Why Is Airline Food Always Dreadful?
Analysis of Factors Influencing Passengers’ Food Wasting Behaviour

Fangzhou You *, Tracy Bhamra and Debra Lilley

School of Design and Creative Arts, Loughborough University, Loughborough, LE11 3TU, UK;
t.bhamra@lboro.ac.uk (T.B.); d.lilley@lboro.ac.uk (D.L.)

* Correspondence: f.you@lboro.ac.uk

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Abstract: Food waste is emerging as a global issue and has been recognised in the Sustainable Development Goals with a specific target to halve per capita global food waste at consumer levels and reduce food losses by 2030. Research on food waste has been neglected particularly in the aviation sector. The International Air Transport Association reported that 5.7 million tonnes of cabin waste was generated on airlines, up to 80.5% of which was leftover food and beverages. The exploration of passengers’ food wasting aims to provide insights for tackling the airline food waste problem. To address this issue, this research investigated the in-flight catering experience of 19 passengers from 21 full-service flights. Qualitative research techniques have been applied to analyse passengers’ food-wasting behaviour by collecting participant-produced photographs and completed questionnaires concerning food-related behaviour. This research identified key factors associated with passengers’ food wasting behaviour by adopting Design for Sustainable Behaviour approaches. Four types of factors were found to influence onboard passenger waste, these were normative, habitual, intentional and situational factors. This research indicates that behavioural change interventions need to incorporate the power of social norms to prevent food waste.

Keywords: food wasting behaviour; in-flight catering service; responsible consumption; behaviour change

1. Introduction

1.1. Research Context

Food waste is a pressing issue that has gained considerable attention worldwide. The Food and Agriculture Organization of the United Nations (FAO) reported that 46 percent of the world’s food losses and waste occurs at the end of the food chain (distribution, sale and final consumption) [1]. In addition, food that has been spoiled can be ascribed to individual consumer shopping or eating habits [1]. To address this issue, the Sustainable Development Goal (SDG) 12 of the 2030 Agenda for Sustainable Development addresses responsible consumption and production to ensure companies and people adopt sustainable development and lifestyles. One of the pivotal targets of SDG 12 is to substantially reduce waste generation through prevention, reduction, recycling and reuse by 2030. To achieve the overarching goal, target 12.8 [2] requires that ‘by 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature’, indicating the importance of individuals in food waste prevention and reduction.

Chapman [3] stated that ‘the sustainability crisis is a behavioural issue, and not one simply of technology, production, and volume’. He pointed out that behaviour is rated as an important driver in
Material consumption. Food wasting behaviour has been explored mainly in household and public contexts. The former was studied based upon behaviour patterns of specific consumer groups through observation, self-report survey and interviews to identify key determinants causing the food waste. Such studies found that intentions and habits were major factors impacting consumers’ food waste [4–7]. The public context is more diverse in terms of food wasting behaviour, including but not limited to university canteens, restaurants and supermarkets [8–10]. It was found that situational factors were associated with consumer’s food wasting behaviour, including food serving, timing, types of food and packaging. Nevertheless, studies of consumer food wasting behaviour have been context driven and only identify some of factors associated with food wasting behaviours. A research gap is to comprehensively explore the factors that affect consumer’s food wasting behaviour.

1.2. Food Waste in the Aviation Industry

The aviation industry in recent years has paid increasing attention to the food waste issue, particularly in the cabin service sector of full-service airlines due to the amount of food wastage and the corresponding impact on the environment and economy. Full-service airlines refers to traditional airlines where their in-flight catering service is included in the price of the ticket. Given that the aviation industry is very strict with food safety and food quality, once loaded, the unconsumed airline meals are regarded as catering waste even if the meals remain unopened. The traditional treatments for airline waste disposal are landfill and incineration, which causes greenhouse gas emissions and contributes significantly to climate change [11].

The International Air Transport Association (IATA) reported that 5.7 million tonnes of onboard waste was generated in 2017 [12]. Based on this number, an estimation of cabin waste volumes indicates that the waste volumes are likely to double over the next ten years. At the global level, air passengers generate 0.52 kg to 1.81 kg of waste, including catering waste, depending on flight length and cabin class [13].

Li [14] conducted an in-flight service waste composition analysis, indicating that food waste was the largest category of cabin waste. In this study, food waste refers to food scraps and unopened meals. The results also indicated that economy class generated more leftover food compared to business and first class. This study addressed the fact that recycling the recyclable items from cabin waste potentially contributes to global environmental protection but no solutions for tackling food waste were identified.

As of 2014, catering waste accounted for 80.5% per flight, including sealed and loose food and beverages contributed (39.2%), unconsumed food and beverages and untouched meals (23.4%), liquid and packaging (18%) [13].

In recent years, initiatives have been proposed to reduce airline cabin waste to achieve zero cabin waste [15], as well as encouraging passengers to engage in food waste prevention. A shift from food supply chain to food consumption has been found indispensable to achieve a sustainable aviation industry and promote responsible consumption.

The project ‘LIFE zero cabin waste’ [16–19] aimed to reduce the amount of airline cabin waste that ends up in landfill and prevent the generation of waste, particularly in the case of Spanish airlines. In this project, several studies had proposed solutions to tackle food waste issue mainly focusing on recycling and reusing the recyclable materials [18,20]. Solutions to reduce airline food waste were mainly proposed from the airline’s perspective. However, recycling and reusing airline waste are not the most promising solutions for airline food waste. Unlike the other recyclable materials identified in this study, food waste cannot be reused or recycled. Food waste generated on international flights is subject to strict regulations in some countries (i.e., European Union, USA, Australia and Canada). The common treatments for collected cabin food waste is landfill and incineration, which is not a sustainable solution in terms of reducing airline food waste. Overall, there is still little known about the relationship between airline food wastage and passengers’ behaviour, which is regarded as a critical action in generating food waste in the cabin service sector.
The overlooked issues of passengers’ food wasting behaviour can be inferred by the following three reasons.

Firstly, airlines were more conscious of branding and customer than cabin waste management. In many cases, unrecyclable materials, such as food scraps, were sent to incineration or landfill as the major waste management solutions when these items could not be prevented, reused or recycled. Moreover, cabin waste cleaning and disposal usually are undertaken by cleaning and waste contractors.

Secondly, restrictive regulations discouraged airlines and other stakeholders to proactively look for solutions to prevent excessive food waste. Regulations indicate that International catering waste (ICW) should be disposed of using controlled measures, such as incinerating or deep burial in an authorised landfill [21]. Therefore, various food wastes from the ICW are regarded as the risky animal by products that are required to be disposed of by waste contractors. Food waste is unable to be reused and recycled once it has been produced during the airline cabin service.

Thirdly, awareness of food waste issues has not been raised among the airline food consumers—passengers. As the service receivers, passengers play an important role in the cabin service sector. Their airline food consumption behaviour potentially influences the airline food generation.

1.3. Design for Sustainable Behaviour as the Solution

To reduce environmental and social impacts produced by consumer behaviour, Design for Sustainable Behaviour (DfSB) has emerged in sustainable design aiming to promote behavioural change through design innovations [22]. DfSB centres on human behaviour in everyday life and finds solutions that reduce negative environmental and social impacts through the interaction between users and products, services and systems. Lilley and Wilson [23] have stressed the definition of sustainable behaviour as not only protecting the natural but also the social environments. To tackle the issues caused by human behaviour, a key step is to find drivers that lead to the behaviour.

In recent years, psychological theories regarding behaviour change have been applied in the field of DfSB, which supports finding and selecting the potential design solutions to alleviate the sustainability crisis [24]. Empirical studies applied those psychological models to explore the opportunities that contribute to energy-saving in household [25,26]; water-saving [27,28]; eco-commuting; [29,30] and stove-using [31]. As of 2019, DfSB has been applied into various types of behaviour and contexts, ranging from energy consumption behaviour from waste consumption behaviour [28,32–35]. The use of psychological models centres on the exploration of factors associated with the unsustainable behaviour. Focusing on either internal or external factors helps designers propose solutions for behaviour change.

Zachrisson and Boks [24] have indicated that a thorough investigation of various factors influencing behaviour can develop the useful design strategies. DfSB provides a framework to understand consumer behaviours and potential opportunities to intervene unsustainable behaviours from an environmental perspective [36]. The first step in the DfSB framework is to understand consumer behaviours in context. Lilley [37] has stressed that the context in which the consumer–products/services/systems interaction takes place is important to understand.

Klöckner and Blöbaum [38] have proposed a Comprehensive Action Determination Model (CADM) as a useful tool for understanding individual’s behaviour from normative, habitual, intentional and situational perspectives, which becomes the latest behavioural model applied in the sustainable field. Even though the CADM is a relatively new model in the field of behavioural research, it incorporates many key factors explored in the other classic theories, such as The Planned Behaviour theory [39]. Therefore, the CADM is believed to better explain variations in human behaviour. By addressing behavioural theories from the CADM combined with the DfSB framework, a number of principles from various factors affecting behaviour have been derived [24] (p. 50). The CADM not only helps with behavioural analysis, but also enables responsible factors and influences to be identified in the context. These findings potentially contribute to choosing appropriate strategies for designing behaviour change interventions.
Returning to consumer’s food wasting behaviour, Ukar et al. [40] have underlined the significance of changing consumer behaviour to reduce the food wastage. Hebrok [41] conducted a comprehensive study of household food wasting drives and proposed different approaches to reduce household food waste through design. She also emphasized that collaboration between important stakeholders is needed when introducing behaviour change interventions.

According to IATA’s suggestions to tackle food waste issues, passengers, as one of the key stakeholders in the cabin service system, should commit to reducing the environmental impact of food waste production. In recent years, airlines have neglected to deliver messages to raise passengers’ awareness of food waste prevention or develop passenger-facing-waste communications [13].

There is limited research focused on interventions particularly aiming at food wasting behaviour in the aviation context. To select the effective behavioural interventions, factors associated with passenger’s food wasting behaviour need to be comprehensively studied.

It was identified that food wasting behaviour was less addressed in the in-flight catering service and needed to be studied in order to prevent passengers’ food wasting behaviour in the near future. The research scope focused on the in-flight catering service on full-service airlines where the food wasting behaviour happened. Consequently, the research question proposed based on the literature review is: what are the factors determining passengers’ food wasting behaviour in the in-flight catering service? Therefore, this research underlined the issue mentioned above by investigating passengers’ onboard behaviour through the whole in-flight catering process. The overarching aim is to understand what the key factors are and how they influence passengers’ food wasting behaviour through the in-flight catering service and to understand the behaviour pattern of passengers who generated food waste, in support of the future study of behaviour change interventions. The findings helped propose possible intervention strategies to inducing sustainable behaviour in air travellers. The in-depth analysis of the mechanism of passengers’ food wasting behaviour would ultimately offer a remedy to reduce food loss and food waste in the aviation industry. To address these research gaps and answer this question, this study sought to obtain data concerning passengers’ food wasting behaviour in the in-flight catering service. It is time to take further step to scrutinise passenger behaviours and to understand why they wasted airline food. Passengers’ behaviour should be studied in this context because their behaviours are closely associated with airline food consumption in the cabin service sector.

2. Materials and Methods

2.1. Sampling Strategy and Participants

This study used a purposive sampling strategy [42] to recruit qualified participants. Purposive sampling is a cost-effective and time-effective sampling method that enables one to obtain representative samples out of a large group of full-service airline passengers, and it is performing better in selecting typical participants compared with other sampling strategies [43]. The sampling procedure was complied with a set of inclusion criteria to prevent any research bias. Participants were eligible to pass from the screening question ‘Do you have any eating disorders?’ to the consent form to the final assessment if they met the following inclusion criteria:

- Aged 18 and above
- Owning smart phones
- Willing to record their airline meals
- Passengers who will travel by full-service airlines

As this was qualitative research, it adopted the sampling strategy suggested by Polkinghorne [44] and aimed for between 5 and 25 participants. A pilot test was conducted to validate the data collection strategies and reliability with a sample of 7 participants from April to July 2019.
The data collection took place between October 2019 and March 2020. A total of 33 individuals were invited to participate this study, of which 19 completed the survey, meaning a response rate of 56%. The demographic information of the sample is shown in Table 1.

| Category              | Sample (%) |
|-----------------------|------------|
| **Gender**            |            |
| Female                | 68         |
| Male                  | 32         |
| **Generation group**  |            |
| Generation Y (1977–1995) | 74     |
| Baby boomer (1946–1964) | 11    |
| Generation Z (1996–onwards) | 5     |
| Generation X (1965–1976) | 5     |
| Traditionalists (1945–earlier) | 5     |
| **Travel purpose**    |            |
| Leisure               | 58         |
| Business              | 42         |
| **Travel frequency**  |            |
| 1–4 times per year    | 68         |
| 5–10 times per year   | 16         |
| 10 or more times per year | 16     |

A total of 68% of respondents were females and 32% were males. Generation Y (1977–1995) prevailed (74% of all respondents in this study), followed by 11% of Baby boomers (1946–1964) and 5% each of Generations Z (1996–onwards), X (1965–1976) and Traditionalists (1945–earlier). Additionally, 58% of respondents travelled for leisure purpose and 42% for business. The difference between these two travel purposes may have influenced their budgets on cabin class choices. In total, 68% of the respondents travelled by airplanes one to four times per year. Respondents who have more than five and up to 10 air trips each year accounted for 32%.

To sum up, airline meals from 13 airline companies were recorded by participants, including 30 meals within 23 trips of flying. Participants were encouraged to record more than one meal in order to observe more factors that affect their behaviour during the in-flight service.

This study was not restricted by flight types. International and domestic flights have been taken into account as long as they qualified as ‘full-service’ airlines. In a total of 23 trips, the top three airlines travelled by the participants were Emirates, China Eastern Airline and Air China. Participants who took long-haul flights (from 6 to 12 h flying) accounted for 74%, followed by 26% of medium-haul (from 3 to 6 h flying) and ultra-long-haul flights (over 12 h flying). No participants in this study had taken short-haul flights (under 3 h flying). All participants were economy class passengers.

2.2. Methods

2.2.1. Data Collection

This research applied a Design for Sustainable Behaviour framework to analyse passengers’ food wasting behaviour and investigated factors associated with their food wasting behaviour. From a DfSB perspective, the understanding of user behaviour formation helps to identify key factors of behavioural change, which also determines ways in which they could be applied within a design context and different control levels of behavioural interventions [45]. Two qualitative research methods were applied in this study.

Firstly, the visual research method photo-elicitation [46] was used for collecting participants’ airline food waste, which helps the researcher to know passenger’s in-flight catering experience by
observing if food wasting behaviour happens. The photograph provides a visible record of participants’ real-life experiences and it helps problem to be exposed and explored by the researcher of the study. Photo-elicitation is especially feasible when participants–researcher communication restricts by the time and location. More importantly, the strength of using this approach is adding to the credibility of the data, which ensures the reliability to a qualitative research [47]. In this study, participants were required to take photographs of their airline meals before and after being eaten. According to participant-produced photographs, food waste generation and category can be clearly identified. Figure 1 presents an example of participant-produced photographs as a technique for data collection.

Figure 1. Example of participant-produced photographs.

Secondly, a semi-structured questionnaire consisting of both formalised and open-ended questions was distributed to the participants. The questionnaire was composed of seven parts: (a) introduction, (b) demographic questions, (c) flight information, (d) antecedent influences, (e) in-flight catering experience, (f) self-reporting of food waste and (g) overall rating for the in-flight catering service. Survey questions were designed to explore participants’ behaviour, by adopting the measures from the CADM [24], including habitual, normative, intentional and situational measures.

1. Normative Measures
   - Dealing with food wastess
     Passengers’ dealing with food waste aimed to explore how personal norms influence their food wasting behaviour. This question measured whether they take away uneaten food or hand over it to flight attendants. Their intentions to be sustainable can be seen from this question.

2. Habitual Measures
   - Pre-flight diets
     Participants were asked whether they ate any food one hour before boarding the flights and what type of food they ate in advance. These two questions measure the impact of the pre-flight diet on passengers’ intake of airline meals. Considering airline meals are usually served 30 min after flights taking off, passengers’ eating behaviour one hour before boarding needed to be measured.

   - Carried-on food
     Carried-on food refers to passengers bringing their own food or drinks onboard the flight. If they did carry their own food, they were required to answer what types of food they brought onboard.
• Meal type

Meal type was set to understand what types of airline meal the respondents had and whether the meal type caused food wasting behaviour if they received the undesired one. Meal type also determines what kind of ingredients will be provided. In other words, food contents may vary from each type of airline meal. Airlines provide a variety of meal types to fulfil the different need of passengers. For those who require special food for dietary, religious or nutritional reasons, airlines designate special meals with up to a dozen choices, including vegan meals, children’s meals, kosher meals and halal meals, etc. Usually, special meals need to be pre-ordered through airline companies by passengers.

• Food ordering

Asking respondents their ways of food ordering follows up the meal-type question. This measure aims to explore participants’ habitual behaviour on food ordering. The past air travel experience and knowledge likely enable passengers to make their favourable meal choices and form their habitual behaviour every time they order airline food.

3. Intentional Measures

This questionnaire used a five-item scale to measure respondents’ perception of food taste, food consistency, food portion, satisfaction and overall in-flight catering experience. Each item in the scale has a corresponding descriptive word to illustrate their perception.

• Food taste

Passengers’ perception of food taste may influence their attitude towards airline meal. Previous study on airline food reviews showed that sweet, salty, spicy and sour are four basic tastes which impact passengers’ attitude and intention to eat. A five-item scale was designed for acquiring respondents’ impression on each taste of food.

• Food consistency

Likewise, food consistency refers to the texture of food, which usually depends on how the airline food has been cooked, stored and re-heated. A five-item scale was included, which listed different food textures from dryness to moistness. Participants’ preference on certain food consistencies may determine their attitudes and intention to eat.

• Food portion

Food portion measures passengers’ need for food. If the provided meal portion surpasses their need, this is likely to cause food wasting behaviour.

• Satisfaction

Passengers’ satisfaction with the received airline meals was tested in the survey. They were also required to explain the reasons why they were unsatisfied with their airline food. Passengers’ satisfaction reflects their attitudes which directly affects their intention to waste food.

• The in-flight catering experience

Lastly, passengers were required to rate the in-flight catering experience holistically. The experience rate reflected their overall experience of the in-flight catering process. A five-item scale was applied to acquire respondents’ feedback.

4. Situational Measures

• Health condition

Health condition was designed to measure the status of respondents’ physical health. This measure aimed to explore whether passengers’ physical health affected their eating behaviour
due to the change in the dining environment. Respondents were required to score their health condition using a five-item scale. Each item has a corresponding descriptive word to illustrate their health status. The higher the score the better the respondent’s health.

- Food allergy
  Food allergy was rated as a potential factor that causes food wasting behaviour. Participants were asked whether they were allergic to certain food. Hence, the result can reveal whether food allergy leads to the certain food being wasted.

- First choice
  First choice refers to explore whether passengers’ meal preference is fulfilled. Less desired meal options and limited food choice may affect their satisfaction of meal service. Hence, the first choice of airline meal is a key indicator understanding passengers’ food wasting behaviour.

- Dining time
  Dining time means when passengers are served with airline food. This factor may influence passengers’ dining habits and lead to food wasting behaviour. An unstable schedule of flying and jetlag have a potential impact on passengers’ behaviour.

The study targeted potential passengers who travel with full-service airlines and consume airline food onboard. Consequently, the passengers who were eligible for the inclusion criteria were invited by email.

2.2.2. Data Analysis

Qualitative research software named NVivo 12 was applied in data analysis. Coding in qualitative research leads researchers to construct theoretical meaning from the data. Choosing a coding method to identify, organise and analyse the data enables ‘a progressive and verifiable mechanism for establishing codes, their origins, relationships to each other, and integration resulting in themes used to construct meaning’ [48].

In this study, thematic coding was used in data analysis of passengers’ in-flight catering experience. This approach enables the researcher to parse and organise similar data into several themes. This study adopted predefined categories from the CADM [49] (p. 682) as main themes to conduct the thematic categorisation for the questionnaire responses. For photographic materials, textual descriptions were produced based on identified food waste in participants’ meals. These materials were coded into corresponding themes. Closed responses were coded in numbers, and open-ended responses were coded into thematic nodes. The results were interpreted to better understand what factors determined food wasting behaviour onboard, and to explore the pattern of passengers’ food wasting behaviour of in-flight catering. Four themes for coding were categorised based on the CADM [38].

Theoretically, except normative processes, the other three processes directly influence people’s behaviour [38] (p. 576). Personal norms, the feeling and expectation of moral obligation, mediate people’s intentions and their perceived behaviour control, which triggers the corresponding actions. Complying with the CADM can clarify the relation between each process and identify key factors that determined passengers’ food wasting behaviour (see Figure 2). Detailed conclusions can be drawn from the qualitative coding process.
3. Results

The results have shown interesting findings for the study.

3.1. Food Waste in Airlines

The findings are presented by quoting participants’ answers. Figure 3 presents a word cloud that was generated by qualitative research software named NVivo 12 [50], illustrating the most wasted food categories identified both in participant-produced photographs and responses.

Figure 3. Most wasted food waste categories.

The top six wasted foods were identified from the participant-produced photographs of their airline meals. Salads were ranked first among this list. Wasted salads were vegan and non-vegan salads. The following influences caused their wasting behaviour: food temperature—P10 ‘I am always not a fan of cold dishes onboard’ and P14 ‘too cold to eat’, food consistency and taste—P12 ‘the pasta salad had a too...
soft texture (overcooked) and very little flavour’, contents of the salad—P11 ‘I’m not a fan of vegetable salads’. For biscuits, a response mentioned about food consistency, particularly the perception of the food dryness—P05 ‘the biscuit is too dry’. Another reason for wasting biscuits due to the lack of need—P07 ‘I’m full’. Reasons for wasting bread were concerning food portion—P03 ‘too large a portion of bread for the size of the meal generally’ and personal dietary habit—P19 ‘(the meal) didn’t provide jam or butter’.

3.2. Overview of Analyses

The results have shown the measures applied in the data collection.

3.2.1. Dietary Habits

Further analyses showed that participants’ dietary habits can be reflected in the following regards, passengers’ diets before flying, their carried-on food and meal choices.

- Pre-flight diets

Participants’ eating food before flying did not directly influence their intention to waste food, but it mediate affected their food choices. When asked whether they had food in the hour before boarding, 70% of the respondents reported that they ate food before getting on the plane. Only P16 had wasted her food due to feeling full. It was not evident that pre-flight diets cause passengers to waste food in medium-haul, long-haul and ultra-long-haul flights. Given the differences in flying duration, it could be assumed that eating one hour before boarding could affect short-haul flight participants’ food wasting behaviour. Moreover, it has been noted that pre-flight diets affected participants’ food choice during the in-flight catering service, which mediate caused their wasting unwanted food: P10 ‘Cause the main dish is already pork and potato, quite heavy. And I had Asian lunch before onboarding (that is why I didn’t pick the other option, i.e., chicken and rice) and I am always not a fan of cold dishes onboard, cause temperature in the cabin is too cold for me.’

- Carried-on food

Participants were asked to specify the food products if they brought carried-on food onboard their flight. The result showed that 35% of respondents who wasted food took their own food and drinks onboard. Most respondents (65%) did not carry any food when taking airplanes. Compared to medium-haul flight passengers, long-haul flights passengers were likely to take carried-on food, as the described reason: P01 ‘Long-time flying makes me dehydrated, so I take extra water and fruits. It is also because that very often I have some fruits at home that I couldn’t finish before I leave for a 10-day trip.’

No carried-on food items had been identified in the photographs and survey responses. Hence, the impact of carried-on food is not evident to passengers’ food wasting behaviour.

- Meal type

Two types of airline meals were investigated in the survey, standard meals and special meals. Several issues were identified in this measure. What emerges from the results reported here is that meal types were associated with the ways of passengers’ food ordering and the unwanted food was likely to be wasted by passengers.

Firstly, the ingredients and food contents in airline meals influenced participants’ satisfaction towards the meal and further influenced their intentions to eat. For example, respondents (P05) said, ‘not enough vegetable’ and ‘I think it is just snack rather than breakfast. I don’t want to eat anything of it.’ Moreover, some foods in the airline meal were incompatible with participant’s (P12) dietary habits, ‘the chicken skin is just something I do not ever like.’ Furthermore, airlines had few vegan meal selections, which was unable to meet every passenger’s expectation. A vegan participant (P15) was unsatisfied with her vegan meal because ‘vegan food makes me hungry and I like dessert which I didn’t get’, indicating the content in the vegan food was not able to fulfil her need.

Secondly, the temperature of certain food affected participants’ intention to eat. As one respondent (P14) said, ‘I don’t like cold foods’, indicating why chilled food had been wasted.
3.2.2. Food Ordering

Food ordering can reflect participants’ habit of acquiring airline meals. 90% of meals were ordered onboard and the other 10% were pre-ordered by participants via telephone, email and the online system. What stands out in this result is most of the participants ordered standard meals without using the pre-order service. Using the pre-order service helps them book designated food in advance, which eliminates some uncertainties when ordering directly from the cabin trolley. Simultaneously, there was only one participant who pre-ordered her meal in order to request a special meal. It was found that onboard ordering is predominantly chosen by participants rather than pre-ordering before their air travel.

3.2.3. Situational Factors

• First choice

When asked whether participants were served with their first choice of meals, 80% of the respondents reported that they had their first choice. For the 20% who did not receive their first choice, food waste was identified at the end. Further analysis of their responses points out that their explanation falls on the no choice available to them. Talking about this issue these respondents (P01, P02, P05) said, ‘there was only one choice’. Taken together, these results suggest that there is an association between first choice and passengers’ food wasting behaviour. Additionally, undesirable food could be rejected by passengers due to the following reasons.

• Dining time

Of the 30 airline meals recorded, 13 meals were served as dinner, 10 meals were served as lunch, and seven meals were breakfast. It was found that a particular food or drink have been left due to dining time reasons. As one respondent (P01) left some coffee and milk of his dinner and indicated that ‘I did not want to have tea or coffee, because I would like to try to get some sleep after one hour.’ The in-flight dining time may not always be compatible with passengers’ daily dining custom and cause food or drink to be wasted. It has been found that dining time is associated with passengers’ dietary habit and accordingly influenced their intentions through the dining process.

• Cabin environment

Cabin environment influenced participant’s perception of food. Temperature is one subjective determinant to waste food. Airline foods are categorised in hot, ambient, chilled and frozen products [51]. Cold dishes have been wasted by a respondent (P10) because ‘… temperature in the cabin is too cold for me.’

Another issue regarding the cabin environment is associated with participants’ health condition. One respondent explained that she wasted food because she has a queasy feeling when she has a proper meal when flying. She also added ‘I’d rather eat sweet or salty snacks, which don’t make me feel queasy.’

• Health condition

The health condition section asked participants to rate their physical status at the beginning of flying to explore whether pre-existing health issues affect their food wasting behaviour. The analysis of the results showed that the health condition has no evident impact on the result of participants’ food wasting behaviour. No notable differences have been found when comparing two groups of participants (who generated leftover food versus who ate all food). Respondents’ ratings of their health condition were mostly centred on ‘Good’ and ‘Excellent’, with a few ratings of ‘Average’ and only one ‘Poor’. No respondent described her/his health condition as ‘Dreadful’. Nevertheless, the respondent with the poor condition did not waste any food.
Further examinations have been taken to explore the relationship between the respondents in ‘Average’ health condition and their reasons for producing food waste. The result showed that passengers’ health condition does not directly affect their dining behaviour. However, certain foods in airline meals (e.g., cold dishes, bland taste food) and cabin environment (e.g., cabin temperature) influence their physical status, which reduces respondents’ appetite.

- Food allergy

Due to the limited sample, no causal relationship between food allergies and passengers’ food wasting behaviour was evident. There was only one respondent had food allergies, but she did not waste food waste due to this reason. A larger sample size would benefit the exploration of the association between food allergy and food wasting behaviour.

3.2.4. Personal Norms

Personal norms were measured according to how passengers handle their food waste. It has been used to explore how personal norms impact their post-dining behaviour and whether their behaviour was sustainable at that time. The response rate was 57% at ‘I gave leftover food to flight attendant’, 37% at ‘I ate all of my food’, 3% at ‘I gave leftover food to other passengers’ and 3% at ‘I took leftover food away’. Some respondents reported that they ate all their food; however, photographs of wasted food still captured several uneaten foods on the trays. This identified food waste either has not been regarded as food waste or ignored by respondents.

This result indicates that participants extensively rely on cabin flight attendants to handle the food waste and dining tray. Few participants shared food with others, which were rated as a sustainable way to reduce food waste. As well as for participants who brought excessive food after landing, they valued the food and prolonged the service life of the airline food. It was another indicator of behaving sustainably. However, these findings also revealed that airlines had potential to influence the personal norms of passengers. Most of the participants were not encouraged to pre-order their food to avoid any unwanted meal options and not offered sustainable choices to deal their leftover food. Therefore, they simply gave food waste to flight attendants since they had paid for the service.

3.2.5. Food Attributes

Food taste

As passengers who generated food waste, 30% of them left airline food due to food taste reasons. Wasted food included a piece of saqima, a sachet of pepper sauce, a grass jelly, a cup of orange juice, a box of pasta salad and a little bit of yogurt dessert. The reasons to waste the food mentioned above were ‘saqima is too sweet’, ‘pepper sauce is too spicy for me’, ‘I think grass jelly tastes like Chinese medicine’, ‘I find orange juice bitter’, ‘the pasta salad had a too soft texture (overcooked) and very little flavour’ and ‘(the yogurt dessert) too sweet’. Table 2 lists passengers’ perception of five tastes of airline food. They were required to rate the taste of their airline meals. The higher the score, the stronger the taste. Conversely, the lower the score, the blander the taste. The score in the middle indicated that this taste was suitable for them and was not counted for the taste perception analysis. The results reveal that salty was the most perceptible taste to participants, followed by spicy, sweet and sour.

| Taste          | Count | Percentage (%) |
|----------------|-------|----------------|
| Salty          | 15    | 38             |
| Spicy          | 8     | 21             |
| Sweet          | 8     | 21             |
| Sour           | 6     | 15             |
| Bitter         | 2     | 5              |

Table 2. Participants’ perception of food taste.
Food consistency

Food consistency is another key reason for participants not to eat their food. Specifically, participants were sensitive to dryness—P05 ‘(the) biscuit is too dry’, hardness—P09 ‘(carrots and peas) a little bit hard’ and softness—P12 ‘the pasta salad had a too soft texture (overcooked)’.

Food portion

More than half of the participants thought that the airline meal portion provided fulfilled their need. However, a few of the participants mentioned that the food portion was beyond their need, such as the bread portion—P03 ‘too large a portion of bread for the size of the meal generally’. It has shown that participants’ perception of the whole airline meal was separate from the individual food items.

3.2.6. Attitudes and the In-flight Catering Experience

Participants’ attitude can be reflected from their satisfaction of airline meals and their in-flight catering experience. Meal satisfaction can be influenced by participants perceived food attributes, such as food taste, food consistency and food portion.

Table 3 shows the passenger’s satisfaction of the airline meal and overall experience of the in-flight catering service.

| Sample                                | Satisfaction (%) | Experience Rate (Mean) |
|---------------------------------------|------------------|------------------------|
| Respondents who wasted food           | 67               | 2.95                   |
| Respondents who did not wasted food   | 90               | 3.70                   |
| All respondents                       | 70               | 3.13                   |

The mean of the experience rate of respondents who wasted food was significantly lower than that of respondents who did not waste food, indicating that respondents who rated in-flight catering experience higher are unlikely to produce food waste during the meal service. In addition to that, Table 4 shows that respondents’ satisfaction was positively correlated with their in-flight catering experience.

Table 4. Correlation between passenger’s satisfaction and experience rate.

| Correlation | Satisfaction | Experience Rate |
|-------------|--------------|-----------------|
| Experience rate | 0.99 $^1$   |                 |

$^1$ +1 represents a perfect correlation, 0 means no correlation and −1 indicates a perfect negative correlation.

The correlation value approximately equals 0.99, indicating that respondents who were not satisfied with their airline meals gave a comparatively lower score on their in-flight catering experience. It can be seen from the results that respondents’ in-flight catering experience was influenced by meal service.

In summary, participants’ satisfaction with airline meals and experience reflected their attitudes towards the overall in-flight catering service. The intentions to waste food potentially influenced by the negative attitudes of participants.

4. Discussion

4.1. Factors Associated with Passengers’ Food Wasting Behaviour

Identified factors were found to have a significant influence on passengers’ personal norms, attitude, intentions and perceived behaviour control, finally affecting their dining behaviour. The key factors associated with passengers’ food wasting behaviour have been indicated in Table 5, where the
pivotal factors that caused the 21 wasted airline meals were represented to show the clusters of themes. The frequency of the identified factors was counted based on the 21 wasted foods, which reveals the influence level of each factor on the food wasting behaviour.

| Themes      | Factors                  | Frequency |
|-------------|--------------------------|-----------|
| Normative   | Personal norms           | 16        |
|             | Pre-flight diets         | 1         |
| Habitual    | Meal type                | 6         |
|             | Food ordering            | 1         |
|             | Food taste               | 13        |
|             | Food consistency         | 4         |
| Intentional | Food portion             | 2         |
|             | Satisfaction             | 6         |
|             | Need of food             | 6         |
|             | Health condition         | 1         |
| Situational | First choice             | 3         |
|             | Dining time              | 1         |
|             | Cabin environment        | 2         |

It should be noted that some of the listed factors were not stand alone but interrelate with one another and together influence participants’ dietary habits, intention to eat and sustainable conduct after eating. For instance, participants’ dietary habits can be traced through the certain items in their meal, the food attributes such as food taste, food consistency and food portion, etc.

4.2. Opportunities for Changing Food Wasting Behaviour

Personal norms are reflected from the way participants handled their airline food. It was found that personal norms are evident in influencing the passengers’ food wasting behaviour, followed by intentional factors such as food taste. Personal norms were recognised to have a relatively stable and long-lasting effect on behavioural intervention [52]. However, personal norms need to be activated by social norms in order to use as behaviour change interventions. For instance, advertising a sustainable dining behaviour at a restaurant resulted in people wasting less food [53]. This indicated that people change their eating behaviour by perceiving social norms.

Overall, the identified key factors influencing passengers’ food wasting behaviour could be set as targets for further research on behaviour change interventions. Several opportunities for airlines to motivate passengers to engage with airlines to reduce food waste can be considered from the following aspects.

Firstly, the design process should consider multiple users in public food consumption scenarios and the degree of various stakeholders’ participation. The findings identified that passengers and airline companies are key actors to prevent the airline food waste generation during the in-flight catering service. The five major stakeholders within the flight catering system are suppliers (food or non-food items manufacturers), providers (airline food caterers), distributors (catering logistic companies), airlines and passengers [13,51,54]. In the intervention phase, airlines and passengers should be considered as key stakeholders in the in-flight catering system. The role of stakeholders in the DfSB process is to work together to propose behavioural intervention strategies in order to reduce airline food waste. Moreover, key stakeholders participating together in the intervention design can exert its strength from different perspectives to bring about the optimal solutions.

Secondly, we have approached the issue of food waste in the in-flight catering service sector of the aviation industry. The exploration of passengers’ in-flight catering experience provided an overview of airline food waste status to the aviation industry, which may draw their attention to this issue and enable the stakeholders to take actions from the industry side.
Lastly, returning to the question posed at the beginning of this study, this study has identified key factors influencing passengers’ food wasting behaviour, including meal type, food taste and consistency, passengers’ need of food and passengers’ satisfaction of airline meals and personal norms, followed by some of the less determinant factors, such as passengers’ pre-flight health condition, diets, the first choice of airline meal, food portion and cabin environment, etc. Those factors associated with passengers’ food wasting behaviour can be used to develop and select appropriate behaviour change interventions in further research.

4.3. Theoretical Contribution

This study has identified that factors influencing passengers’ food wasting behaviour can be categorised into four themes based on the four processes of the Comprehensive Action Determination Model (CADM) [24] (p. 55). Each theme has listed specific factors that have an impact on passengers’ food wasting behaviour by analysing passengers’ responses in the survey.

At the normative level, personal norms were found to be important to raise passengers’ awareness of dealing with airline food waste properly, which can be obtained from their post-dining behaviour.

At the habitual level, meal type was found to mediate passengers’ food wasting behaviour by influencing their satisfaction and their intentions to eat the airline meals served. Food ordering determined the chances for passengers to get their ideal airline meal, but most of them did not use pre-ordering service to secure the meal choice. It was found that participants’ pre-flight diets did not directly cause the food wasting behaviour of passengers, but it mediately influenced their food choices when ordering food onboard.

At the intentional level, perceived food attributes determined passengers’ attitude and satisfaction towards the airline meals. Consequently, negative attitudes influenced passengers’ intention not to eat airline meals. Food taste was the primary attribute that associated with passengers’ attitude. Food consistency came second as a potential factor to influence passengers’ behaviour. Food portion was found to cause passengers’ food wasting behaviour, only if the portion exceeded their needs. Passengers’ satisfaction influenced their intentions to eat the food and ultimately contributed to food waste. Lastly, this study found passengers’ need for food can result in food being wasted.

At the situational level, first choice was found to impact passengers’ food wasting behaviour because it determined whether they had their preferred choices, and that decreased the chances of wasting food. The cabin environment directly impacted on passengers’ physical feelings and intentions, resulting in food wasting behaviour. Health condition had no direct impact on participants’ food wasting behaviour. However, the study has shown that certain foods in airline meals (e.g., cold dishes, bland tasting food) and cabin environment (e.g., cabin temperature) could possibly influence passengers’ physical feelings that reduce their appetite to eat food. Dining time was associated with passengers’ dietary habit and consequently influenced their intentions during the dining process.

4.4. Practical Contribution

These findings have significant implications for understanding how passengers’ food wasting behaviour has been measured through the four action determination processes. The findings of this research provide insights for behaviour change interventions. To select appropriate design strategies for addressing the target behaviour, designers should consider the identified factors within the in-flight catering context. In addition, design for behaviour change interventions should carefully handle the barriers discussed above, especially focusing on the potential constraints of regulations and policies.

The practical strengths of this research are conducting a comprehensive examination of passengers’ behaviour during the in-flight catering service and establishing mixed approaches to collected behavioural data for user research analysis. This study structured a survey questionnaire based on a pre-examined social psychological model, the CADM, to ensure that the survey questions were well-informed and precise. Behavioural influencing factors identified in four processes provided a clear structure to guide the design strategies based on different levels of behaviour control. Therefore,
the findings of this study could support the selection of design strategies for behavioural change in future studies.

5. Conclusions

Understanding passengers’ food wasting behaviour is a pivotal step to reduce food wastage of in-flight catering services. However, this area has been relatively ignored in the field of sustainable behaviour literature, especially in the aviation context. This research addressed this issue by applying the CADM model to identify the key determinants of passengers’ food wasting behaviour. The results demonstrated that the key factors influencing passengers’ food wasting behaviour are normative and intentional factors where reflected from their behaviour in dealing with food waste onboard and dietary habits. The findings contribute to further study of design for passengers’ sustainable behaviour by selecting appropriate behaviour change interventions.

This study has some limitations that future research can address regarding the research methods. The results are based on a small sample size of participants and might not be able to represent all types of airline passengers. Besides, this study had higher numbers of female participants than male participants, which might cause gender bias if comparing behaviour differences between genders. Prospective research can benefit from a larger sample size with balanced genders. In addition to this, future research will explore how to select appropriate behaviour intervention strategies based on the variation in the distribution of behaviour control on identified factors.

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