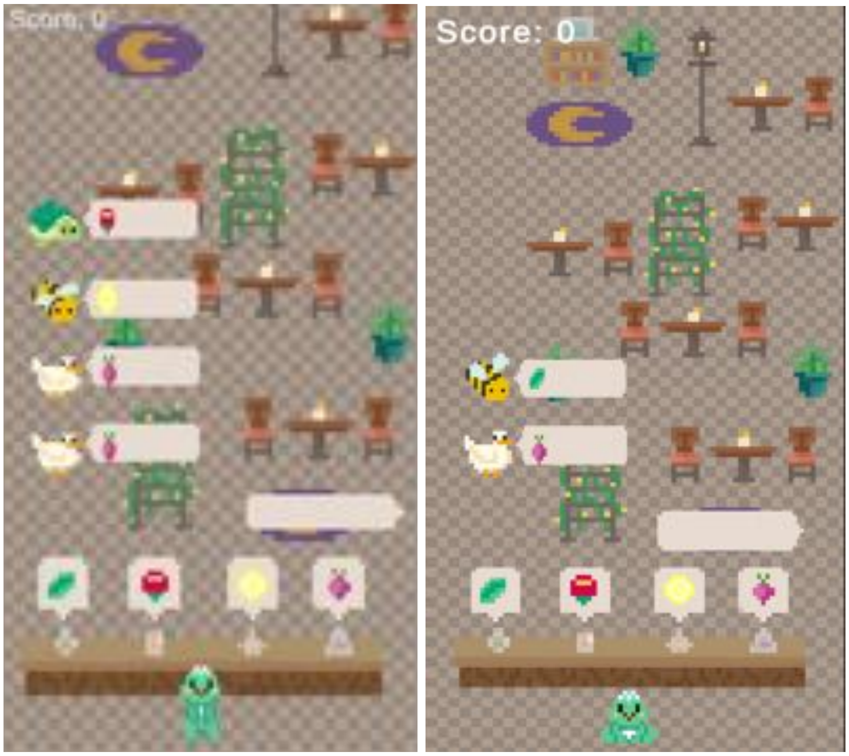


Figure 10: Tea Frog Gameplay

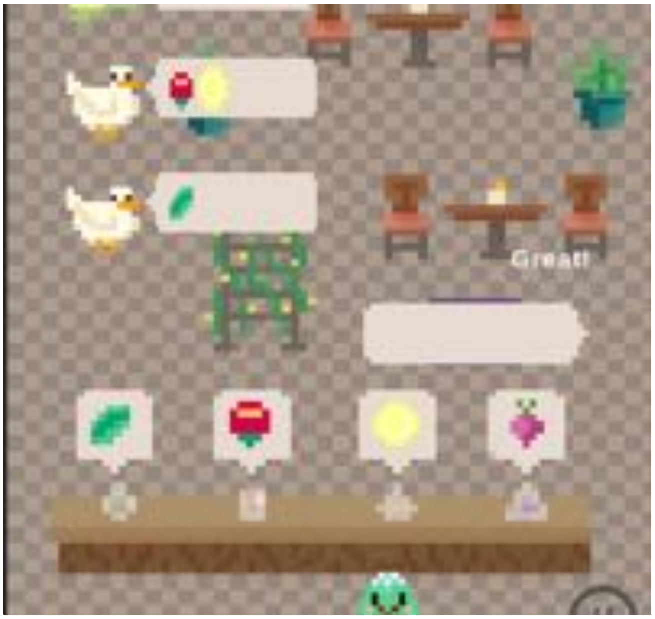


Figure 11: Tea Frog Feedback

PERSONAS INFLUENCE ON INTERACTIVE PROTOTYPE DEVELOPMENT

We have two personas that we considered through the process of our development. They can both be referenced in Figure 1 and Figure 2. The first persona was Sally Soccer, a 43 year old stay at home mom, who is looking for something to do to fill her time while she waits for her son at soccer practice. The other is Peter Part-Time, a 19 year old student who works part time. He’s also looking for an app to fill his time while he has downtime at his job. Both of our users (and in general our target audience) aren’t necessarily hard-core gamers. Rather, they’re people who enjoy the hypercasual genre and need something light, quick, and easy to play. We, as much as possible, tried to align our game design choices with this. For example, the prototype layout we chose was based on what we anticipated would be the easiest for the users to make sense out of based on its similarities to real world application layouts (like text messaging) and its ability to be played one handed for a more casual experience. This is also the reason that we favored tapping ingredients versus swiping over to them, as it required less effort from the players to achieve the same task.

While we wanted the game to be easy, we didn’t want it to be boring either, because it is ultimately meant to be entertaining. Over the course of the development of the application, we increased the spawning rate of customers and the rate at which their orders become more difficult (e.g., include more ingredients). In the initial test versions, it was a little too light, but the game developed better flow as the project went on.

Ultimately it still needs a little balancing to perfectly meet the needs of those users for an easy but engaging game, but it’s on its way in that direction. The influence of their needs and experiences are a big part of what shaped the decisions that we made that led the game to where it is now.

USER EXPERIENCE EVALUATION TECHNIQUE

After getting the feedback from users in the previous round of testing, we decided to make some changes and test again. First of all, we added art assets to the whole game, so the player, customers, UI, menu screen and more all have designs and in some cases animations. As a part of this, we changed the order system to be picture based (instead of placeholder letters). We also revamped the feedback system to be more visible.

We then tested the prototype again. However, this time we encouraged more think-aloud during the test from the users, whereas last time we focused more on getting feedback after they interacted with the product and just observed them while they used it. For this round of testing we were interested to hear their impressions and thought processes as they were happening to help us nail down where issues might be occurring as they occur. We also collected some quantitative metrics (e.g., scale of 1 to 10, how fun/understandable/clear was the product). Of course, like the previous method of testing this could fall into the trap where users try to perform better under a watchful eye, persist with trying to figure things out for longer when they would have given up by themselves, and rating things higher than they felt about them to be kind to us as the test observers.

Testers were a mix of people who had played the game before and people who had not (two who had and two who had not). We had four total. They were not a completely representative sample as they were all college students that we shared classes with, so we didn’t necessarily get good feedback from the perspective of Sally Soccer or the older side of our demographic. We did get good feedback, however, from users both about the things that had improved and the things that we could still work on, although I do think the users were a little kinder giving metrics to our face than they would have been for an unknown person’s game anonymously. Regardless, the data from this round is listed below.

Avg. Fun	Avg. Ease of Use	Avg. Visibility of Feedback	Avg. Overall Rating
8.6	7.6	6.4	9

Table 2: New Experimental Data

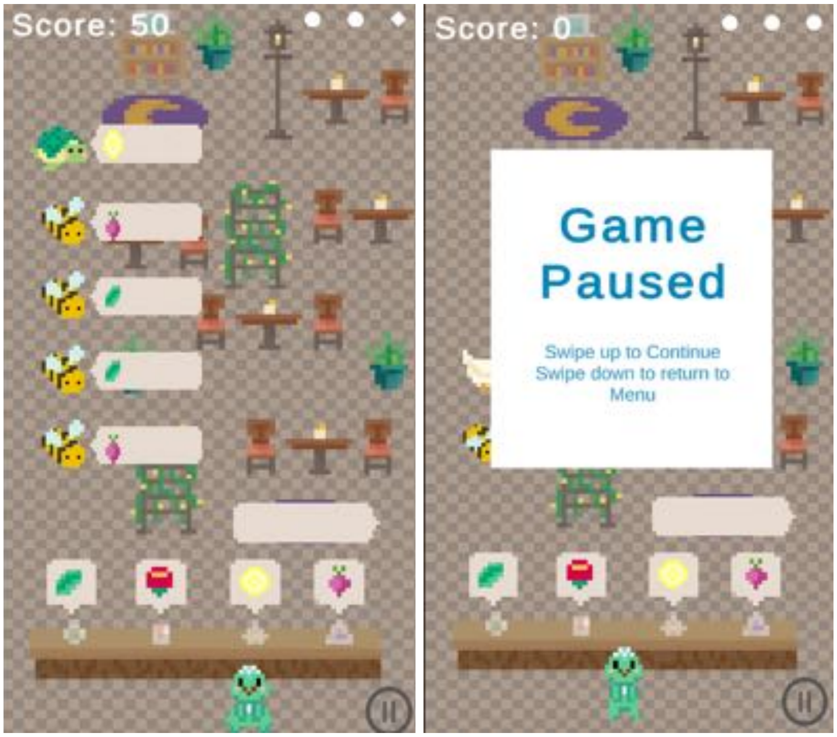
As far as things that had improved, they liked the adjusted rates of the gameplay--the flow seemed to be better. We also had positive feedback about the art assets. Additionally, they figured things out with the game pretty quickly.

However, we did have an issue with the updated swipe-to-serve feature. Users (almost all of this round of testers) were starting their swipes from too low on the screen, and the system wasn’t registering them correctly. Additionally, some of them didn’t notice the feedback messages on the screen. They still on average didn’t rate the visibility of feedback terribly, but it was also the worst performing metric we measured.

Going forward, we would like to increase the visibility of feedback. This would likely look like both adding a visual to show the amount of lives left and increasing the size/visibility of the feedback text. We also would need to make some fixes to the swiping gestures to avoid the problems that this round of testers encountered.

INTERACTIVE PROTOTYPE IMPROVEMENT

Our user experience evaluations revealed to us a couple of elements that we did not originally consider a part of the fundamental requirements of our application that our users would benefit greatly from. To improve upon the previous design we added an in-game pause menu and icons to track the amount of lives the player has. The in-game pause menu allows the players to take a break from the game or return to the main menu without closing the app. The pause menu is accessed by tapping the pause icon in the lower right of the screen, and is closed by swiping up to continue playing or down to return to the menu. The player's current lives are indicated in the top-right of the screen, and the icons change as a result of the player losing a life.



Game Paused

Swipe up to Continue
Swipe down to return to Menu

Figure 12: Game with two lives remaining (Left) and paused game (Right)

BIAS MITIGATION APPROACH

As described previously, we took several steps to make sure we were doing our best to mitigate bias in our research. We had talked about avoiding any anchoring bias by giving users only one of the prototype versions, which is what we did in our tests. We also thought about this in our second round of testing, which is why we were sure to have both users who had and hadn't seen the game before. This way, results were likely based off of the users actual experience and not their comparison between versions (e.g., "both versions were okay but version 2 was different than version 1 which is what I experienced first therefore I think V1 was better").

Additionally, we talked about not wanting to bias users by leading them in a certain direction as the test takers. Our approach was to write a script for the tests and do our best to stay within that script, and if absolutely necessary note any deviation from that script. When users would ask a question about the game, rather than answering a question and potentially leading them one way or another, we would ask a question back to them to prompt them to think more about the product.

HCI GUIDELINES, RULES, AND STANDARDS APPLICATION

For our project, we used Nielsen's 10 Usability Heuristics to guide our design of the interface. We focused particularly on ease of use and giving the user control of the application. For this we implemented simple ways to navigate the application through swipes and kept the game mechanics simple. The game also inherently has error prevention (so that users cannot complete unintended actions) and help in the form of instructions on how to play the game.

Error prevention and help also tie into the Usability Heuristics for Video Games described by Pinelle, Wong, and Stach. We used the video game heuristics to guide some of our decision making as far as what was necessary to implement for gameplay, particularly the feedback provided within the game to give the player information on the current game status. This feedback includes the message that pops up in response to the player sending an order, and the player's "current order" window, which updates as the player adds on ingredients.

In applying Fitts' Law to our application, we considered the different ways in which users may be holding their mobile device to interact with the game. Our design prioritized users who hold the phone with one hand to play, so all of the actions a player can take can be completed on the bottom portion of the device's screen. The design translates without issue into two-handed use, as well.

For much of the application's design, we also incorporated the use of metaphors to explain the interactions. Users swipe from left to right to start the game from the menu, and read the customer orders from left to right to fulfill them. We consider this a metaphor of directionality, as English speakers read from left to right.

Finally, one of our objectives in designing this game was to emphasize the idea that the developers should minimize the cognitive load on the user to prevent them from multitasking. Comments from our test users indicate that they believe this is the kind of game they would play as a mindless activity to unwind or pass the time.

LIMITATIONS IN DESIGN PROCESS

Some of the limitations we faced in the design process we conducted in developing our prototype would include being limited to testing on only one operating system, being unable to test with more users due to health concerns and time constraints, and developing a game with a single mechanic. For testing, we were unable to test our application on Android devices, as only iOS devices were available to us. For this reason, we can't be sure how difficult it would be to release this application on, for example, the Google Play Store, without more testing. As for testing, it would have been beneficial to have more users test our full prototype for our user evaluations, but we were limited to a small demographic due to COVID-19. Having a wider variety of users test our application would give us a better idea of how it fairs as an actual, marketable product. Lastly, the difficulty in developing a game with a single mechanic is making it challenging enough to be fun. We had some difficulty achieving this in the early prototypes of the game, and would need to do a significant amount of testing to ensure our goals are met in terms of fun, casual gameplay.

PROPOSED PATH FORWARD

Should work on this project continue in the future, we would plan on improving the graphical elements of the game, including, but not limited to: more refined art assets, more character designs, and menus and windows that match the style of the game. We would also likely add a leaderboard to the game, so that users can see how other players have done, and try to beat their high-score. These changes, amongst other game design improvements, would be made with the intention of refining the application to a point where we could publish it to a variety of app stores.

CHALLENGES AND LESSON LEARNED

Many of the challenges we encountered while creating this application prototype were coding related, but we also experienced some difficulty in conducting our quasi-experimental research and user evaluations. Coding-wise, we encountered issues related to implementing mobile-based gestures, as it was a new technique for us. After completing this project, though, we are much more comfortable programming the use of taps and swipes on mobile devices, and will be able to use these skills in future projects. In conducting our quasi-experimental research, we encountered several game-breaking bugs that prevented our participants from completing the game. Most, if not all, of these bugs were very quick fixes, and did not prevent any of our participants from completing the test. These bugs were missed in initial testing within our team, because we had neglected to consider the different ways in which users may interact with the application. We had become accustomed to using the application correctly, and did not check to see if using it incorrectly would cause an issue. In this instance, we were not wary of assumptions, but learned from our mistakes and were able to avoid the issue in subsequent testing. The challenges we faced with user evaluation testing were in getting our users to think aloud as they played the game. In hindsight, think-aloud testing may not be as well suited for testing games as it may be for testing other applications, as the users tend to focus solely on the gameplay, especially in a fast-paced game such as the one we developed.

INTERACTIVE PROTOTYPE ACCESS

Given that our prototype was developed for mobile devices, it cannot be accessed via an executable file without being re-developed for a web interface. We are also unable to publish the prototype application due to the cost of applying for a developer account for the Apple App Store and Google Play Store. Use of the application can be demonstrated if necessary.

REFERENCES

Beaudouin-Lafon, M. (n.d.). *Instrumental Interaction: An Interaction Model for Designing Post-WIMP User Interfaces* (Publication). Aarhus N, Denmark: University of Aarhus Dept of Computer Science.

Hoober, S. (2013, February 18). How Do Users Really Hold Mobile Devices? Retrieved November 18, 2020, from https://www.uxmatters.com/mt/archives/2013/02/how-do-users-really-hold-mobile-devices.php