Human-Food Interaction Framework: Understanding Student-Athletes' Extreme Food Needs

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Abstract. The food and kitchen technology industry is quickly growing and changing as user lifestyle preferences shift. This shift is arguably occurring most rapidly in Silicon Valley. There has been tremendous growth in every aspect of the food process, from food delivery services to cooking robots and automation to the ingredients themselves. However, are such food and kitchen technologies addressing the future needs of users? To understand the future needs of Silicon Valley users, we decided to look at extreme users: student athletes. By interviewing six athletes at Stanford University with extreme food needs, we gained insights on the broader future of food. To analyze the needs, we developed a preliminary Human-Food Interaction (HFI) Framework, which allowed us to understand the overall user journey and the specific user needs in each step of this journey (ex. delivery, storage). After analyzing needs, we categorized Silicon Valley food tech services into the different steps in HFI framework. As a result, we found that there is a significant gap between extreme user needs, which are indicative of future needs, and the services currently available in the market.

Keywords: Human-food Interaction, extreme user, Stanford athlete

1 Background

Innovation in food technology is happening rapidly in Silicon Valley. Large companies are starting to recognize the value of the fast-growing food tech industry and are increasingly getting involved in this market by forming a corporate venture arm (such as Tyson and Kellogg), acquiring other innovative food-related companies (such as Nestle), or developing their own innovation teams (such as Google) [1]. Another huge signal of the rising food tech space is that even traditional tech-oriented venture capital firms are now tapping into the food market. In 2018, venture-capital firms invested in food and grocery delivery services more than triple the amount they invested in 2017 [2].

A myriad of food tech startups are automating the culinary food space, and food product innovations are attacking all areas of the food pyramid [3]. Food substitutes,

healthy artisanal products, and an increase in food products catered to the lactose intolerance, gluten-free, vegetarian, and other alternative diet markets are contributing to this increase.

As researchers of Stanford University, which is located at the heart of Silicon Valley, we became curious whether the food tech services and products described above were addressing the future needs of the market. Our problem statement is as follows: are food and kitchen tech addressing future needs? If they are not, where are the gaps and opportunities?

2 Methodology and Framework

In order to understand the future needs of Silicon Valley users, we adopted von Hippel's extreme user research methodology, which is also widely used in Design Thinking methodology. Von Hippel asserts how looking at users with extreme users can help designers develop unprecedented high-technology products [4]. Extreme users' needs are amplified and their work-arounds are often more notable. This helps designers pull out meaningful needs that may not emerge when engaging with people in the middle of the "bell curve". Still, the needs that are uncovered through extreme users are often also needs of a wider population or indicative of future needs. When selecting the group of extreme users, we were inspired by Olympians, who have to follow strict diets and always be conscious of what they eat. Former studies have shown that food can directly affect athletes' performance [5].

We interviewed four Stanford athletes and one Olympian to gain an understanding of how food fit into their lifestyles. The interviews were conducted on Stanford campus over the course of two months. After interviewing the athletes, we interviewed over ten industry experts and food startup founders in Silicon Valley to gain an understanding of food tech trends and the startup ecosystem. We mapped all of the qualitative data we obtained from these interviews onto a framework we developed that outlines the food process from the consumer perspective.

Fig. 1. Human-Food Interaction Framework

The Human-Food Interaction framework starts with a user learning about his or her food ingredients. The user then purchases the ingredients in various platforms, such as a farmer's market. Next, the ingredients are delivered to the user's house by the user or a third party. Once the ingredients are delivered, the user stores them in different storage areas or appliances depending on their preservative capabilities. When the user decides to eat, the user turns the ingredients into a ready-to-eat dish by first ideating and then cooking. Lastly, the user consumes the food and disposes of the food waste from the meal. HFI framework allowed us to analyze the user needs in a more systematic way and parse down the problem space.

3 Preliminary Findings

3.1 User Persona

Based on athlete interviews, we created a user persona of our extreme users. Named Julia, our user persona embodies the lifestyle of the student athletes.

Julia is a sophomore in Stanford women's rowing team. She is always busy with her coursework and training, but she manages them by staying extremely disciplined. Her social life, such as going to frat parties on weekends, is often compromised. Nonetheless, she does not care too much because she has her team and coach who will always support her. Because she does not have time to cook nor knows how to cook, she eats at dining halls and snacks often. Although cooking is not her expertise, she cares deeply about what she puts in her mouth. She perceives her body as a system which she has to optimize by inputting optimal fuel, which is food. When eating food, she cares more about its nutrition and functionality than its flavor. Therefore, she refuses to eat highly processed food or eat it in a small amount if necessary. To make sure that she is optimizing her food consumption, she logs what she eats every day.

3.2 Interview Result

The main finding is that although the needs of athletes differ based on sport, the common ultimate goal is to optimize nutrition for performance through streamlined food process. Athletes view food similar to how they view their workouts and aim to efficiently optimize their portfolio of nutrients for performance of the human system, with no regard to the social or enjoyment aspects of food. The common trends among the athletes that we observed and the athlete's specific food needs in each step of HFI framework can be summarized as below.

Table 1. Stanford Athletes' Food Needs

Process	Common Trends	Needs
Ingredients	Wants to understand what is in the food Fresh, nutritious ingredients Price matters	Access fresh, nutritious food Understand food information
Shopping	Infrequent shopping Buy things that last long	Minimize time spent shopping for new ingredients Save money
Delivery	Minimize transportation Carry snacks	Eat frequently Transport fresh food Minimize transportation
Storage	Food has to stay fresh Store has to be user friendly Flexibility in temperature and size is desired Want a storage that is shared but does not feel like it is shared	Customize and personalize size, temp, compartments, etc. Preserve fresh foods
Cooking	Having control over food choices Assembly (ex. sandwich) over cooking Lack of interest and time	Make healthy choices Choose what to assemble Minimize time and resources Maximize nutrition
Eating	Snacking Meal Supplement Convenience Logging Part of training (to optimize performance) Feels like a chore	Keep track of food Customize nutrition Optimize their nutrition to perform best

3.3 Need Mapping

After summarizing the user needs, we listed out a number of Silicon Valley-based food tech services and products, based on which step of HFI framework they were focusing on. When we compared currently available food technologies and our extreme user's needs, there were specific gaps in the step-specific needs in storage. Regarding storage, the users wanted to customize and personalize the size and temperature of the storage compartments, but such a service could not be found. Overall, there was only a dearth of services that tackled storage problems.

Table 2. Food Tech Startups/Services and The Needs that They Address

Process	Startups and Services	Needs Addressed
Ingredients	Impossible Foods, New Wave Food, Tiny Farms, Sugarlogix, Clara Food, Food Composition Scanner, Soylent	Eat delicious food that's good for the people and the planet Ensure transparency Eat safely Eat fast and efficient
Shopping	AmazonGo, VR/AR (smart label), Block chain	Shop fast and convenient without waiting Ensure 24hr availability Save time and money
Delivery	Instacart, UberEats, Blue Apron, Drones, Autonomous Cars, Starship	Deliver faster with better selection and service Deliver fresh food for less food waste Be fast, smart, safe, and cost-efficient
Storage	Smart Fridges	Manage food to avoid food waste
Cooking	**Ideation** Chef Watson, AI rec engines, Yummly, Iniit, Pic2Recipe **Cooking** Blue Apron, Meal Kits, Food 3D printer, Robots (Zume, Moley, Momentum, Flippy), Nima, Nomiku **Eating** Miraculin, NuTekSalt, Eating w/ VR, Soylent	Provide customized recipes based on ingredients Track and control cooking processes Cook faster and easier Know your body type and compatibility
Waste	Smart Fridge, Biodegradable utensils, Treasure 8, Automated Inventory, Smart Packaging	Keep food fresh and notify the expiration date Upcycle food waste

3.4 Lack of Interconnectivity

Interestingly, there were several steps in this framework that were desired to be connected for the user, but this connection did not exist. The connections were not apparent in the needs addressed by tech products because most of these solutions focused on only a single step of the process. There was a significant lack of services that enhance the connectivity between storage and the steps around it, such as delivery or cooking. For example, there was a need for bridging the gap between delivery and storage processes to essentially create a customized grocery store at home. This could also be in the form of on-demand ingredients in order to minimize storage (e.g. Amazon Dash for ingredients).

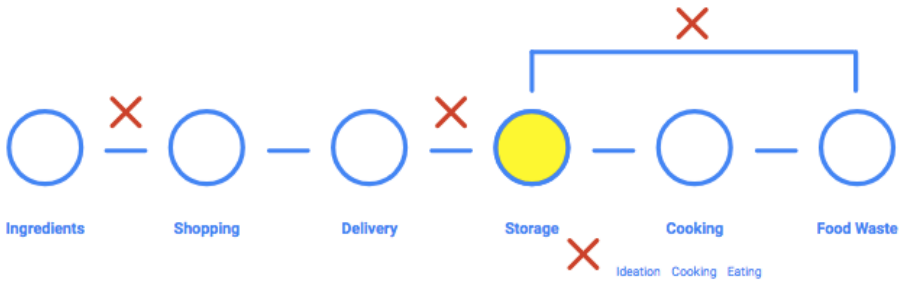

Fig. 2. Lack of Interconnectivity Around Storage ("X" indicates a gap between two steps)

4 Conclusion and Limitations

In this study, we found that most food tech companies are not designing for the interconnected future user needs, resulting in an ecosystem of independent solutions to a codependent problem. To design for the future, the food technology industry needs to develop a concept based on the whole food process, not based on a single product, in order to address customized needs and lifestyles of users.

To focus on extreme users, the user studies in this research were conducted with exclusively Stanford athletes. For future research, it would be valuable to conduct user studies with a diverse range of extreme users, for example, children, people with disabilities, people with no refrigerator, etc. in order to compare and contrast how they use their kitchen and interact with food.

Expanding the research, both the user studies and industry/trend analyses, to less innovative contexts would be interesting, since our research was highly limited to the Silicon Valley context. It would also be valuable to gather and analyze quantitative data on usage of kitchen products, well-being indices, neuro/physical performance analyses, etc. to supplement the qualitative findings from the user studies. It would be useful to take these findings and research their managerial product implications based on the gaps and opportunities found and suggest new products and features.

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