Identifying factors that promote consumer behaviours causing expired domestic food waste

INTRODUCTION

Food waste presents a threat to the environment because of greenhouse gas contributions and the wasted resources used to produce, process, market, transport and refrigerate food (Fischer et al., 1995; Godfray et al., 2010; Parfitt et al., 2010; Parry et al., 2004; Rosenzweig and Parry, 1994). These implications represent wastes along the entire food supply chain, having adverse effects on agriculture, the economy, land availability, the environment, and food sustainability and security (Kaiser, 2011).

Numerous research has provided insights suggesting opportunities to reduce food waste at critical stages of the supply chain. These include food management alterations by the agricultural industry, food grocers and processing industries, as well as food marketing commerce and hospitality and retail industries (Cox et al., 2010; Godfray et al., 2010; Kantor et al., 1997; Parfitt et al., 2010; Tsiros and Heilman, 2005). Industry has targeted food spoilage reduction by examining consumer behaviour to inform food policies and industry standards (Tsiros and Heilman, 2005). Interventions assisting consumers have included mitigation strategies to reduce domestic food waste (e.g. Ene, 2008; Schneider, 2008). Technology that targets behaviour is one such way to assist in reducing domestic food waste. However, despite efforts, the average consumers' annual household garbage comprises 40-60% food waste (Caswell, 2008), contributing approximately 20% to landfills (Wade, 2011, p. 48). Stern (2000) argues that behaviours impacting the environment are environmentally significant behaviours. We argue behaviours causing domestic food waste are environmentally significant behaviours. These behaviours are complex, and Stern (2000) suggests that many behaviour change theories are insufficient in determining environmentally significant behavioural indicators (Stern, 2000).

There are a number of theories to explain behaviour change. The Theory of Planned Behaviour (TPB) is widely used to explain behaviour change by providing possible causes of behaviour through examining consumers' beliefs, attitudes and intentions (Ajzen, 2011). TPB does not accommodate a consumer's knowledge and skill for particular actions and is therefore, inadequate in determining the impact of such indicators. Also, a number of external influences are not included in the TPB formula, such as: community expectations, advertisement and marketing, and public policies in place that support behaviour.

For this paper, the Value-Belief-Norm (VBN) theory has proven useful for examining the impact of consumer decision-making behaviour regarding food and wastage. VBN theory provides a framework to examine causes of behaviours that are associated with non-activist environmentalism, which refers to consumers whose behaviours impact the environment, regardless of intent (Stern, 2000). Understanding the circumstances in which these behaviours occur helps to identify the original causes. These causes can then be addressed to encourage a change in behaviour (Stern, 2000) in terms of:

(i) Attitudinal factors regarding an individual's norms, values and beliefs;

(ii) External or contextual forces, which refer to the level of impact that community, institutional, social and legal expectations have on an individual;
(iii) Personal capabilities concerning the knowledge and skills required for an individual to perform an action;
(iv) Habit or routine regarding an individual's established habitual behaviour and everyday practice.

Different combinations of these conditions can influence consumer behaviour. Our study seeks to identify the factors promoting consumer behaviours resulting in domestic food waste.

LITERATURE REVIEW

Schneider (2008) argues that on average, around 25% of the available food supply is wasted globally. Wastages happen along the food supply chain with significant portions of losses occurring in domestic settings (Ambler-Edwards et al., 2009) and to a lesser extent at food retail outlets (Kantor et al., 1997; Schneider, 2008). Industry implement a variety of policies and initiatives to reduce and manage food wastages (e.g. using waste as animal feed) (Darlington et al., 2009; Tsiros and Heilman, 2005). Domestic food waste is largely uncontrolled despite numerous attempts to reduce it by means of behaviour modification, raising food waste awareness, and persuasion using intrinsic and incentive motivation (e.g. Bucci et al., 2010; Thieme et al., 2012). Bucci et al. (2010) examined a fridge that alerts users about product expiration dates, suggests recipes, sends shopping lists via SMS or email, and posts messages to household members. Thieme et al. (2012) examined the effectiveness of BinCam; a camera placed in a bin alerting consumers of their waste practices. There is a range of explanations as to why these initiatives failed to result in sustained behaviour change, including perceived usefulness, perceived ease of use (Davis, 1986), and challenges regarding consumers acceptance to use technology aimed at supporting everyday activities and practices. Within the household, Kantor et al. (1997) found that the majority of waste comprised of expired foods, forgotten in storage. Quantities of domestic food wastes are attributable to consumer behaviours, promoted by many influences occurring during food purchasing, cooking, consumption, and disposal.

Baumeister (2002) and Ene (2008) argue that consumers are encouraged to purchase food excessively, because of exposure to marketing ploys influencing their decisions to buy products impulsively, irrespective of the value to consumers. Further, commercially processed food is a relatively cheap commodity, encouraging consumers to stockpile food or buy in bulk. Those consumers that have not experienced scarcity are often not overly concerned about ensuring the consumption of all the food they purchased before it expires. Therefore, they are more likely to throw out expired unconsumed goods (Godfray et al., 2010). In their review, Tsiros and Heilman (2005) explored how methods for industry could assist reduced food spoilage by examining consumer behaviours regarding the effect that expiration dates have on purchasing decisions. Their insights show many consumers require a greater awareness of food expiry labelling and the literacy to adequately interpret such labels. This would enables consumers to become better informed of accidental product purchasing close to expiration. Tsiros and Heilman (2005) also argue that there is a greater need for industry to provide uniform classification methods to date the expiry of food. This action

would serve to further reduce consumer confusion regarding food expiration, not only during food purchasing, but in domestic settings as well. These external influences point to underlying promoters of particular food purchasing behaviours that contributing to domestic food waste, such as the stockpiling of food. To help overcome these influences, our study investigates the factors directly influencing those behaviours that resulting in domestic food waste.

Influencing consumer behaviours is no easy task, and has been met with varying successes in the past. Vermeir and Verbekev (2006) argue that increases in consumer interest and attitudes towards sustainable food practices does not necessarily trigger a change in consumer behaviour. While consumers may have an interest towards sustainable food practices, external factors may prevent them from performing and sustaining such practices. Stern (2000) claims that the most effective approach to encourage a change in environmentally significant behaviour requires a combination of interventions, including: (i) using religious and moral approaches that appeal to the values of individuals and influence their worldviews; (ii) providing information and education to shift an individual's attitude; (iii) rewarding desired behaviours through material or monetary incentives and penalising individuals for undesired behaviours; (iv) providing a shared understanding of rules and expectations through community management. However,, Stern (2000) also argues regardless of the combination of interventions used, at least one intervention must remove key barriers preventing change and should be tailored to an individual's situation. Meulenberg (2003) suggests sustainable food practices are based on a decision-making process that engages a consumer, not only in their individual desires and needs, but also their perceived social responsibility. Vermeir and Verbekev (2006) found that everyday purchasing and consumption practices are heavily motivated by a variety of influences such as convenience, habitual behaviour, diet and health concerns, perceived value for money, hedonism / lifestyle, and social responsibility perceived through social norms. However, some consumers may still be resistant to change (Dawson, 2000; Tucker and Douglas, 2007). This reinforces the need to consider opportunities to influence external factors to help people adopt and sustain behaviours to reduce food wastage.

Factors that influence food behaviours include social norms, attitudes, cultural upbringing, experience, knowledge, and understanding of food (Brunner et al., 2007 cited in (Ganglbauer, Fitzpatrick, & Comber, 2013)). Knowledge and understanding of food refer to an individual's *food literacy* (Vidgen and Gallegos, 2010). Vidgen and Gallegos (2010) describe food literacy as the knowledge and understanding that individuals and communities have of food, and how it can be used to meet their needs. Schneider and Obersteiner (2007) provide key drivers that shape behaviours, resulting in food wastage. They suggest that age, income, and time spent at home are factors to consider when examining behaviours. Situational conditions, such as smell, appetite, desire for food have implications for food wastage (Schneider, 2008). Schneider (2008) proposes several methods of waste prevention for use in households: a shopping list, using highlighted tabulated measurements for rational food portion sizes, education in creative uses of food leftovers, education about the equivalent monetary value of wasted food items for a given consumer, and general food waste awareness training.

Therefore, our study is guided by the research question: *Why do consumers waste domestic food?*

METHODOLOGY

Two sequential methods of data collection (DC) over a three month period were employed to address the research questions: DC1 – a convergent interviewing process (Dick, 1990, 2000), and DC2 – ethnographically inspired participant observations. Convergent interviews (DC1) involved 12 participants (Table 1). Participant observations (DC2) involved 6 households comprising 17 individuals (Table 2).

Participants were recruited from a survey disseminated to the general public before the undertaking of DC1 and DC2. DC1 and DC2 participants underwent a screening process before they were recruited. In the case of DC1, participants were recruited based on a dissimilar combination of their age, sex, living arrangements, working arrangements and household type, as required in a convergent interview protocol (Dick, 1990, 2000). DC2 initially employed similar restrictions for recruitment. However, the households initially approached expressed reluctance to become involved in the study because of the intensive and personal nature of the observations, which made us reduce the original restrictions to only require more than one occupant per household in DC2. This enabled us to examine external and contextual forces that may surface and might be significant in influencing household behaviours regarding food with respect to the four considerations of the VBN theory: (i) attitudinal factors; (ii) external and contextual forces; (iii) personal capabilities; (iv) routine or habit.

The procedure in DC1 consisted of open-ended questions concerning five main areas: grocery shopping practices and experiences, food storage practices, household cooking habits, food waste management practices, and food waste prevalence. Interviews took 45 minutes on average, and participants were encouraged to add further details they thought relevant. These details were then converted into questions and integrated into future interviews. DC1 took place over a four-week period. Participants were continually recruited until theme saturation occurred and no new themes surfaced. Thematical analysis was applied to the interviews to derive emergent themes.

DC2 followed the progression of food during the consumer phase of the food lifecycle over a four week period. This entailed observing household practices during post-purchasing (receipt), storage, and consumption of food. It also required observing waste management practices. Five questions guided observations: (a) What shopping practices do households employ? (b) What do consumers characterise as expired food? (c) How do consumers handle expired waste? (d) What quantity of expired waste do households produce? (e) Is a system of food organisation practiced when households store food?

Addressing these questions involved the research team completing a five stage process: (1) the collection of shopping dockets; (2) taking photos of the inside of the fridges; (3) examining the contents of a bin (provided to households), which contained the expired food waste accumulated over one week; (4) weekly informal interviews, and; (5) a final debrief interview, which was carried out once at the conclusion of the study. With the exception of the final interview, each component was actioned once a week in the participant's home with

questions directed at a single household representative who had been chosen by all household residents. The interview questions addressed the participants' food purchasing, cooking, consumption, and waste management practices. Fridge photos applied visual ethnographic techniques (Choi, 2010; Pink, 2007; Schwartz, 1989) to examine the subtle differences in storage patterns between households. Fridge photos additionally illustrated the movement of food and provided contextual insights about interactions consumers had with their food. The collection of shopping item lists and shopping receipts depicted an approximate inventory of food for households. This, in conjunction with interview responses, helped us in identifying household shopping practices.

Final interviews in DC2 explored the experiences of household residents and comprised open-ended questions, concerning three areas: i) The experiences of consumers during the study; ii) The impression of consumers whether they felt the study had an impact on their awareness of their food shopping, storing, consumption, and waste management practices; iii) Suggestions for future technologies that may encourage reduced expired domestic wastage.

FINDINGS

Four underlying themes emerged from the results and are discussed in order of prevalence and importance. Themes relate to our study participants' common practices regarding their food purchasing, storage and consumption or wastage.

Domestic food storage practices

Storage practices emerged as the most significant theme influencing the link between behaviour and food waste prevalence. On investigating consumer storage practices, our findings showed that a range of factors promote different behaviours causing expired food waste. There is an underlying need to assist consumers with food storage and support a system of organisation to help consumers easily locate items. DC1 participants provided details of how they store food in their household. Their responses characterised three food storage practices: a systematic and categorisation approach, an approach where items are placed in available locations, and an approach based on random and non-systematic placement of food items. DC1 responses showed most consumers have some knowledge of their current household food supply. DC2 observations indicated that implementing a systematic and categorisation approach is likely to reduce the amount of food waste. However, a number of DC2 households stated locating free space to place food led to disorganisation, resulting in food becoming easily lost and often expiring before being relocated. DC2 observations often associated this occurrence with refrigerators that reached storage capacity when yet more items had to be added. Comments regarding the low visibility of food items within the refrigerator, particularly of items that were not located towards the front of shelves, also surfaced in both DC1 and DC2.

Household H2 in DC2 provided a key example of a household that implemented an organised food storage system (Figure 1). H2 discarded expired food only once during the study (a single product of mayonnaise), whereas all other DC2 households discarded expired food each week of the study. (Note that H2 joined the study in the second week of the experiment; hence there are no photos from the first week.) H2 indicated that food expiring was not

common in their household, because their storage system was structured and orderly and all household members proactively took part in making themselves aware of the available food and its location. H2 also noted their initiative in learning how to increase food longevity by identifying ways to better store and preserve food. Figure 1 illustrates the different assortment of containers used by H2 to store food in their fridge. Similar storage patterns are implemented in all food storage locations. In addition, responses from all household members in H2 indicated that they were reluctant to throw away expired food if it had only recently passed its expiry date. H2 would commonly eat produce that appeared bruised or had abrasions. However, four DC1 participants' responses showed that because of a number of negative experiences with food in the past, some individuals pay close attention to matters concerning food. Participants' responses suggested that for some individuals, food that has remained in storage for more than a few days is disposed of. Childhood experiences of food – particularly dairy expiring before its actual expiry date – contributed to this behaviour.

Firstly, these findings suggest consumers could benefit from a better understanding of food edibility, including when food can still be consumed safely. Secondly, these findings point to a need of informing and persuading consumers to adopt methods to not only better store and preserve food, but also to use food creatively and in more diverse ways before it expires. The findings also highlight the benefits of devising a tailored way to establish an organised system of food storage and the strong association with lower waste production in households with such systems.

Food shopping and purchasing practices

On investigating consumer purchasing behaviours, our findings showed consumers are often unaware of their food stock, and this lack of information promotes the purchasing of items they already own. DC1 revealed participants' shopping practices could be characterised as 'under-prepared' or 'prepared.'

- *Under-prepared:* Those who did little to prepare prior to food shopping and would commonly purchase similar food items during each shopping experience. Participants would seldom review their current food stock before going to shop for more food and thus risk stockpiling items that were already in the fridge or pantry;
- *Prepared:* Those who planned and structured their shopping experiences based on a shopping list, where food was purchased according to planned meals. Often the participant would examine the fridge or pantry before creating the list.

Six DC1 participants and three DC2 participants used shopping lists. The shopping frequency across both characteristics generally matched a large shop once a week, with several smaller 'top-up' shops to purchase high turn over foods, such as milk and bread. DC1 and DC2 responses showed that the majority of food they purchased was from major supermarket chains, with some stating they also purchased fresh produce from delis and farmers markets. Those who commented on farmers markets noted the shorter shelf life of items purchased at farmers markets and stated frequently being frustrated with items expiring before they were able to consume them. C2, C7, C8, and C9 in DC1 stated food variety and freshness were the main considerations influencing the choice to shop at a particular supermarket chain over another. Bulk purchasing attitudes were prevalent in both DC1 and DC2, motivated by its perceived monetary benefit. This was noted with frequent comments regarding "buy bulk and

save." Bulk purchases were also reported to be one of the prime contributors to expired food waste. DC1 respondents provided examples such as buying spring onions in bulk (spring onions are often purchased in bundles), but not using all spring onions available when cooking, "because there was [sic] too many to use" [C2]. This was the case with a variety of produce items often sold in bulk (e.g., tomatoes, spinach, and celery). Further, DC2 observations showed that households with more than one person purchasing food are subject to miscommunication between household members, which led to multiple same-day purchases of a product. This occurrence was not prevalent across the study households. However, H1 and H4 mentioned this occurrence happening more than once during the study. DC1 interviewees also stated that on occasion, they would shop for specific planned meals. However, unforseen events would prevent them from being able to consume the food for the planned meal. For example, C9 stated, "I had planned to eat the salad I bought for lunch, but my sister-in-law came over for lunch and we decided to go out. I never got the chance to eat it after that."

DC2 observations showed that some fresh produce were not always refrigerated and often expired within two days of purchase. On raising this practice with households, responses showed that the participants did not know appropriate preservation methods to prolong food shelf life or had limited refrigeration space. H3 provides an example of limited refrigeration space (Figure 1). H3 stated their fridge was small and space was a continuous problem; therefore, they indicated they did not practice systematic storage. However, condiments and dairy products are generally kept in specific parts of the fridge such as the shelves on the door (Figure 2). Responses from DC1 and DC2 showed that consumers regularly cook large meals to last for several days. The cooked meal or leftovers were wrapped or repackaged and placed into the refrigerator, often "wherever there was room to do so" [H3]. DC2 households that undertook this practice also stated that items and item locations would easily be forgotten, particularly if placed or pushed behind other items. In many instances, participants' responses implied those orphaned products expired more frequently than others, because they "wouldn't [sic] be found until the regular clean out of the fridge" [H1]. Respondents also indicated that given the opportunity to reflect on common household practices, which is what DC2 facilitated, household members reduced the quantity of food purchased. This was because the members took more notice of food spoilage occurring as a result of: stockpiling, forgetting the locations of placed items and increasing their food knowledge and literacy. This highlights the need to find better ways to make consumers more aware of their current food supply in storage, thereby minimising food stockpiling and make better, more informed choices during food purchasing. It also stresses a need to inform consumers of methods to increase food longevity tailored to their households.

Food cooking and consumption practices

When examining food purchasing and consumption behaviours, the findings suggested a majority of our participants might not know how to judge whether food is edible or spoiled, particularly with regards to leftover ingredients or meals placed in storage. DC1 responses showed that participants would occasionally cook large meals with the intention to consume them over several sittings. However, some DC1 participants stated on occasion inadvertently cooked meals larger than they could consume in a single sitting. In both situations, the participants would store the leftovers in the fridge. DC2 observations showed that leftover

meals were often consumed over consecutive days and would rarely expire. However, the household bin photos (for expired wastage) illustrated that on occasion, leftovers became no longer edible before they could be consumed. On raising this occurrence with household members, a common theme surfaced regarding their lost desire to consume leftovers. DC2 observations also revealed that the majority of households regularly produced leftover ingredients. The participants' responses about this practice suggested that the leftover ingredients were often forgotten about when placed back in storage, because they were small and often placed behind other items. Responses further showed that other household members did not always know if leftover ingredients were available, because the leftovers were placed in storage by another household member and was not communicated to others. This points to a need for consumers to become informed of the locations of leftover meal and ingredients. DC2 observations also illustrated that two households had misinformed knowledge of when leftover ingredients expire and would often discard the ingredient for fear it would taint a meal. H1 in DC2 stated they did not know how to trust their senses to judge food's edibility and would therefore dispose of any foods they were unsure of (Figure 3). This highlights a need to inform consumers about the durability and shelf life of foods in food storage.

DISCUSSION

The findings from DC1 and DC2 were used to identify underlying factors promoting those consumer behaviours resulting in expired domestic food waste. The strongest theme emerging from our analysis is that the majority of expired wastage in domestic environments occurs because of behaviours enacted during food purchasing, storage, and consumption. The identified factors for such behaviours all pivot around food storage. If key information about food items stored within the household is provided during food purchasing, consumers are less likely to purchase items they already own. This practice would reduce food stockpiling and consequently reduce expired wastages associated with such behaviours. In addition, if consumers employ a system of food storage, particularly with high turnover foods, a reduction in expired waste caused from forgotten foods is likely to be experienced. Therefore, a systematic approach to food storage could assist consumers in increasing the likelihood that food is consumed before it expires. The findings do not necessarily shed light on how a system of storage may work effectively in a household. However, based on our findings we have trialled the use of a colour code scheme within a household's fridge. The colour code scheme is similar to that often used with kitchen chopping boards depicting which cutting board to use for specific food groups (examples include using the colour green for produce and the colour red for meat) ([redacted]).

More generally, our findings also showed that working on improving the ad hoc communication between household members involved in food purchasing may further alleviate food wastage because of the doubling up of products. Further, our findings indicate the root cause of communication challenges again, stem from a lack of systematic food storage within households. This reinforces our observations that a system of food storage would assist consumers to easily identify the location of their available foods. However, a lack of real-time information about a consumer's current food supply may also contribute to the cause of these incidents occurring. Our findings also indicate that mechanisms for

domestic waste reduction such as shopping lists and planning meals (Schneider, 2008) may also reduce the occurrence of these incidents and help to encourage a shift in shopping routine. Therefore, opportunities to present consumers with mechanisms for systematic food storage and providing real-time information about current food stock when purchasing food may offer fruitful avenues for future research.

We also found our study participants to be prone to marketing ploys during food shopping that promoted savings through bulk purchases, confirming arguments raised by Baumeister (2002) and Ene (2008). Further, when we examine consumer behaviour through VBN theory, it shows how external and contextual forces can drive behaviour that result in food wastage. Stern (2000) argues advertising and monetary incentives are external forces that can influence consumers' decision-making. In this case, our study participants were susceptible to the advertising and known monetary benefits that accompany bulk purchases. If consumers are provided with key information about their current food supply, in conjunction with being reminded of the impact of previous purchase decisions (e.g., a whole bunch of spring onions being wasted, as the recipe only calls for one), it may better inform their purchasing choices, encouraging a shift in consumer purchasing behaviours, and in turn, consumer demand. However, foods such as spring onions are often only sold in bulk. In these cases, there is a need to provide greater awareness and support the knowledge and skills to better utilise food creatively in order to ensure its consumption before expiration. Facilitating social engagement between consumers may present one such opportunity to increase the personal capabilities (Stern, 2000) of consumers. For example, sharing of recipes and cooking experiences between consumers could help individuals learn new ways to better utilise the food they purchase.

We observed our study participants to experience difficulties in judging food's edibility. The findings showed consumers, particularly those who had negative experiences with food in the past, were prone to dispose of food prematurely. In addition, consumers often did not know whether foods such as leftover meals and ingredients were still suitable for consumption. VBN theory regards the personal capabilities of individuals, including their knowledge and skills to perform a task, as a cause of behaviours that may contribute to undesirable behaviours. A consumer's food literacy based on their acquired knowledge and past experiences with food has a significant impact on their behavioural intention. Schneider (2008) and Brunner et al. (2007) stated that consumer knowledge, experience, and understanding of food are key influences on consumer behaviour. These influences also indicate a consumer's personal capabilities regarding food. According to VBN theory, a consumer's habit and routine greatly influences their behaviours and changing behaviour requires old habits to be broken (Stern, 2000). Our findings show that consumers could benefit from mechanisms that support consumer learning with regards to food literacy. Therefore, this presents opportunities for future research to explore how consumers can be provided with a greater knowledge of food and its edibility to reduce the premature disposal of food.

In addition, some study participants would cook large meals with the intention of consuming them over several consecutive days in an effort to save time and money. However, occasionally consumers would lose the desire to consume the same food after one or two sittings, confirming factors previously identified by Schneider (2008). These situations are

noted as a minor factor for two reasons: (1) This factor is less likely to contribute to behavioural intent, and our findings depicted little waste caused by these situations; and (2) these situations might be prevented if the major factors are addressed.

Therefore, our findings suggest three major and two minor causal factors promote behaviours resulting in domestic food wastage. The distinction between 'major' and 'minor' is as follows: 'Major' refers to a significant contribution to behavioural intent, and a larger quantity of expired food waste is likely to be generated as a result. 'Minor' refers to less significant contributions to behavioural intent, often outside a consumer's control, and a smaller quantity of expired waste is likely to be produced. The following characterises each of the factors identified by our study:

- Current Household Food Supply Knowledge – Does the consumer know what food items are currently available for consumption in their household? This factor becomes increasingly important with longer shelf life food items.
- Current Household Food Item Location Knowledge – Does the consumer know where to locate a desired food item within their household?
- Food Literacy – referring to the acquired knowledge and past experiences of consumers
    - Has the consumer had negative experiences with particular foods previously, which has thereby led to repeated practices where food is disposed of prematurely?
    - Does the consumer know how to creatively use food when cooking meals in order to ensure its consumption before expiration?

Our study identified two minor factors:

- Unplanned events – Has the consumer experienced ad hoc, 'spur-of-the-moment' situations that led to a cancellation of a previously planned consumption of food, purchased specifically for that planned meal?
- No desire to consume leftover food – Has the consumer cooked a large meal with the intention for it to span several consecutive meal times, but lost desire to consume the leftovers before they expire?

Understanding these factors promoting behavioural intent is crucial for mitigating their impact. We analyse these factors using VBN theory as a lens. From this, we are able to segment each factor into a combination of the four considerations, which Stern (2000) argues are key causes of behaviours associated with nonactivist environmentalism. *First*, a consumer's knowledge of their current household food supply underpins several influences that result in wastage. These included: (i) the tendency for our participants to stockpile food, which were influenced by external forces during purchasing, such as advertising and marketing ploys; (ii) the shopping routine of some of our participants who would commonly do little to prepare before shopping, such as using shopping lists and pre-planning meals.

Second, we argue the ability of consumers to locate desired foods can be evaluated by examining household routine. This consideration refers to the need for a household to develop a pre-planned systematic food storage routine, which household members practice continuously.

Third, we argue a consumer's food literacy can be examined with respect to their personal capabilities to judge a food edibility using their knowledge, skills and past experiences.

However, we suggest that attitudinal factors, such as a consumer's beliefs and values placed on food and its edibility influences their behaviours, possibly resulting in wastage. For example, a consumer's negative experiences with food previously can instil the belief not to trust the edibility of those particular foods in the future. This may encourage the habit of an individual to prematurely dispose of food.

Fourth, attitudinal factors and external forces can also impede consumers using pre-planned meals. Our participants noted having purchased food for a planned mealtime. However, spur-of-the-moment situations led to the cancellation of consuming that food, which resulted in wastage. Evaluating this practice with respect to VBN theory, we argue that norms and social expectations, such as the need to entertain visitors instead of consuming food purchased for a pre-planned mealtime, can cause behaviours that result in food wastage. We further argue a consumer's willingness to consume leftover food after they have lost the desire to do so can be explained through attitudinal factors, specifically the value placed on the leftover food the individual is consuming.

Employing VBN theory allowed us to better understand why consumers are impacted by attitudinal factors, external and contextual forces, personal capabilities, and habit or routine. This allowed us to understand how these factors promote behaviours leading to food wastage. While consumers might have an interest in reducing domestic waste, external or contextual factors can prevent them from pursuing that initiative and therefore, confirms the findings of Vermeir and Verbeke (2006) suggesting attitudes and interest do not denote behaviour. Figure 4 shows a visual representation of the identified causal factors promoting those behaviours resulting in expired domestic food waste and a synopsis of our discussion. The figure depicts a four stage process that food follows post-purchase and shows where the factors are likely to promote behaviours.

CONCLUSION

Our study investigated and sought to better understand the causes of consumer behaviours that result in expired domestic food wastage through the lens of the VBN theory. We identified three core causal factors: (i) food supply knowledge; (ii) food location knowledge; (iii) food literacy. The analysis of our data assisted us in proposing opportunities to influence consumer behaviours and avenues for future research. This included examples such as: (i) mechanisms to support consumer learning regarding food literacy and personal capabilities through sharing of recipes and cooking experiences; (ii) interventions assisting systemic storage practices in household fridges to help consumers identify the location of food; (iii) providing real-time information of current food stocks during food purchasing to reduce food stockpiling. We argued VBN theory was useful for our study to help us determine and explain the impact of consumer behaviour regarding food and wastage. Through the analysis of our findings, we were able to segment the factors we identified into the four considerations noted by the VBN theory: (i) attitudinal factors; (ii) external and contextual forces; (iii) personal capabilities; (iv) routine or habit. Understanding these factors paves the way for future research targeting their mitigation or reducing their influence on behaviours. The experimental research design we used for our study can be applied to future interventions targeting behaviour change to reduce domestic food wastage.

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#	Participant Description	Shopping Habits	Living Arrangements	Food Waste Production
C1	22 year old female actress	One large shop a week	Shared household	One or two vegetables a week
C2	40 year old professional male	Several small shops through the week	Family household (including a partner and child)	A 5L bin's worth a week
C3	30 year old professional female	One small shop a week	Shared household	A 5L bin's worth a week
C4	77 year old female pensioner	Make regular shops per week	Three bedroom house - live alone	One or two vegetables a month
C5	26 year old professional male	Per meal shopping (several small top up shops a week)	Family household – live with parents	One or two items a week
C6	19 year old male university student	As-needed shopping	Unit - live with sister	No items
C7	29 year old female student nurse	Once a week large shop with several small shops throughout the week	Couple household	A 5L bin's worth a week.
C8	28 year old male PhD student, sessional academic	Once a week large shop with several small shops throughout the week	Couple household	A 5L bin's worth a week.
C9	37 year old female professional	Several small shops through the week	Family household (including a partner and child)	A 5L bin's worth a week
C10	31 year old female PhD student	Per meal shopping (several small top up shops a week)	Couple household	One or two vegetables a month
C11	28 year old male professional	Per meal shopping (several small top up shops a week)	Couple household	One or two vegetables a month
C12	41 year old female PhD student	One large shop a week, two small shops a fortnight	Family household	Several vegetables a week

Table 1. A description of the similarities and differences between DC1 participants.

#	Household Type	Living Arrangements	Number of Occupants in Household	Shopping Habits	Household Income
H1	House	Family household	Three (including a child)	One big shop a week, with one or two small top up shops	>$200,000pa
H2	House	Family household	Three (including a dependant adult)	One big shop a week	>$200,000pa
H3	Apartment	Couple household	Two	One big shop at the markets a week, with several small top ups	$80,000pa
H4	Unit	Shared household	Three (a couple and a house mate)	Several small shops a week	>$150,000pa
H5	Apartment	Couple	Two	One moderate shop a week,	$80,000pa

		household		with several small top ups	
H6	House	Shared household	Four	Two small shops a week	>$100,000pa

Table 2. A description of defining characteristics of each DC2 household.