Framing Instead of Solving: Approaching the Wicked problem of Restaurant Food Waste through Service Design Research

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Content

요약

The hospitality and food service sector is the food sector that generates the most food waste. To deliver a more sustainable service, the food service industry needs to understand and reduce customer plate waste, which is mostly avoidable. Several studies have investigated the drivers of plate waste behaviors and proposed mitigations. However, service designers need actionable insights that inspire innovative solutions. The goals of this study are twofold. The first goal is to identify factors influencing young consumers' food waste behavior in restaurants. The second goal is to frame food waste challenges as design opportunities for service designers. A photo diary was conducted with 10 Korean university students. Participants took before and after photos of two meals and fill out questionnaires. The questions include personal background, considerations when choosing a meal, satisfaction with the meal, and reasons for leaving food. Both qualitative and quantitative data were collected and analyzed. The results suggest that lack of awareness and control are the key drivers of leftovers. The food waste problem is framed into "How Might We" design opportunities for service design. Interventions should focus on improving communication with oneself, dining partners, and restaurants. The paper contributes by demonstrating the service design research approach to framing wicked problems with the example of restaurant food waste.

Keywords: Food service industry, Food waste, Service Design, Sustainability, Wicked problems

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1. Introduction

Food waste in restaurants is a serious threat to sustainable consumption and production. It is an ongoing, unsolved problem because they only have temporary solutions. Food waste is an example of a complex societal or wicked problem with no clear definitions, causes, or solutions (Rittel & Webber, 1973). Food waste represents an unstructured problem, involves multiple stakeholders & perspectives, and cannot be solved once and for all (Närvänen et al., 2020).

Design has been criticized as a 'solutionist' or a quick fix for complex problems (Blythe et al., 2016). Silicon Valley and many research labs provide solutions to problems that do not exist or make oversimplified solutions for complicated social, political, and environmental problems (Morozov, 2014). When tackling complex problems, instead of attempting to solve them, designers must move from a focus on solution space to a problem space, which means considering different approaches in defining and framing the problem itself (Baumer & Silberman, 2011).

In this paper, we illustrate the concept of framing wicked problems through service design research with the example of restaurant food waste.

1.1 Food waste and sustainable development

Globally, an estimated 17 percent of the food produced is wasted yearly (United Nations Environment Programme, 2021). Food waste has been a global concern because of its economic, social, and environmental impacts. It is estimated that the worldwide loss of food waste is nearly 2.6 trillion dollars per year, considering all three sustainability dimensions, including a trillion in economic costs, 900 billion in social costs, and 700 billion in environmental costs (FAO, 2014a). Food waste has social impacts, contributing to higher costs in food-producing, raising food prices, and making food less accessible. One-fourth of the world population faces food insecurity at a moderate or severe level (UNICEF, 2020). The severity of food insecurity is magnified further by the COVID-19 pandemic (Neff, 2020). In addition, food waste contributes to the emission of greenhouse gases as leftovers are thrown out into landfills (FAO, 2014a). When the produced food is thrown away, we waste not only the food itself but also resources used in the production and distribution of food, including water, land, energy, labor, and capital. The urgency and seriousness of the food waste issue are reflected in one of the United Nations' 17 Sustainable Development Goals (SDGs). SDG's target 12.3 aims at reducing food waste at the retail and consumer level by 50% by 2023 to ensure sustainable production and consumption (Nations, 2015).

1.2 Food waste definition

Food waste or loss refers to foods directed for human consumption, excluding parts of food that are not edible (Gustavsson, 2011). The recent definition suggests that food loss and waste refer to "a deterioration in food quantity and quality along the food supply chain" (FAO, 2021). More specifically, the distinction between food waste and

food loss is recognized because the causes of food waste and solutions differ from those of food loss (FAO, 2014b). The Food and Agriculture Organization (FAO) defines food loss as food that gets spoiled or discarded along the supply chain from harvest and processing but not at the retail level. In contrast, food waste occurs at the retail and consumption stage (FAO, 2019). The definition also excludes food redirected to the non-food chain (such as animal feed, compost, and energy) and inedible parts (such as bones). <Fig. 1-1> shows the distinction between food loss and food waste at different stages in the food supply chain.

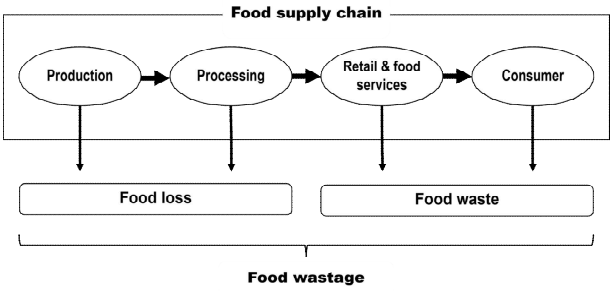

Fig 1-1. The difference between food loss and food waste. Adapted from FAO, 2019

1.3 Food waste in the food service sector

Food wastage may occur during any stages of the food supply chain, including production, handling & storage, processing & packaging, distribution & market, and consumption (Lipinski et al., 2013). Research has shown that food wastage is more prevalent closer to production or 'near the farm' in developing countries and closer to consumption or 'near the fork' in developed countries (FAO, 2011). More than 46% of food wastage happens at consumption alone in industrialized countries (FAO, 2016). World resource institute suggests that efforts to reduce food wastage should focus on stages 'close to the fork' in developed regions (Lipinski et al., 2013). As food travels along the supply chain, the environmental impact accumulates. Thus, reducing food waste downstream near the consumer reduces the environmental impact at that stage, and the impact generated upstream (Read et al., 2020).

The hospitality and food service (HaFS) sector is among the sector that generates the most food waste. The HaFS sector includes all establishments that serve food and beverages for immediate consumption in an out-of-home context (WRAP, 2013a). Restaurants, hotels, health care, education, and staff catering are key sub-domains (WRAP, 2013a). It is estimated that the HaFS industry contributes to nearly one-third of global food waste (United Nations Environment Programme, 2021). Meanwhile, 79% of food waste in HaFS is avoidable and could have been consumed (Oliveira et al., 2016). Therefore, there is a significant potential to cut food waste at this stage of the supply chain

The origin of food waste generated in the food service sector can be categorized as 'kitchen waste' from spoilage during preparation and cooking, 'serving waste' from cooked and prepared meals often as a result of overproduction, and 'customer plate waste' which is leftovers by customers on a plate (Silvennoinen et al., 2015). A study in the UK shows that 45% of food waste in HaFS comes from preparation, 34% comes back from the customer's plate, and 21% is spoilage (WRAP, 2013a). More specifically, the percentage of food waste from customer plate waste at

restaurants can be as high as 50% (Silvennoinen et al., 2015). Studies show that most plate waste is avoidable and that reducing plate waste contributes directly to profitability in restaurant businesses (Silvennoinen et al., 2015). Moreover, plate waste reflects the customer's perspective regarding the menu and can indicate dissatisfaction. Above all, the food service industry needs to focus more on understanding and reducing customer plate waste to deliver a more sustainable food service.

2. Literature Review

2.1 Food waste drivers

Research has suggested several reasons why customers leave food on their plates. They found that customers are mainly responsible because of their taste preferences, haste and greediness, not concerned about leaving food, valuing food less, and having no sense of responsibility (Katajajuuri et al., 2011; WRAP, 2013b). Besides, a few studies research food-wasting behavior by measuring intention to avoid food waste, based on the Theory of Planned Behavior (Ajzen & Madden, 1986). Among them, a study in a company cafeteria in Germany finds that personal norms and attitudes determine consumers' intention to avoid leftovers, and subjective norms and perceived behavior control are less relevant (Lorenz et al., 2017). On the contrary, another study in Turkey shows that perceived behavior control is the most substantial influence on the intention to reduce food waste (Coşkun & Yetkin Özbük, 2020). Characteristics of consumers, including their age, education, and income levels, affect food waste behavior (Zhang et al., 2022). However, another study shows that age and gender are irrelevant to consumer motivation (Goodman-Smith et al., 2020).

In addition, little research has studied contextual factors associated with leftovers. A study in New Zealand also finds more plate waste in restaurants when the meal is expensive, longer in duration, or at dinner time (Goodman-Smith et al., 2020). Moreover, research shows that the purpose of the meal matters, as food waste in dining for social gatherings tends to be higher than in private and work meals (Wang et al., 2017). The study regarding the food service sector in China also shows that their dining culture is a significant cause of food-wasting behavior as people tend to order too much and want to try more dishes than they can eat (Filimonau et al., 2020).

Doggy bags or taking leftovers home effectively mitigate food waste; however, they are not widely practiced. A study at a university in Hong Kong shows that the intention to avoid food waste is the strongest predictor of whether customers will take away leftovers, regardless of the price of the meal and location inside or outside campus (Wong, 2019). Studies also find reasons related to influences of social norms, including fear of troubling staff for doggy bags and embarrassment of taking leftovers home (Giaccherini et al., 2021; Hamerman et al., 2018; Mirosa et al., 2018; WRAP, 2013b).

Most studies related to restaurants focus on kitchen waste. However, only few studies investigate the roles of restaurants on customer plate waste. Reasons related to food's faults include unsuitable flavoring, over-portioning, and plate composition (Sustainable Restaurant Association, 2010; von Massow & McAdams, 2015;

WRAP, 2013b).

2.2 Food waste mitigations

Many studies have proposed mitigations to prevent food waste related to consumption in food sectors such as school cafeterias, hotels, and hospitals. Interventions such as reducing portion size, varying portion size & price, or paying by weight are proposed. (Filimonau et al., 2020; Sustainable Restaurant Association, 2010). In university dining halls, trayless dining intervention has proven to reduce consumption and leftovers (Rajbhandari-Thapa et al., 2018). Other suggestions are to observe customers' eating and plan the menu according to seasons (Sustainable Restaurant Association, 2010).

Among the solutions to prevent food waste, pervasive communication has been widely adopted and studied. A study in a university cafeteria shows that a simple to-the-point prompt message stimulates a 15% reduction in food waste (Whitehair et al., 2013). In contrast, a study of restaurants in the Netherlands shows that informative campaign makes customers willing to pay the same price for less food more often, even though the impact is insignificant (Jagau & Vyrastekova, 2017). Regarding the to-go boxes or doggy bags, the informative, prompt messages effectively encourage customers to take away leftovers, but not the normative messages (Stöckli et al., 2018). In addition, another study shows that providing customers with the doggy bag by default does not have a statistically significant impact on stimulating the use of doggy bags but encourages people to consume the entire meal instead. (Giaccherini et al., 2021)

Other solutions are related to diverting leftovers from going to the garbage bin. Redistributing surplus food can be difficult due to stringent regulations; thus, many restaurants give out food to their employee instead of donating it (Sakaguchi et al., 2018). Another solution is to sell leftovers cheaper (Wansink & van Ittersum, 2013). Technology adoption can also prevent food waste by using online communication to facilitate food sharing in universities through social media (Lazell, 2016).

Regarding design solutions, design research targets food waste in household settings (Ganglbauer et al., 2012, 2013), but research in out-of-home contexts is limited. A study finds opportunities to design products for leftover packing and transport (Bozzola et al., 2017). Other studies adopt sustainability perspectives. The product ideas include a sustainable lunch concept made of ingredients that would otherwise be thrown out (Asp, 2019). Another study presents and analyzes a case study of platform business models, including a mobile app that sells leftovers at discount prices (Mattila et al., 2020).

To summarize, studies have found the drivers of food waste and proposed mitigations to prevent them. Nonetheless, the current research investigates the causes of food waste in specific aspects but lacks a high-level perspective of customers' behaviors. Meanwhile, research on solutions to food waste shows significant potential; however, they are primarily passive and shallow. Most importantly, despite many efforts from the food service industry, the food waste problem in restaurants remains unsolved. Design Thinking can help tackle wicked problems through iterative problem-solving

processes by reframing the problem in human-centric ways (Buchanan, 1992). When designing for complex issues such as food waste, an oversimplification of the problem can be misleading and harmful. Diagnoses and prescriptions made by researchers can hinder designers from designing innovative solutions. Therefore, this research aims to hand over actionable insights to service designers. Instead of solving, we frame the problem into design challenges. In other words, we raise better questions that inform and inspire designers.

3. Method

3.1 Research goal and research questions

Our research explores various aspects of dining to gain a higher level of insights regarding food-wasting behavior and derive implications for service designers. The goals of this study are twofold: 1) to identify factors that may contribute to young consumers' food-wasting behavior at restaurants and 2) to frame food waste challenges into design opportunities for service designers.

3.2 Participants and recruitment

The target of this study was university students. Students frequently rely on on-campus food services or nearby restaurants during the semester instead of dining at home. While the results of this study do not represent the broader young population, their behaviors help clarify the challenges of food waste in food service management. Since university students dine inside and outside the campus, choosing this target group allows us to collect data in restaurants and education sub-domains of the Hospitality and Food Service sector.

Criteria for participation are Korean university students who have been studying at the campus for at least one year. We exclude foreigners to ensure conformity among target groups. The participants had to take note of two meals, one inside the campus and the other meal outside the campus. Upon application, they answer screening questions to select participants that meet the criteria above. Screening questions contained demographics including age, degree of study, diet condition, and eating profile, including frequency of eating out. The recruitment was announced on the university's online communities.

Out of 62 applications, 12 people were selected from frequent diners while trying to select participants with the most diversity. In total, six males and six females were selected. Toward the end of the experiment, two participants did not complete the assigned task. Thus, only ten people participated in the photo diary study (M=5, F=5). The small sample size was opted for due to the qualitative nature of the study. Out of 10 participants, six were in their early 20s, and four were in their late 20s. Five participants were undergraduate students, and five participants were graduate students. All participants spent at least one year at the campus and ate out frequently (more than six times per week) except for one male participant selected because of his diet. Three out of ten participants were on a diet (M5, F4, F5).

3.3 Study design and analysis

The method used in the study is an ethnographic approach using a photo diary. A photo diary was chosen because we wanted to capture participants' experiences in their natural environment and at the moment the events occur. Since the food waste topic can be considered sensitive, the absence of the researcher would help participants feel more comfortable answering freely using the self-report method. In addition, a photo diary allows the researcher to collect data from several participants simultaneously compared to field observations. Photos could also help us cross-check what participants said.

The photo diary study consisted of two parts: 1) taking before and after photos of two meals and 2) filling out the questionnaires. Participants communicated with a researcher through the social messenger application KakaoYellow ID, where they were given a link to write a diary and received reminders until they had completed the task. Questionnaires and photos were uploaded through an online survey platform. There was no physical meeting, and all diary notes were recorded with student numbers instead of real names. Thus, anonymity was guaranteed to encourage participants to answer questions truthfully.

We asked participants to record two meals, one inside the campus and the other outside, to compare the characteristics of restaurants and see how they affected eating behaviors in one person, and eventually expected to bring more varieties and insights. The duration lasted for two days. Participants were promised a small monetary compensation for their participation. The estimated total time for the task was 20 minutes, including taking pictures and filling out the questionnaires.

The questionnaires consisted of three parts. Part I was about the diner's background. Two types of information were collected: 1) personal consideration when choosing a meal and 2) satisfaction with the meal. Aspects considered when choosing a meal were added to the question list because of the presumption that people who eat outside for social experience or on special occasions may leave more food than those who intentionally visit the place for food. These aspects include dining for food, atmosphere, cost, and service. Satisfaction with the meal was added because bad food quality may lead to leftovers, especially inside the campus. Overall satisfaction and satisfaction regarding quality, taste, portion size, and value for money were asked. Part II was about contextual factors. Participants were asked to input the time of the meal, whom they dined with, how many people they dined with, cost and duration of the meal. This part was about reasons for leaving and not leaving food. They were asked to describe their reasons in a short paragraph.

The primary analysis method is a qualitative interpretation of the photos and quotes from participants, which were backed up with quantitative data from the questionnaires. The collected data were analyzed as follows:

1) Photos were examined to see what kind of food people left and to cross-examine what people said.

2) Reasons for leaving and not leaving food were analyzed through simple open coding and grouped to see if there were patterns based on the place of dining or the participant's diet condition.

3) We examined whether diners' personal factors were related to the tendency to leftovers.

Demographics, including gender, age group, degree of study, and diet condition, were analyzed using the Chi-square of independence test.

4) Two factors, personal consideration when choosing a meal and satisfaction with the meal, were analyzed using T-test analysis.

5) Contextual factors influencing food-wasting behavior, including place, time, dining partner (relationship and number of people), cost, and meal duration, were plotted to see if they may influence leftovers.

Although the data samples are small, we conducted the chi-independent test to see if there is a significant association between these contextual factors and leftovers.

4. Results

4.1 Photos

The following sections consist of the interpretations of before and after photos collected from 10 participants (Fig. 4-1). For participant M1, there are two photos of two meals, one inside and one outside the campus. Photos after the meal were not recorded because participants forgot to take the photos. He had a buffet-style lunch with his friend for the meal inside the campus, and had left some food. Outside the campus, he had a Japanese pork cutlet with rice for lunch and reported no food left.

Participant M2 was satisfied with the taste and finished both meals. Inside the campus, he had a cafeteria-style lunch where he picked dishes and paid for each one. His lunch was meat & kimchi rice bowl and soup. Other dishes were dessert, including rice cake, a glass of sweet drink, and two yogurt drinks. He had dinner outside the campus and finished the rice and main dish, the pork rib soup with potatoes. It appeared that a restaurant served the side dish. The omelet side dish was all consumed, while some vegetables and Kimchi were left.

Inside the campus, participant M3 had a cafeteria-style breakfast. His breakfast included a bowl of rice, steamed fish, vegetables, Kimchi, roasted seaweed, and a milk carton. There were no leftovers. Outside the campus, he has a Japanese-style rice bowl during lunch. He asked for extra rice, but it was too much, so he left some. Two types of side dishes were served. Kimchi was eaten, but pickled radish was untouched. It was unclear if restaurants or customers served the side dish; however, it was more likely that he or his friend served themselves, but no one liked it.

Participant M4 had a buffet-style lunch inside the campus where he could serve himself as much as he wanted at a fixed price. He took a lot of stir-fried meat, sausage, and lettuce. He also took some radish Kimchi and Kimchi soup. He admitted that “he served himself too much,” so there was some leftover Kimchi. For the meal outside the campus, he had grilled meat and giblets at dinner time. A piece of potato and rice cake, some vegetables, many types of sauces, and seaweed soup were left.

Inside the campus, participant M5 dined at a pick-up-style restaurant similar to full-service dining, except the food had to be picked up at the counter. His lunch consisted of chicken wings & fries, pizza, pasta, and a glass of drink, which he shared with his intimate partner. Except for the

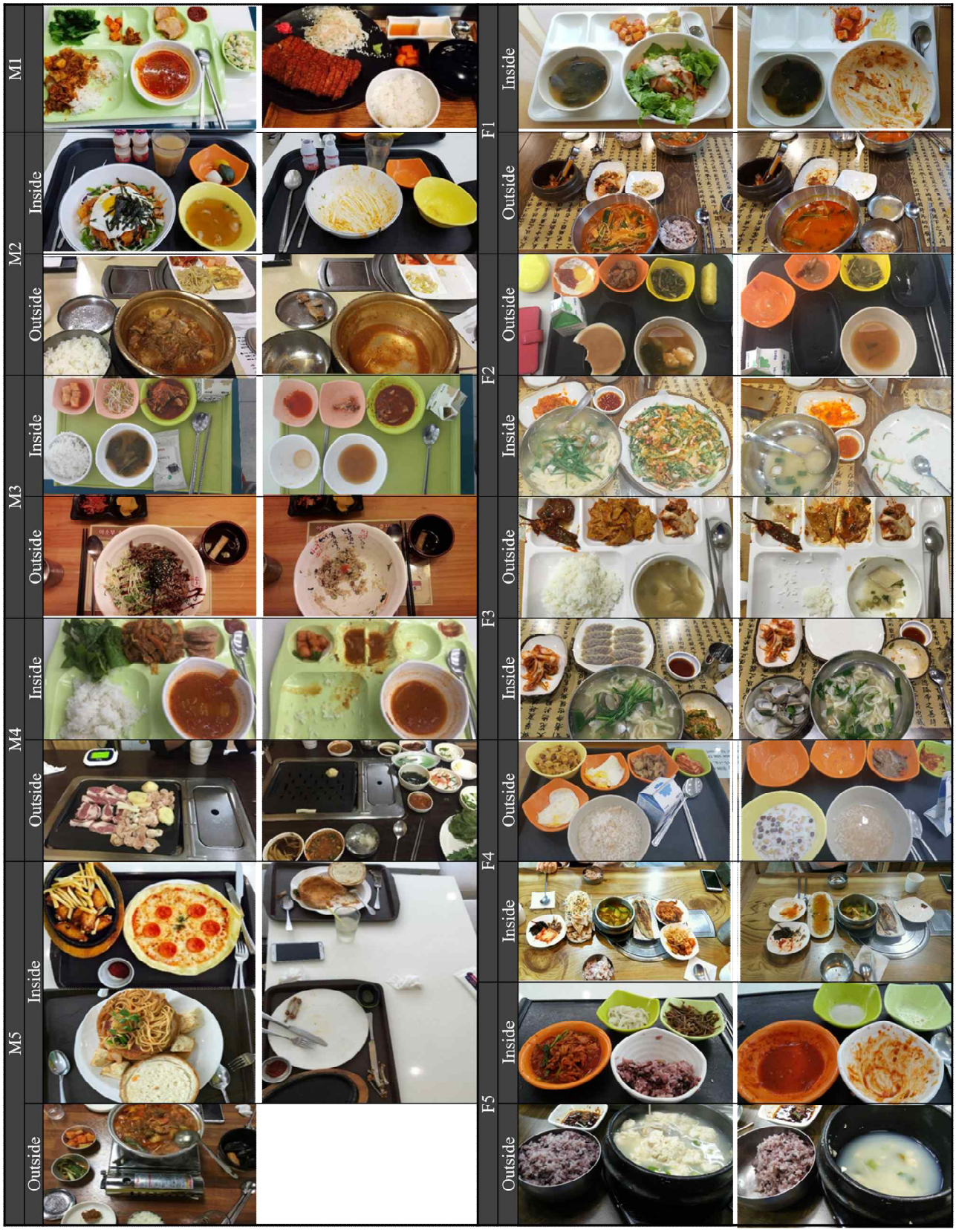

Fig 4-1 Before and after photos of the meals collected from 10 participants, inside and outside campus

bread, which was served as a container of pasta, he finished it all.

Inside the campus, participant F1 had a buffet-style lunch. A rice bowl with vegetables, Kimchi, and chicken nuggets was served. There were not many side dishes besides radish Kimchi, and a bowl of soup were left. She was hungry and very dissatisfied with the value for money. Perhaps, other dishes were not good besides the rice bowl and nuggets. She had spicy beef soup outside the campus for dinner with her intimate partner. Some rice and vegetables in the soup were left. She explained that because rice and noodles were served, the amount was too much. However, her partner finished both. Also, Kimchi was self-served.

Participant F2 had a cafeteria-style breakfast inside the campus after morning exercise. She opted for bread instead of rice. Besides some vegetable side dishes left due to bad taste, she was hungry and finished most of the food. Although the quantity was okay, she was dissatisfied with the quality, taste, and value for money. For the meal outside campus, she had clam hand-cut- noodle soup and Korean pizza for dinner with her intimate partner. They could finish the meal because she dined with her intimate partner.

Participant F3 had a buffet-style dinner inside the campus. She mentioned, "Sujebi and fish cake were the food she liked, so she ate all." However, we could see that she did not finish them. She left some chili because it was too salty. Some rice was left, and Kimchi was not touched. Outside the campus, Kimchi was served but not eaten. The main dish was clam hand-cut noodle soup. She liked dumpling and thus also ordered dumplings. The dumplings were finished, but half of the main dish was left. She explained that the main dish was not something she wanted in the first place, saying, "The food I usually order went out, so I changed the menu. The portion is huge".

Inside the campus, participant F4 had a cafeteria-style breakfast. She got cereals and rice porridge but got full before finishing everything. While she was satisfied with the taste, she was dissatisfied with the meal quality. For the meal outside campus, she had grilled meat and fish for dinner with her friend. Most side dishes were finished, but the vegetables in the soup and half of the fish were left. She was satisfied with the meal overall, but dissatisfied with the value for money. It could be because the main dish was small, and other dishes served did not meet her preferences and ended up being wasted.

Inside the campus, participant F5 had a cafeteria-style lunch. She asked for less rice, and nothing was left. Outside the campus, the rice was served in a full bowl, but she could only finish half of it.

Overall, leftovers mainly consisted of starch (rice, noodles, bread, and cereal), vegetables in side dishes and soup, and pickles like Kimchi. The types of food that are left are similar both inside and outside the campus.

4.2 Reasons for (NOT) leaving food

Participants described reasons for leaving food and not leaving food (Tab. 4-1). The most frequent reasons are big portion and feeling full, mentioned six and five times respectively. Reasons for big portions are the amount of food, too many starches, and side dishes. Large portions also result

Tab. 4－1 Reasons for leaving and not leaving food

	Code	#	Quotes from participants
Reasons for leaving food	Big portion	6	I asked for more rice, but it was too much (M3) Too many side dishes are served (M4) I served myself too much (M4) Both rice and noodles are served (F1) The portion is too big (F3) The amount is too much (F5)
	Feeling full	5	I was full (M1, M5, F4, F4) I had late lunch (F5)
	Bad taste	2	It was tasteless (F2) It was too salty. I also don't like this menu (F3)
Reasons for NOT leaving food	Good taste	6	It was delicious (M2, M4, M4, M5) It was so delicious. Even though I was full, I can keep eating (M5) It was the food that I like (F3)
	Appetite	3	I was hungry, and it was delicious (M2) I was hungry (F1) I was hungry after exercise (F2)
	Right portion	2	I asked for less rice (F5) The amount of the given side dishes was appropriate. I can refill only the side dish I want. (F5)
	Dine with others	1	I ate with my partner and we finished it all. (F2)
	Satisfaction	1	If only a bit is left, I tried to finish it all (M3)

from serving themselves too much and asking for more but ending up with too much. Reasons for feeling full include feeling full of this meal and the last meal. Other reasons were bad taste or saltiness and food aversion. One participant wrote that what she wanted ran out, so she ordered a different menu and wasted food because it was not something she liked.

Reasons for NOT leaving food can be summarized as follows. The most frequently mentioned reason was good taste, including food being delicious or matching their preference, mentioned six times, followed by increased appetite, mentioned three times. Another reason was the proper amount due to asking for less and refilling just what one wants. Other reasons were dining with others and satisfaction for finishing the food.

Reasons for leaving food and not leaving food are compared between the diet group and non-diet group, and the inside campus group and outside campus group (Tab. 4-2).

4.3 Personal and contextual factors

The result showed that some factors might influence leftovers, while others do not. Among personal factors, gender strongly correlated with

Tab. 4－2 Reasons for leaving food and not leaving food compared between groups

	Diet group		Non-diet group		Inside campus group		Outside campus group	
	Reasons	#	Reasons	#	Reasons	#	Reasons	#
Reasons for leaving food	Feeling full	6	Bad taste	2	Feeling full	3	Big portion	1
	Big portion	5	Big portion	1	Bad taste	2	Feeling full	1
	Bad taste	2	Feeling full	1	Big portion	1		
Reasons for NOT leaving food	Good taste	6	Good taste	4	Good taste	3	Good taste	4
	Right portion	3	Appetite	3	Appetite	2	Appetite	1
		2	Dine with others	1	Right portion	1	Right portion	1
		1	Satisfaction	1	Satisfaction	1	Dine with others	1

leftover, while other demographic aspects, including age, degree of study, and diet condition, did not seem to associate with leftover. The result suggested no association between personal consideration when dining or satisfaction with the meal result suggested no association between personal consideration when dining or satisfaction with the meal with leftovers. However, higher taste satisfaction seemed to lead to leftovers, while higher taste satisfaction seemed to lead to fewer leftovers. Among contextual factors, the meal duration strongly correlates with leftovers, followed by a relationship of dining partner, number of people dining with, and place of dining. The result suggests no association between place or time of dining with leftovers. The findings were summarized along with the p-value in <Tab. 4-3>, and the details are described in the sections below.

When examining if the personal background is associated with a tendency to leave food, we found that gender is a strong indicator of leftovers, with female participants leaving food twice as often as male participants.

When comparing the frequency of leaving food, out of 13 meals that contained food waste, seven meals were from inside campus. The frequencies of leaving food were similar inside and outside the campus. However, when comparing the amount of waste created, meals outside campus created more significant food waste than meals inside the campus.

There is a tendency for people to waste more for meals less than 5000 won than meals that cost more. All meals costed between 5000 and 10000 won were eaten outside the campus and compared to meals costed between 10000 won, and 20000 won eaten outside the campus, the latter created leftovers more than twice as frequent. The result implied that a more expensive meal does not necessarily lead to fewer leftovers. Instead, the result suggested that the amount of food served in more expensive meals is typically larger than in cheaper meals, thus leading to more leftovers.

It is unclear if the number of people on the table influenced the creation of leftovers. However, the proportion of people leaving food in a large group (more than 2) was more significant than when they were eating alone or in pairs.

Tab. 4-3 Summary of findings regarding personal and contextual factors that may associate with leftover

	Factor	P-value
Personal factor	Demographic	
	Gender	0.16*
	Age	0.44
	Degree of study	0.64
	Diet condition	0.92
	Consideration when choosing the meal	
	Service	41.2
	Atmosphere	47.8
	Food	
	Cost	5.1
	Satisfaction of the meal	
	Taste	0.40
	Overall	0.69
	Value for money	0.74
	Quality	0.93
	Quantity	0.96
Contextual factor	Restaurant	
	Place	0.64
	Cost	0.32*
	Dining partner	
	Number of people	0.31*
	Relationship	0.24*
	Time	0.98
	Duration	0.18*

When looking at the relationship of dining partners, there seemed to be a tendency to leave food more when people dine with friends than with close ones such as intimate partners and family members. Compared to dining alone, people may get negatively influenced by their dining partner in terms of leaving food. On the contrary, when relationships are intimate, participants waste less food when dining with others. The result suggested that intimacy or the relationship of the dining partner might be a crucial factor to consider.

People spend less than 30 minutes when eating inside the campus and more time outside campus. Meals taken longer time tend to waste less frequently. Dining duration may influence leftovers. Although haste seems to be a reasonable explanation, none of the participants mentioned they were in a hurry. during meal lasted less than 30 minutes.

5. Discussion

In this study, we investigated the influences of diner's personal factors and contextual factors, including dining partners and types of restaurants, on food-wasting behaviors. The parties which impact and are impacted by diner's food-wasting behaviors can be summarized in <Fig. 5-1>.

The sources of leftovers can be categorized into three categories: 1) what is served, 2) how much is served, and 3) how much of what is served (Fig. 5-2). The first category, what is served, refers to serving the types of food that are not preferred. This type of leftover is common in Korean restaurants, where various side dishes are served. The second category, how much is served, refers to serving too much food, such as too much rice and vegetables. When each staple is not adjusted, the overall amount can be too much. The third category, how much of what is served, refers to the plate composition. For example, when soup and rice are meant to be eaten together, if the ratio of the soup compared to rice is too much, customers may finish the rice before they can finish the soup. Another example is a dish with more than one starch staple, such as pasta & bread or noodles & rice, which often creates leftovers.

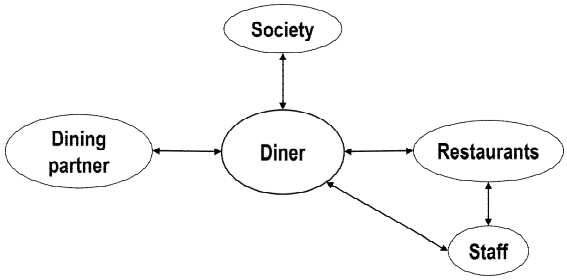

Fig. 5-1 Stakeholder Map

By analyzing the results, we can draw observations on aspects that positively and negatively influence leftovers. These key aspects include awareness, control, communication, and social norms (Fig. 5-2). Awareness and control, which reduce the chances of creating leftovers, can be achieved through communication. Each aspect will be explained in detail in the following section.

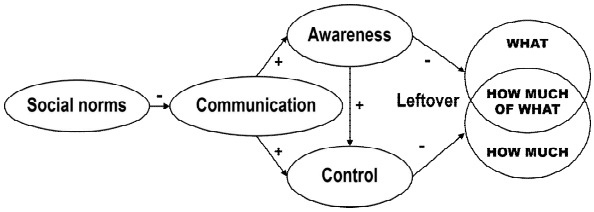

Fig. 5-2 Influence Diagram

Two key aspects influencing leftovers can be extracted: awareness and control. The first aspect, awareness, refers to knowledge regarding appropriate portion sizes and the type of food being served. Typically, awareness can be achieved by recalling past experiences. Diners are usually more aware of the meal when dining at a place they frequently visit than first-time visitors. However, specific menu items sometimes ran out, leaving diners no choice but to order an uncertain option. In addition, diners should be aware of their food intake and food preferences of themselves and their dining partners' when sharing meals. Awareness also refers to knowledge about one's appetite level, which may differ from meal to meal. For example, reasons that vary one's appetite could be exercise level and when they last had their meal (Tab. 4-1).

The second aspect, control, refers to the ability to take charge of serving size and type of food being served. Contrary to home dining where diners have more freedom, dining at restaurants has more restrictions. When categorizing the reasons according to where the meal took place, people had more control when they ate inside campus than eating outside (Tab. 4-2). Words associated with eating inside the campus were 'serving oneself' and 'asking for less.' It was observed that 'asking for less' is not typical for dining outside the campus (Fig. 5-3). Although participants might have some control when they visited restaurants outside the campus, such as asking for more rice, it seemed that they still did not have much control over how much will be given.

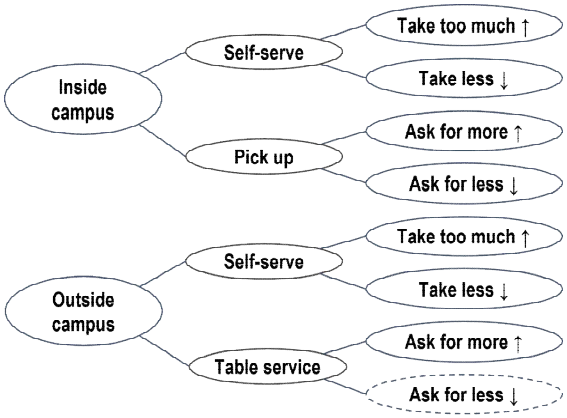

Fig. 5-3 Actions that are taken by participants that lead to more or less leftover

Based on the two influential aspects of awareness and control, an implication for design to reduce food waste at restaurants can be derived, which is to design for communication. Communication with self (i.e., memory recall, food journal), dining partners, and restaurants can increase diner's awareness. Meanwhile, communication with restaurants and staff can increase diner's control. In addition, design should overcome the biggest hurdle for communication, which is social norms. One example is that diners feel sorry to request restaurant staff. We observed that the same participant asked for less rice at the restaurants inside the campus but not outside the campus. Thus, there is an opportunity to create a friendlier atmosphere to promote wanted behaviors that people hesitate to make.

Based on these findings, we propose the following design opportunities for service designers to ideate solutions to tackle food waste (Tab. 5-1). Here are some examples of design intervention ideas generated using the proposed "How Might We" design opportunities. For example, for HMW 6 and HMW 8, restaurants can offer varied portion

size options so diners can choose without asking the staff separately. Related to HMW 6, restaurants could give more customization to each customer, which could be recognized as a service with more hospitality. Instead of an option for extra, the restaurant can implement a minus option, meaning an option for less or no particular food. In Korean dining culture, restaurants often serve the same food without considering individual food preferences. Food restrictions due to medical conditions or religious beliefs are also not well received by restaurants. When combined with HMW 9, a minus

Tab. 5-1 "How Might We" Design Opportunity

Stakeholder	Challenge	Key Aspect	"How Might We" Design Opportunity
Diner	Customer who is still full from a previous meal may consume less than usual. Customer serves themselves too much.	Awareness	HMW1: How might we customers determine the right portion depending on their food intake and appetite?
	When a dish is shared, the customer finds it difficult to recognize a portion size for one person.	Awareness	HMW 2: How might we help customers determine the right portion when ordering a shared dish?
Dining partner	Customers may order or take food that neither he nor his partner likes.	Awareness Communication	HMW 3: How might we help customers communicate with their dining partners better regarding their food preferences?
	When others finish their food, one may feel socially obliged to finish too.	Social norms	HMW 4: How might we help customers eat at their comfortable pace?
Restaurant & Staff	First-time customer finds it difficult to grasp the idea of how much the serving portion will be.	Awareness Communication	HMW 5: How might we help restaurants better communicate the portion size?
	The customer is simply a guest at restaurants.	Control	HMW 6: How might we give customers more control of what is served at restaurants?
	The customer asked for more rice, but the amount is too much.	Communication	HMW 7: How might we help customers better communicate the amount they want to the staff?
	Restaurants serve plenty amount of food to make sure that customers are satisfied.	Awareness Communication	HMW 8: How might we help restaurants serve the appropriate portion for each individual?
		Social norms	HMW 9: How might we create a recognition that serving less food is more luxurious?
	Customers are reluctant to request restaurant staff.	Communication Social norms	HMW 10: How might we help customers communicate with restaurants more comfortably?
Society	Meat is valuable, and vegetables and rice are not considered food waste.	Awareness Social norms	HMW 11: How might we create a dining culture that value every type of food?

option can be branded as a luxury item, giving a restaurant an innovative value proposition.

For HMW 8, we argue that adjusting the amount of starch could allow restaurants to customize portions based on personal food intake. While it is difficult to customize a portion of meat or main dishes, which are often restricted by the characteristic of raw material (such as one whole fish or chicken), or how the dish is cooked, the amount of bread can be easily adjusted. Serving the right amount of starch for each individual can ensure that customers are satisfied in terms of functional purpose (i.e., being full) and provide emotional satisfaction by not leaving food.

When comparing the findings from this study to existing ones, we propose some different perspectives. Regarding diners' faults, the study supports the argument that taste preference and greediness are the reasons behind food waste. However, we argue that greediness can be reframed as overestimating the amount of food one can eat or a lack of awareness regarding one's food intake. Regarding the restaurant's faults, the study supports reasons such as unsuitable flavoring, over-portioning, and plate composition. More specifically, Korean restaurants often serve a relatively large amount of starch. In Korean meals, the staple food is rice and noodles; sometimes, rice and noodles are served. We observed that while female and male participants tended to leave side dishes, female participants tended to leave more rice and noodles than male participants. Over-portioning and plate compositions could result from the lack of communication regarding the diner's food intake to the staff who prepare the meal. Regarding social norms, our findings support that diners are afraid of troubling staff. Moreover, we found that the relationship between dining partners may affect leftovers. Social interactions and norms among dining partners can be an interesting area to investigate further.

6. Conclusion

The study shows that some factors may influence leftovers while others do not. Among personal factors, gender shows a strong relationship with leftovers. In contrast, other demographic aspects such as age, degree of study, and diet condition do not show strong relations with the frequency of leftovers. Among contextual factors, the meal duration shows a strong relationship with leftovers, followed by a relationship of dining partner, number of people dining with, and place of dining.

Starchy staples, including rice, noodles, and bread, are the food people waste most, followed by vegetables in side dishes. Reasons for leaving food are big portions, feeling full and bad taste, while reasons for not leaving food are good taste, appetite, right portion, dining with others, and satisfaction of finishing food.

To summarize, the paper contributes by suggesting a higher-level perspective about factors influencing food waste, including lack of awareness and control. In addition, the paper also proposes "How Might We" design opportunities to ideate interventions to improve communication with self, dining partners, and restaurants.

There are a few limitations of this study. The first limitation is the small sample size, which makes it challenging to interpret quantitative data.

Due to the small sample size, the T-test and Chi-square independent test results are not statistically significant. However, we could determine certain factors which show more relation to leftover. Future studies can study these factors with more participants.

The second limitation is that data collection requires much effort from participants. While a photo diary allows researchers to conduct a study in their natural environment, participants have to be reminded to take actions that are not more difficult without the researcher's presence. Even if reminders are sent around meal times, taking photos after the meal is not natural and often forgotten. Future experiments should be designed to overcome these difficulties.

In addition, although the questionnaires included a few questions regarding the dining context, it was not easy to analyze the data without knowing the full context. Future studies can implement different research techniques, such as video ethnography. We can expect interesting insights that could not be captured with questionnaires by observing interactions between dining partners, and restaurant staff, especially when ordering food. Moreover, a follow-up interview can be conducted to clarify our interpretation of the photo diary and better understand participants' food-wasting behaviors.

In the following study, we plan to validate the proposed concept by conducting an ideation workshop with service designers. Although this study does not yet provide a direct answer to food waste, we expect that our research contributes as a helpful case study for service researchers to adopt a service design research approach to frame wicked and complex problems.

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해결대신 프레이밍: 서비스 디자인 연구를 통해 음식점 음식물쓰레기라는 난제에 접근

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요약

환대문화에서 비롯한 요식업 부문은 음식 쓰레기를 가장 많이 발생시키는 식품 부문이다. 지속가능한 서비스를 제공하기 위해 외식업계가 음식 낭비에 대한 문제를 이해하고 줄일 필요가 있는데, 이는 대부분 피할 수 있는 일이다. 기존 연구에서 음식물 쓰레기 행동의 동인과 제안된 완화 조치를 조사하였다. 그러나 난제를 해결하기 위해 서비스 디자이너는 혁신적인 솔루션을 고무할 수 있는 실행 가능한 통찰력이 필요하다. 본 연구의 목적은 두 가지이다. 첫 번째 목표는 음식점에서 젊은 소비자들이 음식을 남기는 행동에 영향을 미치는 요인을 파악하는 것이다. 두 번째 목표는 음식물 쓰레기 문제를 서비스 디자이너의 디자인 기회로 프레이밍(Framing) 하는 것이다. 국내 대학생 10명과 함께 사진 일기 (Photo Diary) 연구를 진행하였다. 참가자들은 두 끼 식사의 전후 사진을 찍고 설문지를 작성하였다. 질문은 개인적인 배경과 식사 선택 시 고려 사항, 식사에 대한 만족도, 음식을 남기는 이유 등이다. 실험을 바탕으로 정성적 데이터와 정량적 데이터를 모두 수집하고 분석하였다. 그 결과 의식과 통제력 부족이 남은 음식물의 주요 동인이라는 것을 시사하였다. 서비스 디자인을 위한 음식물 쓰레기 문제는 “How Might We” 디자인 기회로 프레이밍 된다. 자신, 식사 파트너, 식당과의 의사소통을 개선하는 데 개입의 초점을 맞춰야 한다. 본 논문은 음식점 음식물 쓰레기의 예를 들어 난제를 프레이밍 하는 서비스 디자인 연구 접근 방식을 입증함으로써 이바지한다.

표제어: 외식서비스산업, 음식물 쓰레기, 서비스 디자인, 지속 가능성, 난제

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