1.0 Introduction

In the United Kingdom (UK), one-third of consumer expenditure is in the food service sector (National Archives, 2007). On average, one in six meals is eaten outside the home (British Nutrition Foundation, 2016) with consumption increasing (Public Health England, 2017). In UK food service, the cost of food waste is reported as £3 billion per annum (GOV, 2017), which is unnecessary for society, the environment and the economy (Bond et al., 2013). Multiple definitions of food waste exist (see Busby et al., 2014; FAO, 2016; Stenmarck et al., 2016; FSA 2017a; Clark and Manning, 2018 and others). Food waste can be differentiated between edible food which could be eaten in the future (avoidable), leftovers or discarded food perhaps on plates e.g. potato skins i.e. possible avoidable or in cooking utensils and food that is inedible (unavoidable) e.g. sour milk, banana skins (Wenlock et al. 1980; Parfitt et al., 2010; Quested et al., 2011; Kranert et al., 2012). Over-nutrition and diverting food away from human consumption to animal feed is also seen by some as a source of wasted food (Parfitt et al., 2010). Food waste can also be described as recoverable for human consumption or non-recoverable (Kantor et al., 1997). In this study, food waste is determined as the unconsumed edible item that is safe and nutritious and is rejected by customers either as plate waste or via other activities and interactions during food service.
The food supply chain needs to be more sustainable in terms of its economic, environmental and social impact. This means reducing food waste through careful planning, recording, and communication (Silvennoinen et al., 2015; Raak et al., 2016; Redlingshofer et al., 2017). In a study in Sweden, 80% of food wasted in a works canteen was avoidable (Betz et al., 2015).

Three types of food waste occur in food service: kitchen waste, serving loss and plate waste i.e. food on a plate left uneaten (Heikkila et al., 2016). Approximately thirty percent of total food waste is estimated to come from plate waste in food service in the UK (The House of Commons, 2017). Factors that influence food waste in food service include: food type and quantity, poor prediction of the number of meals required at a meal serving (Eriksson et al., 2018). Inefficiency in food service management is also influenced by a lack of attention to dietary habits, rigid food procurement specifications, menu composition, and meal presentation with these latter four factors causing 15.3% of food waste in school catering (Falasconi et al., 2015). Indeed, a pre-ordering system by students could be an option to reduce food waste (Fastrak, 2015). Numerous studies have attempted to explain the relationship between food waste behaviour in food service and associated situational and individual factors. These are now explored.

2.0 Situational factors influencing food waste behaviour.

Situational factors include communication within the food service environment and choice architecture and choice design such as plate size (Brian and Koert, 2013) or portion size. Communication including the welcome to the food area, and any repeated messaging and logos focusing on food waste may influence individuals (Ferreira et al., 2013; Aschemann-Witzel et al., 2015). Similarly, in an educational setting, peers, teachers, and canteen staff may influence unfavourable food intake or alternatively sometimes encourage behaviour that contributes to less food waste (Heikkilä et al., 2016; Kuo and Shih, 2016). Although participants who have bigger plate eat 45% more they also have 135% more food leftovers than those that have smaller plate (Wansink and Ittersum, 2013). Similarly, offering a large plate size may influence
perceived behavioural control regarding eating all food on a plate (Berkowitz et al., 2016). Therefore, varied portion sizes and plate sizes, palatable food, and providing food waste related information in the canteen serving area may reduce consumer-related food waste (Aschemann-Witazel et al., 2016; Lorenz et al., 2017).

3.0 Individual factors influencing food waste behaviour.

Individual factors such as palatability (Eertmans et al., 2001; Gase et al., 2014; Betz et al., 2015); acceptability, knowledge and awareness (Principato et al., 2015; Aschemann-Witzel et al., 2018); price or value, gender and age are now considered.

3.1 Palatability

Palatability simply means those foods that are acceptable to an individual’s palate. Studies have examined specific food types and waste during food service e.g. fruit and vegetables to explain the differentiated nature of people’s waste behaviour. Among all food waste, fruit and vegetables have the highest wastage rate (45%-51.4% see Byker et al. 2014; FAO, 2017), and in food service specifically, salad fruit and vegetables account for over 25% of waste (Silvennoinen et al., 2015) and in a school setting this rises to 40% (Gase et al., 2014). Further, vegetables pose a challenge to reduction, reuse and recycling the waste due to their higher biodegradability representing a loss of nutrients, money and biomass (Plazzotta et al., 2017). In the wider context, potatoes, rice and pasta account for 29% of food waste; salad vegetables and fruit (25%), bread and grains (14%); meat (for meat eaters 9%); fish (5%), dairy products (3%) and the rest is classed as other products (Silvennoinen et al., 2015).

Ferreira et al., (2013) point out that food acceptability is positively related to energy and protein content of food. The changing behaviour of students into consuming less healthy food, may lead to more waste in the food service environment (Lazell, 2016). Zepeda and Balaine (2017) disagree stating participants in their study were willing to waste more animal products
than plant products, particularly whole plant products driven by environmental concern more than health concern.

3.2 Knowledge and awareness

Richter (2017) divided people who waste food into three groups (guilty, unwitting, and careless) based on their understanding of the level of the food waste problem and indicated that the more information they are given the more this may influence their food waste behaviour. Social media may influence students’ food waste behaviour in a university setting (Lazell, 2016). However, Young et al., (2016) argued and confirmed that there is no significant decrease in food waste after interaction with social media. In their study, after using a retailer’s Facebook, digital magazine, and e-newsletter for five months, there was no significant different in self-reported food waste reduction comparing the control group and test group. Grainger and Stewart (2017) question the methodology that Young et al. used and this is supported by Adams et al., (2005), who argue that although self-reporting methods give good documentary records, as a methodology it is not as accurate as actually weighing the plates to determine food waste behaviour. Similarly, Buzzard et al., (1996) argued that a self-reporting method is reliant on the honesty of the subjects in reporting their consumption. This conflicts with the view held by Gaiani et al., (2018) that a self-reporting method provides less bias due to feeling less observed or a sense of being judged by the researcher.

3.3 Price

Cost remains the key motivator for reducing food waste (WRAP, 2013). Price-focused consumers have a lower tendency to waste food and their decision is based on a price versus quality trade-off with knowledge as a mediating factor (Aschemann-Witzel et al. 2017). Whilst this research did not consider food service the price versus quality dynamic is worthy of consideration in this setting.

3.4 Gender
In a university-based study, average female plate waste was twice males’ plate waste in both the control week and experimental week (Kuo and Shih, 2016). Conversely, Sauer et al., (2012) suggest that there is no significant difference in food waste by gender. However, in another study female and lower income participants tended to express a greater price-focus and higher self-reported level of food waste (Aschemann-Witzel et al., 2017).

3.5 Age

Age influences plate waste with older people less inclined to waste food (Aschemann-Witzel et al., 2017). In a study of Spanish and Italian youths (n=380), researchers reported that over 60% of their food was wasted (Mondejar-Jimenez et al., 2016) and the younger generation is reported as being higher wasters of food when compared with other age groups (WRAP, 2014; Derqui and Fernandez, 2017; Principato et al., 2017). However, there is indication that as the younger generation shows increased awareness, their willingness to waste food decreases (Principato et al., 2015).

3.6 Multiple factorial effects on food waste

Awareness of the negative consequences of food waste, educational level, peer influences and perceptions of the university’s waste management processes result in different amounts of waste around campus (Zhang et al., 2017). After an intervention of showing posters about food waste, female plate waste reduced by 20%, while males’ plate waste increased from 54.7g in the control week to 81.5g which is a 50% increase after the intervention, and argued as males being more rebellious than females (Kuo and Shih, 2016). However, Sauer et al., (2012) rejected the hypothesis and indicated that the overall waste by each gender decreased by 41.1% (female) and 39.0% (male), even though there is no statistically significant gender difference on food wastage before and after the posting of slogans in a canteen setting.

Suboptimal quality is a factor that leads to food waste. Consumers’ determination of suboptimal quality is caused by the food’s visual appearance, and is influenced by demographic
(age, nationality) and personality characteristics such as value orientation, effectiveness in environment consideration (Hooge et al., 2017). Educating consumers that “ugly” fruit and vegetables carry the same amount of nutrients as standard vegetables may increase awareness of the minimal impact of cosmetic quality issues (Beausang et al., 2017). Time spent eating a meal correlates with the amount of food waste as when students’ meal times are limited to less than 20 minutes, they waste more food than they waste when they have five minutes more to eat (Cohen et al., 2016).

After reviewing previous research, only two studies have considered UK students’ household food waste awareness (Clark and Manning, 2018; and Lanfranchi et al., 2016). The other studies on university students’ intentions on food waste in food service sector focus on Italy (Principato et al., 2015), Finland (Silvennoinen et al., 2015) and Sweden (Engstrom and Carlsson-Kanyama 2004; Lorenz et al., 2017). In the studies reviewed here, plate leftovers have been estimated to contribute between 25% (Silvennoinen et al., 2015) to 60% (Engstrom and Carlsson-Kanyama 2004) of all food waste. Only one study (WRAP, not dated) has sought to investigate what makes people leave food on their plate in food service, and in primary and secondary school (WRAP, 2011), thus food waste intention of UK students in a university food service area has not been investigated in detail. This leads to the research question this research has sought to address:

What are the causes of food waste in a university setting and the factors that influence the insinuated intention to waste food among staff and students?

The next section considers the methodology.

5.0 Methodology

This study is grounded in the literature and seeks to consider the themes that arise in the context of a food service setting. The unit of analysis is therefore “the student”, although the rationale for the research recognises that the student does not exist in isolation, but is also influenced by
the environment in which they purchase a plated meal in terms of both the physical facilities, and also the other individuals with whom a person may consume food. A quantitative approach was employed using an on-line survey (Bristol Online Survey), distributed by email and by Facebook to the student group pages, which although the approach is rigid and formal (Saunders, et al. 2012), enables the examination of relationships between variables using both descriptive and inferential statistics (survey available on request). Based on the consideration of the total number of staff (n=650) and students (n=4800) at the university of study to achieve a 90% confidence level with a 5% margin of error, the ideal sample size is 258. Convenience sampling was used (between February and March 2018) and the sample (n = 260) was split into four age groups (18 to 26, 27 to 35, 36-45, and above 46) as staff were also considered. A pilot study (n = 26) found clarity of response and minimum changes were required to grammar within the questionnaire. The design and analysis of each question was based on the review of secondary literature (Lusk and Briggeman, 2009; Ferreira et al., 2013; Cohen et al., 2015; Kuo and Shih, 2015; Silvennoinen et al., 2015; British Nutrition Foundation, 2016; Heikkila et al., 2016; Aschemann-Witzel et al., 2017; Plazzotta et al., 2017; Public Health England, 2017; Zepedu and Balaine, 2017).

Descriptive analysis used included frequency, percentage and mean rank for each question and inferentially by IBM SPSS Statistics version 22. Inferential analysis to test associations (bivariate analysis) and correlation between variables used the Chi-squared test, Kruskal-Wallis and Pearson correlation considering gender, age, salary, education, frequency of eating plated meals, reported knowledge of food waste, plate size and portion size and influence of peers.

6.0 Results and analysis

The results section is structured using four themes: demographic description, eating habits, knowledge of food waste and insinuated intention to waste food.
6.1 Respondent demographics (gender, age, occupation, salary, and education)

There were 260 respondents to the questionnaire more than two thirds (72.7%) were females, and the rest were male. More than one in ten \((n = 28)\) were academic staff (10.8%) administration and support staff (23.1%) and the rest were students (66.2%). The age of respondents was between 18 and 26 (66%) with from 27 to 35 (6.2%), 36-45, (11.2%) and above 46 (16.5%). More than 60% of participants (61.2%) stated they had an income under £15,000 annually, and about 15% of them earned £15,001 to £25,000, and the rest (23%) had an income of more than £25,001 per annum. Nearly half of the participants had A-Level or below as their highest education qualification (49.2%), and the remainder had a bachelor’s degree or higher degree (50.8%). The data profile of the survey when analysed meant that the possible inferential analysis for occupation and income was limited.

6.2 Eating habits

Interestingly, nearly 40% of participants had a meal less than once a week on campus, and almost one third bought a meal 1-3 times weekly. Some respondents \((n=18)\) did not eat a meal on campus but their attitude toward plate waste is included in the analysis for inclusiveness but may be a potential limitation in the study. The average meal time at lunch was 32 minutes while the dinner time (evening meal) was shorter, at 19 minutes. Figure 1 shows respondents were broadly split into three groups regarding length of time spent on lunch: 20 minutes, 30 minutes and 60 minutes, respectively. Similarly, there were two main groups of respondents that either spent 30 minutes or less on eating the evening meal, or instead spent 60 minutes eating.

**Take in Figure 1**

More than half of the students always had their meal with friends (51.9%) and nearly one third of them sometimes ate with friends (29.2%). Only 19% ate alone. Using the Kruskal Wallis test, it was found that eating with friends did not influence food waste at \(p< 0.05\).
6.3 Knowledge of food waste

Half of the respondents (53.1%) had not read about the environmental impact of food waste, and 66% of students had not studied food waste on their course. Only 29% of academic staff (n = 8) taught about food waste in class.

6.4 Insinuated intention to waste food

The insinuated willingness to waste different categories of food showed that 73.1% of participants would waste potato and rice, more than fruit and vegetables (52.6%), while more than half of respondents would choose to eat meat (69.6%), and fish (56.5%) when they were nearly full rather than waste it. Almost half of the participants would always eat dairy products (48.8%) and the remainder would be willing to waste them (40.4%) with 10.8% of respondents indicating they would not put dairy products on their plate due to allergy or ethical reasons.

The influence of gender on willingness to waste food, by food category, was considered and also associated factors of influence. The twelve hypotheses tested were:

- H1: Gender influences the intention to waste meat when on plate
- H2: Gender difference influences the intention to waste fruit and vegetables when on plate
- H3: Gender difference influences the intention to waste dairy (cheese, yogurt, milk) when on plate.
- H4: Gender influences the intention to waste potato and rice when on plate.
- H5: Gender difference influences the intention to waste fish when on plate.
- H6: Gender influences whether the intention to waste food is influenced by the cost of the meal.
- H7: Gender influences whether individuals will continue eating even if they are full.
- H8: Gender influences whether vegetables would be left on the plate in preference to meat.
• H9 Gender influences whether bread/potato would be left on the plate in preference to meat.

• H10 Gender influences whether an individual will put more food on their plate if they have a bigger plate.

• H11 Gender influences whether if an individual will say yes if the person will say yes if a serving person asks if I would like more food on my plate.

• H12: Gender influences whether I will waste more food if I have a bigger plate.

There was no association with gender found for H1, H2 and H3, but for H4, and H5 there was a statistically significant difference by gender at p< 0.05. There was a significant difference for potato and rice (H4, p= 0.029) and fish (H5, p = 0.037), where females are statistically significantly more likely than males to leave these foods on their plates. Interestingly women in the study are also three times more likely not to put fish on their plate in the first place (Table 1).

**Take in Table 1**

There was no difference by gender on the influence of the cost of the meal on intention to waste food (H6: p = 0.467). Males (64.8%) are more likely than female (43.4%) to continue eating when they are full and clear their plate (H7) and this is statistically significant at p <0.05 (see Table 2). However, there was no statistically significant difference by gender as to whether it was asserted that vegetables or bread and potatoes (H8, H9) would be left on the plate over and above the meat portion (Table 2).

**Take in Table 2**

The size of plate did have an influence where females reported they would be affected by plate size (H10), and were statistically significantly more likely to have more food if they had a bigger plate and also to waste more food (H10, H12 see Table 2). When asked for the level of agreement or disagreement with the statement “If I spend more money on my meal, I am less
likely to waste it” two thirds (63.8%) agreed or strongly agreed with the statement with a quarter of respondents strongly agreeing (24.6%). Gender was not found to be an influencing factor in the response (H6 see Table 2). However, when the influencing factor of income was evaluated and the relationship found as statistically significant (p=0.008) at p <0.01. Thus, the level of income influences willingness to waste food with 67% of individuals who earn less than £25,000 per annum indicating willingness to waste less food if they spend more money on their meal compared with 53% of people who earn above that amount. When asked if they would waste food if encouraged to have a portion by the server 48.2% of females agreed or strongly agreed and 56.4% of males so there was no difference by gender.

7.0 Discussion

The secondary research reviewed in this paper identified a number of causes and factors that influence food waste in a food service and in some instances within an educational setting. These factors are considered here in light of the empirical data analysis and synthesised into a conceptual map (Figure 2). The causes of food waste (in blue), the influencing factors on food waste (green) and the solutions (red) circles combine within the map.

Take in Figure 2

One of the potential causes of food waste was suggested that eating with friends will influence the amount of food leftovers (Young et al., 2016). However, in this study, no association between eating with friends and the influence on the amount of food waste by category was identified. Kuo and Shih (2016) suggest that females waste twice as much food as males whilst Sauer et al., (2012) found no difference. The findings of this study have extended this further into considering categories of food waste intention and how they are influenced by gender. Of the hypotheses tested, this study shows that gender has a statistically significant influence on the waste of potato and rice, and on fish. However, it is noted by a previous study (Betz et al., 2015) that food palatability is of impact and females have been
shown here to be less likely to put fish on their plate in the first place. Further, Silvennoinen et al., (2015) found that a 25% rise of food waste in school canteen was found when fish was served in the menu. This is supported as a potential issue in this study so further work should be done at the university to see if serving fish increases plate waste.

Research by Silvennoinen et al., (2015) found gender difference in intention to waste the main course and salad. The finding in this study with intention to waste, salad, fruit and vegetables suggest there is no difference by gender. However, the work did concur with the gender influence on waste potato and rice. Males are more likely than females to continue eating when they are full and clear their plate and this is statistically significant at p <0.05. The results indicate that plate size positively influences the plate waste, it concurred with previous studies (Ferreira et al., 2013; Cohen et al., 2014; Berkowitz et al., 2016; Lorenz et al., 2017). Further, this research indicated that females strongly suggested that they are more influenced by plate size and more likely to waste food if they have a bigger plate. Therefore, a recommendation to reduce the food waste in the food service environment is to provide a variety plate sizes and associated pricing structure. This approach could also consider the differentiated intention to waste food of different types. Currently at the university, plated breakfast meals are priced according to the number of portions on the plate. This could be extended to the lunch-time and dinner and if combined with differentiated plate size could reduce food waste.

The literature suggests the use of videos, social media and greater communication with food service customers is of value to reduce food waste (Zhang et al. 2017). Consideration of nutrient value and calorific content will also influence perceptions of food choice and food waste behaviour. Aschemann-Witzel et al., (2015) support this asserting that communicating with consumers about food waste by poster or video during lunch-time in the canteen can trigger consumers to waste less. The influence of the length of meal-time and its impact on plate waste is identified in the literature (Cohen et al., 2016) and was quantified in this research but is worthy of more investigation. A recommendation from this research is that there should be a
wider strategy to increase awareness of food waste both in the food service setting (posters, notices, videos) and during fresher’s induction at the start of university with perhaps a welcome pack on “reducing food waste”. Communicating with customers about reducing plate food waste is important. Interactive posters and prompts can nudge behaviour towards resource saving, but this needs to include clear messages and feedback (Agha-Hossein et al., 2015).

Visual prompts are designed to communicate information and encourage a particular response, decision or behaviour and include notices, videos, infographics, posters, signs, stickers (Bartram, 2009; Shearer et al., 2017). The value of visual prompts increases if text and pictures are used together either to promote certain behaviour or to prohibit others although indiscriminate use of such cues can limit their effectiveness (Shearer et al., 2017). Further work should be done in the food service environment to see which cues are of most benefit.

8.0 Conclusion

The aim of this research was to consider the factors that influence plate waste in a university food service setting and the insinuated intention to waste food among staff and students. The study demonstrated that the insinuated intention to waste food is influenced by multiple factors including gender, different categories of food, plate size, portion size, and palatability. The dataset meant that the factors of age and knowledge awareness could not be assessed in detail, but this is worthy of further study. Two recommendations to reduce food waste in the university food service setting include providing a variation in plate size and pricing strategy by portion rather than a whole meal, and communicating with staff and students in the food service setting.

This study focused on reported knowledge and intention of respondents. However, empirical work that now looks at actual behaviour rather than self-reported intention can examine the actual level of plate food waste and the effectiveness of the adoption of the recommendations in this study when implemented in practice. Most specifically this should look at in-situ prompts and messaging that can influence behaviour and reduce food plate waste. This should include
the type of media and its influence i.e. static or interactive, the tone (polite or direct) and how different cues are perceived by consumers in given situations.
1. References


Table 1: Respondents self-reported intention to eat or leave on plate by food type (percentage)

<table>
<thead>
<tr>
<th></th>
<th>Potato &amp; Rice</th>
<th>Fish</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>Would not put on my plate (e.g. allergy or ethical reason)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Always eat</td>
<td>22.8</td>
<td>38.0</td>
</tr>
<tr>
<td>Might leave</td>
<td>59.3</td>
<td>52.1</td>
</tr>
<tr>
<td>Very likely to leave</td>
<td>17.9</td>
<td>9.9</td>
</tr>
</tbody>
</table>

Table 2: Respondents self-reported intention regarding food waste
<table>
<thead>
<tr>
<th></th>
<th>H6: If I spend more money on my meal, I am less likely to waste my food. (Data merged due to data analysis requirement)</th>
<th>H7: Even if I am full I always clear my plate.</th>
<th>H8: I will waste more vegetables than meat if I have food left over after a meal.</th>
<th>H9: I will waste more bread/potato than meat if I have food left over after a meal.</th>
<th>H10: I will put more food on my plate if I get a bigger plate.</th>
<th>H11: I will say yes if the person putting food on my plate encourages me to have more.</th>
<th>H12: I will waste more food if I have a bigger plate.</th>
</tr>
</thead>
<tbody>
<tr>
<td>p</td>
<td>0.467</td>
<td>.000**</td>
<td>0.191</td>
<td>0.876</td>
<td>0.019*</td>
<td>0.156</td>
<td>0.000**</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>65.6</td>
<td>6.9</td>
<td>9.5</td>
<td>13.8</td>
<td>8.5</td>
<td>6.3</td>
<td>7.4</td>
</tr>
<tr>
<td>Agree</td>
<td></td>
<td>36.5</td>
<td>40.7</td>
<td>46.6</td>
<td>51.3</td>
<td>41.8</td>
<td>36.0</td>
</tr>
<tr>
<td>Neither agree or disagree</td>
<td>15.9</td>
<td>18.0</td>
<td>16.4</td>
<td>10.6</td>
<td>12.2</td>
<td>15.3</td>
<td>25.9</td>
</tr>
<tr>
<td>Disagree</td>
<td>18.5</td>
<td>32.3</td>
<td>25.4</td>
<td>23.8</td>
<td>21.2</td>
<td>28.6</td>
<td>27.0</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td></td>
<td>6.3</td>
<td>7.9</td>
<td>5.3</td>
<td>6.9</td>
<td>7.9</td>
<td>3.7</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>59.2</td>
<td>31.0</td>
<td>12.7</td>
<td>13.8</td>
<td>8.8</td>
<td>8.1</td>
<td>7.3</td>
</tr>
<tr>
<td>Agree</td>
<td>33.8</td>
<td>52.1</td>
<td>47.7</td>
<td>48.1</td>
<td>42.3</td>
<td>32.7</td>
<td></td>
</tr>
<tr>
<td>Neither agree or disagree</td>
<td>15.5</td>
<td>9.9</td>
<td>11.3</td>
<td>11.2</td>
<td>14.6</td>
<td>16.2</td>
<td>23.8</td>
</tr>
<tr>
<td>Disagree</td>
<td>25.4</td>
<td>23.9</td>
<td>14.1</td>
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<td>25.0</td>
<td>27.3</td>
</tr>
<tr>
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<td>1.4</td>
<td>9.9</td>
<td>5.0</td>
<td>9.6</td>
<td>8.5</td>
<td>8.8</td>
</tr>
</tbody>
</table>

* significant at p < 0.05  ** significant at p < 0.001
Figure 1: Time spent at lunch-time for eating a meal

Figure 2: Causes, influencing factors and solutions for food waste in an educational food service setting