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Analysis of the Impact of Plastic Packaging on Food Waste Behavior in UK Households

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Abstract: This research is designed to analyse the impact of plastic packaging for food products on households' food waste behaviour in the UK. The photo-elicitation approach is employed to achieve this research goal, and the sample consists of fifteen respondents in the Wales region and in particular in Bangor. As a result, this research finds that most of the respondents are in favour of a significant impact of food packaging on food waste, and most of them indicate that plastic food packaging can contribute relatively more to food waste than other types of food packaging. On the other hand, there also exist a few respondents who consider that there is no relationship between food packaging and food waste.

Keywords: plastic packaging; food waste; household behavior; photo-elicitation; UK households

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1. Introduction

Reducing food losses and waste is an emerging challenge for global sustainability. In order to reduce food waste, it is necessary to understand the consumer behaviour patterns and the reasons why people discard food. Numerous recent studies focus on examining the nexus of packaging design and food waste, and most of them have confirmed a significant impact of packaging design on food waste (see, e.g. Hanssen et al., 2017; Martins et al., 2019; Wikström and Williams, 2017; Wilson et al., 2017). This study is also interested in this relation and attempts to analyse the consumer behaviour towards food waste in the UK. More specifically, this study intends to focus on a more particular research subject, namely how does plastic packaging for food products affect households' food waste behaviour in the UK?

The major objective of the current study is to examine the impact of plastic packaging on food waste in the UK. In other words, this study tries to analyse whether the use of the plastic packaging for food products has a significant impact on households' behaviour towards food waste in the UK, and if it has, then whether the impact is positive or negative. A positive impact implies that the use of the plastic packaging for food products can mitigate people's food waste behaviour, while a negative impact implies that the use of the plastic packaging for food products can facilitate people's food waste behaviour. In order to achieve the research goal, this study will focus on the relationships between packaging functionalization, food waste and consumer behaviour, and figure out these relationships by means of the photo-elicitation approach.

Although there exist many studies that examine the impact of packaging design on food waste, there is almost no study that focus on the impact of plastic packaging or take into the consumer behaviour in the UK. This means that, the research subject of this study is quite new and will be contribute to the literature. The remainder of the research is organised as follows. In the next section, a review of the related literature is presented. The most related literature to the current research refers to those that focus on the impact of food packaging design on food waste. In addition to this literature, the literature regarding other topics that are less related to the current research will also be reviewed in this section, such as the environmental impact of food waste and the other techniques for reducing food waste. Section 3 describes the data collection process. Section 4 provides and discusses the analysing results. The final chapter ends up with a brief conclusion.

2. Literature Review

2.1. The Impact of Food Packaging Design on Food Waste

While there is limited research directly linking plastic food packaging to food waste, several studies explore the broader impact of packaging design on waste (Bolton & Alba, 2012; Cornil & Chandon, 2016; Hanssen et al., 2017). Verghese et al. (2013) highlight a dynamic relationship influenced by consumption patterns and supply chain structures, emphasizing that packaging should facilitate food protection from farm to fork. Wikström and Williams (2017) suggest that smaller packaging can reduce waste, advocating for a balance between packaging's environmental impact and its role in minimizing food waste. Research indicates that larger packages, which can lead to waste due to unconsumed food, and challenging-to-empty containers contribute significantly to food waste (Williams et al., 2012). Hanssen et al. (2017) support packaging optimization in reducing waste, while Wilson et al. (2017) find that concerns over food safety and quality influence waste behavior, particularly regarding expiration dates. Their findings indicate that consumers often discard food as expiration approaches, viewing this as necessary rather than wasteful. Wikström, Williams, and Venkatesh (2016) demonstrate that trays outperform lightweight tubes in both recycling rates and waste reduction. Poyatos-Racionero et al. (2018) advocate for intelligent packaging with dynamic expiration dates to better inform consumers about food safety, thus reducing waste. Similarly, Yokokawa et al. (2018) show that highly functionalized packaging can decrease waste in Japan's ham market by reducing consumer discards. Martins et al. (2019) emphasize active packaging, which uses compounds like antimicrobials to extend shelf life and reduce waste. Conversely, Principato et al. (2015) found that many consumers believe packaging's environmental impact overshadows its influence on waste, as more than 60% of their sample did not recognize significant impacts of packaging design on food loss.

2.2. The Environmental Impact of Food Waste

Numerous studies have documented the significant negative environmental impact of food waste (Beitzen-Heineke et al., 2017; Beretta & Hellweg, 2019). Dilkes-Hoffman et al. (2018) quantify food waste's contribution to greenhouse gas emissions, asserting that reducing food waste effectively lowers these emissions. Their findings highlight the role of biodegradable packaging in mitigating environmental damage.

Tonini et al. (2018) utilize life cycle assessment to demonstrate food waste's detrimental effects through land use changes and food production. Beitzen-Heineke et al. (2017) explore zero-packaging grocery stores, which can promote resource-efficient behaviors while potentially sacrificing consumer convenience.

2.3. The Photo-Elicitation Approach

This study employs the photo-elicitation approach, a qualitative methodology that uses photographs to elicit participant insights (Lachal et al., 2012). This method encourages verbal expression of complex concepts and fosters a relaxed interview atmosphere.

Participants take photos related to the research topic, enhancing their engagement. Interviews follow, where participants present their photographs and respond to guided questions.

While the approach allows subjective expression, it requires participants to articulate their reasoning behind photo selections to ensure validity (Frith & Harcourt, 2007). In this study, photographic evidence will be collected in Wales, focusing specifically on recycling and food waste.

3. Data

3.1. Data Description

The photo-elicitation approach is divided into two steps, namely (1) letting the volunteers to take photos regarding our research topic to make them to be involved in the research and (2) interviewing them based on the photos they took. This means that, the data of this research consist of two parts, namely the photos provided by the volunteers and the information collected from the interviews. It should be mentioned that the functions of these two parts of data are different. The first part of data is used for generating the second part of data, while the second part of data is used for generating our research results. As a result, this research successfully collects the photos from fifteen respondents, among which only one is the local resident in Bangor and the rest fourteen are international students in Bangor University. This means that, the sample size of this research is fifteen.

The first part of data is received from fifteen volunteers who take photos regarding food waste lasting for a week and provide these photos to the author of this research. As a result, some volunteers finally provide more than ten photos with taking two or more photos for each day under the week; while some volunteers finally provide less than five photos with taking one photo for two days or more. After gathering these photos, the interviews are then conducted in the form of face to face. The interviewer has prepared a number of pre-set questions for the interview and these questions are interpreted in the following parts of this section. The table 1 below shows the personal information of the respondents.

Table 1. Respondents characteristics.

Respondents	Gender	Age	Home Country	Favourite Food Packaging Type
1	Male	Between 31 and 35	Saudi Arabia	Plastic packaging
2	Female	Between 18 and 21	China	Paper Packaging
3	Female	Between 18 and 21	China	Plastic packaging
4	Female	Between 18 and 21	Vietnam	Paper Packaging
5	Female	Between 31 and 35	Thailand	Do not really care about packaging type
6	Male	Between 26 and 30	Greece	Paper Packaging
7	Female	Between 22 and 25	Italy	Paper Packaging
8	Female	Between 22 and 25	Colombia	No Packaging
9	Female	Between 26 and 30	Welsh	Paper Packaging
10	Female	Between 22 and 25	Kenya	Plastic packaging
11	Male	Between 18 and 21	Wales, UK	Paper Packaging
12	Female	Between 22 and 25	Wales, UK	Plastic packaging
13	Female	Between 22 and 25	Wales, UK	Plastic packaging
14	Female	Between 22 and 25	Saudi Arabia	Plastic packaging

15	Female	Between 22 and 25	Vietnam	Paper Packaging

As can be seen from table 1, there are three male respondents and twelve female respondents that take part in our research. These respondents come from nine different countries, namely China, Colombia, Greece, Italy, Kenya, Saudi Arabia, Thailand, Vietnam and Wales, UK. Most of the respondents are aged between 22 and 26.

3.2. The Pre-Set Questions for the Interview

The pre-set questions are divided into four sections. The first section of the questions is used for collecting the personal information of the interviewees. There are overall four questions being included in this section:

3.2.1. Section A Q1

What is your gender?

There are three optional answers of this question provided for the interviewees, namely "Female", "Male" and "Prefer not to say". They should choose one from the three answers and they are allowed to not tell their gender if they feel that this question is related to their privacy and they are not willing to share. If an interviewee really chooses "Prefer not to say", I will not let anybody know his/her gender and I will not mention his/her gender in the research.

3.2.2. Section A Q2

How old are you?

There are seven optional answers of the second question in section A provided for the interviewees, namely "Between 18 and 22", "Between 22 and 26", "Between 26 and 30", "Between 30 and 35", "Between 35 and 40", "Above 40" and "Prefer not to say". They should choose one from the seven answers and they are also allowed to not tell their age if they feel that this question is related to their privacy and they are not willing to share. If an interviewee really chooses "Prefer not to say", I will not let anybody know his/her age and I will not mention his/her age in the research.

3.2.3. Section A Q3

Where are you from?

There are two options of this question for the interviewees. That is, they can either tell their home countries or choose "Prefer not to say". If they feel that this question is related to their privacy and they are not willing to share, they can choose the latter option. If an interviewee really chooses "Prefer not to say", I will not let anybody know his/her home country and I will not mention his/her home country in the research.

3.2.4. Section A Q4

What is your favourite food packaging type?

There are five optional answers of the last question in section A provided for the interviewees, namely "Paper packaging", "Plastic packaging", "Metal packaging", "Other" and "Prefer not to say". If they feel that this question is related to their privacy and they are not willing to share, they can choose the latter optional answer. If an interviewee really chooses "Prefer not to say", I will not let anybody know his/her favourite food packaging type and I will not mention his/her favourite food packaging type in the research.

After that, the second section of the questions (i.e. section B) is used for asking the interviewees to their experiences and overall opinion of their photo-elicitation assignment (Johnson et al. 2011). In this section, there are overall three questions relating to the photo-elicitation assignment being offered to the interviewees and they are allowed to respond freely to these questions with no optional answers.

3.2.5. Section B Q5

What do you think about taking pictures for this project?

The first question under this section is aimed at understanding the interviewees' opinions regarding the photo-elicitation approach being used as the research method for our research topic. If an interviewee indicates that this approach is not appropriate for this research topic, he/she will be asked to give the reasons why he/she does not consider this approach a good one. There are no optional answers for this question, which means, the interviewees are allowed to respond freely to this question.

3.2.6. Section B Q6

What do you like the most about it? Why?

The second question under this section is aimed at understanding the interviewees' interest points toward the photo-elicitation approach. Also, they are allowed to respond freely to this question.

3.2.7. Section B Q7

What do you dislike? Why?

The last question under this section is aimed at understanding the interviewees' disliked points toward the photo-elicitation approach. Again, they are allowed to respond freely to this question.

Subsequently, the interviewees will be asked to review the photos that they provide and select five of them that they most wanted to share or that they consider are particularly interesting. It should be mentioned here that if the total number of the photos provided by an interviewee is less than five, then he/she will have no need to select among the photos and should use them all. After that, the interviewees will also be asked to title the photos that they select out from all photos (Johnson, Sharkey and Dean, 2011). Then, we can proceed to the section C questions. In this section, this research introduces Shaffer's (1983) SHOWeD technique which suggests us to focus on five aspects regarding the photos, namely 'See', 'Happening', 'Our', 'Why exist', and 'Do'. According to Johnson, Sharkey and Dean (2011) and Shaffer (1983), the major strength of the SHOWeD technique is that it is able to start a discussion about the photos that may go beyond what is objectively perceived.

The questions in section C are described as follows. It should be mentioned that these are only the main questions in this section, and the interviewer may sometime ask further questions to clarify or expand on the answers given by the interviewees toward these questions. As the further questions vary from interviewees, they are not provided here. It should also be mentioned here that the locations at which the interviews are conducted can either be participants' homes or interviewer's home. In addition, the duration of each entire interview should be around 30 to 90 minutes and the most time-consuming part should be in this section.

3.2.8. Section C Q8

What do you See in this photo?

The first question under section C is aimed at letting the interviewees to directly describe the photo in order to understand what the photos shows to us.

3.2.9. Section C Q9

What is Happening in this photo?

The second question under section C is aimed at letting the interviewees to describe the event behind the photo. In other words, this question is aimed at letting the interviewees to give an explanation on why this photo occurs.

3.2.10. Section C Q10

How does this relate to Our life?

After that, the third question under section C is more difficult than the previous ones. This question requires the interviewees to relate the theme reflected by the photos that they provide to our life. Therefore, this requires the interviewees to have a heuristic thought and be able to relate food waste to their lifestyles.

3.2.11. Section C Q11

Why does this problem, concern, or strength exist?

The next question under this section is also a heuristic question, which requires the interviewees to think about the reasons why does the problem of food waste exist. There are many reasons that the interviewees can take into account. If the interviewees cannot think of any reason within a short time, the interviewer can give them some hints. For example, the interviewer can let the interviewees to take into account the external reasons such as the economic state of the country or the environment. Besides, the interviewer can also let the interviewees to take into account the internal reasons such as people's value towards food waste or the packaging design of the foods. In particular, the interviewer should try, as far as possible, to guide the interviewees to think about the relation between the packaging design and food waste.

3.2.12. Section C Q12

What can we Do about it?

The last question under this section is also a heuristic question, which requires the interviewees to come up with the ideas on how to deal with the problem of food waste. In particular, the interviewer should try, as far as possible, to guide the interviewees to think about the effect of improving the packaging design on reducing food waste.

If the interviewees have already given sufficient discussions regarding the topics under our research (i.e. the effect of food packaging design on food waste and the ways on how to improve packaging design in order to reduce food waste) after these questions, then the interview can be finished here. If the interviewees have not given sufficient discussions regarding the topics under our research after these questions, however, we will have to proceed to section D to ask some further questions for the interviewees.

The questions in section D are designed in case that if the interviewees do not give sufficient discussions regarding the relation between food packaging design and food waste in the previous section. Thus, the questions provided in this section are aimed at letting the interviewees directly discuss the effect of food packaging design on food waste.

3.2.13. Section D Q13

What is your opinion in food waste?

The first question under the final section is aimed at understanding the interviewees' value on food waste. In other words, we need to know whether the interviewees' attitudes toward food waste is positive or neutral, or even negative. A positive attitude means that the interviewee considers that food waste is bad and we need to eliminate such action as far as possible. On the other hand, a neutral attitude means that the interviewee considers that food waste is not of his/her business, and there is no need o take time to reduce food waste. A negative attitude means that the interviewee considers that food waste is good, which we consider is an unlikely attitude of the interviewees.

3.2.14. Section D Q14

Do you think there is a relation between packaging material and food waste?

The second question under this section is aimed at guiding the interviewees to think about the relation between packaging material and food waste. They may have not realized that there may exist a relation between packaging material and food waste in the

previous section, thus, if this is true, we will have to provide this question in order to guide them to take into account the probable effect of different packaging materials on food waste.

3.2.15. Section D Q15

If your answer is YES for the previous question, then what type of packaging material do think is most likely to lead to food waste? Why?

If the answer given by an interviewee for the previous question is yes, then we can proceed to the final question, which is aimed at figuring out which packaging material the interviewee consider is most likely to result in food waste and the reasons why the interviewee thinks so.

4. Results

4.1. Analysing Results

The analysing results reflect overall five themes, which can be clustered into three superordinate themes. The themes are reported in the table 2 below. As can be seen, the three superordinate themes are, respectively, (1) food packaging and food waste are both related to the environment; (2) food packaging and food waste are related/unrelated and; (3) plastic food packaging contributes to food waste. Further, these themes are divided into five sub-themes. To be more specific, the first superordinate theme is divided into two sub-themes, namely (a) most food packaging is non-recyclable and environmental-unfriendly and; (b) food waste is detrimental to the environment. The second superordinate theme is divided into two sub-themes, namely (a) food packaging contributes to food waste and; (b) food packaging is unrelated to food waste. Finally, the third superordinate theme is detailed as plastic food packaging contributes relatively more to food waste than other types of food packaging.

Table 2. Analysing results: the main themes.

Superordinate themes	Themes
Food packaging and food waste are both related to the environment	Most food packaging is non-recyclable and environmental-unfriendly Food waste is detrimental to the environment
Food packaging and food waste are related/unrelated	Food packaging contributes to food waste Food packaging is unrelated to food waste
Plastic food packaging contributes to food waste	Plastic food packaging contributes relatively more to food waste than other types of food packaging

4.1.1. Theme 1: Most Food Packaging Is Non-Recyclable and Environmental-Unfriendly

The first theme is about the relationship between food packaging and the environment. Almost all respondents agree with the opinion that food packaging are mostly non-recyclable and environmental-unfriendly.

What I am seeing in the picture is the health foods that I choose, but the packaging for most of the foods in the picture is non-recyclable (Respondent 1)

For instance, Figure 1 provides a picture that is titled as “healthy food”, and he states that most food packaging in the picture is non-recyclable. Through the picture the respondent argues that food packaging is only convenient to the consumers, but is not friendly to the environment. Thus, he calls for the large production of environmental-friendly food packaging.

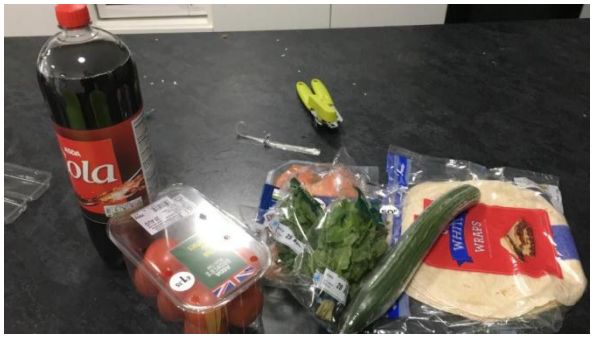

Figure 1. titled "Healthy food" by respondent 1.

Similarly, the respondent 4 provides a photo that is titled as "Plastic". She states that all food packaging bags in the photo are plastic bags and she argues that these plastics are harmful to the environment and eventually to our lives. However, she also acknowledges that we cannot live without plastic food packaging.

In my opinion the plastic packaging could cause a lot of harmful impacts to the environment and eventually to our lives (Respondent 4)

According to her point of view, if there is no plastic bag, the expiration dates of the foods will become shorter and the delivery of the foods from suppliers to the sales points will become inconvenient. Thus, even she understands that the plastic food packaging is harmful to the environment, she is still in favour of the use of the plastic food packaging. However, the respondent herself prefers paper packaging rather than plastic packaging Figure 2.

Figure 2. titled "Plastic" by respondent 4.

Figure 3 shows the photo provided by respondent 5. She names the photo as "something like this". According to the picture, the respondent says that she has made a plastic pollution for the world. This means that, she understands that the plastic food packaging is a pollution to the environment, but she cannot stop making the plastic pollution to the world.

I start to make a plastic pollution for the world (Respondent 5)

The respondent also indicates that she does not care about the packaging type for the foods, what she really cares about are the quality and taste of the foods inside. This implies that, when she selecting what foods to buy, she might not notice the packaging of the foods.

Figure 3. titled "something like this" by respondent 5.

4.1.2. Theme 2: Food Waste Is Detrimental to the Environment

The next theme is about the relationship between food waste and the environment. Most respondents have argued that food waste is detrimental to the environment. For example, respondent 1 states that food waste can pose a significant impact on our lives as well as the lives of other living things.

The food waste that we are contributing individually can be small but if you consider it collectively it can have a huge impact on our lives, the lives of other living things and the planet as a whole (Respondent 1)

Similarly, respondent 8 and respondent 12 both argues that food waste can contribute to climate deteriorate and world hunger. To be more specific, respondent 8 states that food waste is a massive contributor to the climate crisis and can lead to world hunger.

Food waste is a massive contributor to the climate crisis. Overall, we waste enough food that could instead be used to alleviate world hunger. It will be good if we only buy what we need (Respondent 8)

Respondent 12 indicates that food waste is associated with more carbon emission and therefore contributes to the problem of global warming.

Food waste is associated with more carbon emission and the problem of global warming and thus is environmentally harmful (Respondent 12)

The other respondents consider that food waste is a problem of resource waste and can lead to resource exhaustion. For example, respondent 2 argues that the food resources available to us are limited and food waste exacerbates this problem and speeds up the process of resource exhaustion.

Resources are limited and food waste plays a role in reducing the resources available to us (Respondent 2)

Respondent 9 also highlights that the food resources in this planet is limited.

Food waste means resource waste, and for a planet with limited resources, food waste is guilty (Respondent 9)

Respondent 13 argues that we have to spend more resources to deal with the wasted foods.

We have to spend more resources to deal with food waste, which can be easily saved if there is no food waste (Respondent 13)

Respondent 15 indicates that food waste reflects a problem of imbalance in resource allocation, and this problem can lead to resource exhaustion in some places while resource surplus in other places, which is a challenge to the sustainability of the environment.

Food waste reflects a problem of an imbalance in resource allocation, and such an imbalance should be addressed because it leads to resource exhaustion in some places while resource surplus in other places, which threatens the sustainability of the environment (Respondent 15)

4.1.3. Theme 3: Food Packaging Contributes to Food Waste

After that, the third theme is about the relationship between food packaging and food waste, which comes to the research subject of this study. This theme indicates that there exists a positive causality running from food packaging to food waste, i.e. food packaging contributes to food waste.

The thing that we can do is introducing planet friendly packaging system and therefore reduce food waste … My opinion on food waste is that people are becoming increasingly wasteful, and this can be attributed to the unavailability of variety of foods and packaging system … Each food requires different form of packaging to use and to store it so that there would be less food waste (Respondent 1)

Respondent 1 says that the simple and single food packaging system contributes to food waste. According to his point of view, each food requires different form of packaging to store, which means, the single food packaging system is not appropriate for storing different types of food. Only the variety of the food packaging system can be helpful in reducing food waste.

When we buy food, we buy exactly what we need. When food comes packaged it often is more than what we need. That is, we are unable to consume it and have to end up throwing it away (Respondent 8)

Respondent 8 indicates that when food comes packaged it often is more than what we need. When we buy food that is more than what we really need, we are likely to throw away the food that we have not eaten up at the end. Therefore, food packaging may lead to food waste.

Similar argument is also provided by respondent 9, who argues that many food packaging bags are big, which lead us to be unable to eat up the food all at once and therefore result in food waste.

Many food packaging bags are big, which means, the food inside is usually more than what we really need. If we cannot eat up the food all at once, we usually throw it away because it is not fresh any more (Respondent 9)

Respondents 12 argues that some food packaging bags' designs are not good for saving foods. Therefore, the design styles of the food packaging bags contribute to food waste.

Some food packaging bags' designs are not good because they are not designed to save food (Respondent 12)

Respondents 14 also argues that the design styles of the food packaging bags lead to food waste because the packaging bags usually cannot store foods after we open them.

We usually throw away the food packaging bag with food inside because the bag cannot store food after we open it (Respondent 14)

4.1.4. Theme 4: Food Packaging Is Unrelated to Food Waste

The fourth theme is also about the relationship between food packaging and food waste but indicates that there is no relationship between them. There are four respondents who consider that food packaging is unrelated to food waste.

I do not think that food packaging is related to food waste because food waste happens even if there is no packaging for the food. No matter what type of packaging material being used, food waste still happens if we do not consider that food waste is a bad thing and should be avoided (Respondent 2)

For instance, respondent 2 argues that food waste takes place even if there is no packaging for the food.

I believe these are two different things. Food is wasted because it is not used, we usually buy stuff that we do not really use. The packaging material most of the times is just necessary for the buying-selling system (Respondent 7)

Similarly, respondent 7 also indicates that food packaging and food waste are two different things. She argues that the packaging material is just necessary for the buying-selling system but is not related to food waste.

Food waste is because people do not have a mind of saving food, but is not due to food packaging (Respondent 11)

Respondent 11 argues that people's mind of saving food is more important than food packaging in terms of preventing food waste.

I cannot think of a relationship between food packaging and food waste, and in my opinion, food waste cannot be attributed to food packaging material or food packaging design (Respondent 13)

Respondent 13 argues that food waste cannot be attributed to the material used or design style of the food packaging.

4.1.5. Theme 5: Plastic Food Packaging Contributes Relatively More to Food Waste Than Other Types of Food Packaging

The final theme indicates that plastic food packaging contributes relatively more to food waste than other types of food packaging. Most of the respondents consider that plastic food packaging is one of the most significant contributor factors that lead to food waste.

Each packaging has its own advantages and disadvantages but overall plastic packaging is relatively more likely to lead to food waste because it provides a perfect closed environment for the bacteria to grow (Respondent 1)

For instance, respondent 1 argues that plastic food packaging provides a perfect closed environment for the bacteria to grow. According to his point of view, plastic food packaging can lead to food spoilage and therefore contributes to food waste. However, it should be mentioned that his viewpoint is correct only for some specific types of food. Plastic food packaging can lead to food spoilage only for some foods that are hard to keep long or need a ventilated environment, but it actually provides the best storage condition for most types of food. Plastic food packaging is developed aimed at extending the storage time of most types of food. However, this research is in favour of the argument of respondent 1 because plastic food packaging does play a role in leading to food spoilage for some particular types of food.

Respondent 6 gives a similar argument that plastic food packaging provides a closed space, which is not good for food preservation.

Plastic food packaging has a closed space, which is likely to lead some foods to go bad over time (Respondent 6)

Respondent 3 argues that the size of the plastic food packaging bags is a factor contributing to food waste. She indicates that the plastic food packaging bags are usually bigger than other types of bags, and therefore we usually cannot eat up the food inside all at once and throw away the packaging bags with food that we have not eaten up.

Plastic food packaging bags are usually bigger than other types of bags, so we usually cannot eat up the food inside and throw away the packaging bags with food that we have not eaten up (Respondent 3)

Similar arguments are also provided by respondent 4, who argues that plastic food packaging bags are usually designed as one-off bags, and therefore are not appropriate for storing foods.

People like eating fresh foods, so they usually throw away the food that they have not eaten up. Plastic food packaging bags are usually designed as one-off bags, so they are not good for storing foods and therefore they can lead people to waste food with considering the fresh factor (Respondent 4)

Respondent 7 presents a similar argument that the plastic food packaging is not good for storing foods after open and that people always like fresh foods and therefore people often throw away the foods that they cannot eat up all at once.

Plastic food packaging is helpful in storing foods before open, but people tend to throw away the foods and buy new foods if they cannot eat up them at once because people like fresh foods (Respondent 7)

Some respondents such as respondent 8 and respondent 9 argue that food packaging using other materials such as papers can lead to less food waste than the plastic food packaging. Respondent 8 considers that paper food packaging can lead to less food waste than plastic food packaging because for foods packaged by papers, they are usually fresh foods and cannot be stored for a long time, and people usually eat up these types of food all at once and thus, there is no food waste.

Paper packaging is helpful in reducing food waste because for foods packaged by papers, they are usually fresh foods and cannot be stored for a long time. People usually eat up these types of food within one day and therefore there is no food waste. For foods packaged by plastic, however, they can usually be stored for a long time. But people often forget the foods and if they cannot eat up the foods within a few days, they usually throw away them (Respondent 8)

I think I waste more foods when they are packaged by plastic than by other materials such as papers (Respondent 9)

In addition, respondent 12 considers that plastic food packaging contributes to food waste because she sees that most wasted foods are packaged by plastic.

I see that most wasted foods are packaged by plastic. So I think that plastic packaging contributes to food waste (Respondent 12)

Besides, respondent 14 argues that people prefer the plastic packaging usually do not have a mind of environment protection, and therefore do not care about food waste.

I think plastic packaging contributes more to food waste because people who prefer the plastic packaging usually do not care about the environment and therefore do not care about food waste (Respondent 14)

All these arguments above are in favour of a positive causality running from the use of plastic food packaging to food waste. As a consequence, most of the respondents that have taken part in our research are in favour of a significant impact of food packaging on food waste, and most of them (actually nine of them) consider that plastic food packaging contributes relatively more to food waste than other types of food packaging.

4.2. ANOVA Analysis

In order to further analyse the results, this study introduces the ANOVA approach to distinguish systematically differences between different groups of the respondents. The full sample is firstly divided into two subsamples, namely the male respondents and the female respondents. There are overall three male respondents and twelve female respondents that have taken part in the interviews. As a consequence, the testing results show that there is no significant difference on the opinions regarding theme 2, theme 4 and theme 5 between male and female respondents at the 10% level. That is to say, there is no significant evidence revealing that either male respondents or female respondents tend to be more in favour of the opinions that food waste is detrimental to the environment, or food packaging is unrelated to food waste, or plastic food packaging contributes relatively more to food waste than other types of food packaging. However, there exists significant differences on the opinions regarding theme 1 and theme 3 between male and female respondents at the 1% level. To be more specific, the male respondents tend to be more in favour of the opinion that most food packaging is non-recyclable and environmental-unfriendly, while the female respondents tend to be more in favour of the opinion that food packaging contributes to food waste.

After that, the full sample is divided into the Asian respondents and the non-Asian respondents. There are overall seven Asian respondents and eight non-Asian respondents. This study is interested in the opinion differences between them. According to the final testing results, there is no significant difference on the opinions regarding theme 1, theme 3 and theme 4 between the Asian respondents and the non-Asian respondents at the 10% level. This means that, there is no significant evidence revealing that either the Asian respondents or the non-Asian respondents tend to be more in favour of the opinions that

most food packaging is non-recyclable and environmental-unfriendly, or food packaging contributes to food waste, or food packaging is unrelated to food waste. However, there exists significant differences on the opinions regarding theme 2 and theme 5 between the Asian respondents and the non-Asian respondents at the 10% level. Specifically, the non-Asian respondents tend to be more in favour of the opinions that food waste is detrimental to the environment and plastic food packaging contributes relatively more to food waste than other types of food packaging. This may be attributed to the fact that plastic food packaging is more popular in the Asian countries than in other countries.

4.3. Discussions on the Results

Actually, most of the respondents consider that plastic food packaging is much more harmful to the environment than any other type of food packaging and that it is one of the major pollutions to the world. This means that, people tend to have a prejudice on the plastic food packaging or a bias on the plastic material when taking into account the concept of environmental protection. In fact, environmental protection has been a hot topic during recent decades because of resource waste and environmental deterioration, and people today are educated to be responsible to the entire environment since they were very young. Thus, when talking about plastic material, people's first thought tends to be that they should act as an environmental protector and refuse the use of plastic.

Such a prejudice towards plastic material may lead our research results to be biased. That is, when talking about plastic food packaging, people's first thought may be that it is bad and it should be reduced just because it is plastic. People may not think deeply about the real impact of plastic food packaging on food waste when they already treat plastic material as bad. When they treat plastic material as environmentally harmful, they may consider that we should avoid the use of plastic material in any sector. With the prejudice towards plastic food packaging, people may come up with many reasons why plastic food packaging can contribute to food waste even if they do not think so initially. That is to say, such prejudice towards plastic food packaging may lead people to give an answer that they think is "right" rather than one from their "deep heart".

Another possible reason why people consider plastic food packaging contributes relatively more to food waste than other types of food packaging is that most foods that we can buy from stores and markets are packaged by plastic. As stated by respondent 12, she sees that most wasted foods are packaged by plastic and therefore she considers that plastic packaging contributes more to food waste than other types of food packaging. This logistic makes sense but she does not consider that most foods are packaged by plastic. This means that, this may not because plastic food packaging contributes relatively more to food waste than other types of food packaging, but instead may because almost all foods are packaged by plastic. She may also see some wasted foods that are packaged by other materials such as papers, but she only remembers those that are packaged by plastic because most wasted foods are packaged by plastic. In other words, she may have ignored the very few wasted foods that are packaged by other materials.

5. Conclusion

This paper investigates the impact of plastic food packaging on food waste in the UK, particularly within the Wales region, employing a photo-elicitation approach to analyze individuals' perspectives on the relationship between plastic packaging and food waste. This method enhances memory recall and encourages participants to share their experiences more openly. The findings indicate that the majority of respondents believe plastic packaging significantly contributes to food waste, with nine individuals specifically noting its greater impact compared to other materials.

Key arguments from these respondents include: (1) plastic packaging creates an optimal environment for bacterial growth; (2) larger plastic bags often result in leftover food being discarded along with the packaging; (3) single-use plastic bags are unsuitable for

food storage; (4) plastic is ineffective for storing opened food, leading to increased waste; (5) packaging materials such as paper result in less food waste; and (6) consumers who prefer plastic packaging tend to overlook environmental concerns.

However, four respondents argue that there is no significant correlation between packaging and food waste, asserting that waste occurs regardless of packaging, that packaging is necessary for commerce but unrelated to waste, and that a mindset focused on food preservation is more crucial.

The limitations of this research include: first, participants may exhibit biases against plastic due to environmental concerns, which could potentially skew the findings; second, as most store-bought foods are packaged in plastic, respondents may perceive it as more wasteful simply due to its prevalence, overshadowing the impact of other materials.

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