THE UNIVERSITY
of EDINBURGH

Date labelling and the waste of dairy products by consumers

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Thesis submitted for the degree of

Doctor of Philosophy

University of Edinburgh

School of Geosciences

2018

Abstract

The objective of this thesis is to advance our understanding of how consumers use date labels and the implications of date-label use for household dairy product waste. It does this by investigating the effect of psychological, social, and contextual factors on date-label use and willingness to consume dairy products in relation to the expiry date. These effects are tested using structural equation models and survey data gathered from 548 Scottish consumers.

The results of this study make two contributions to the literature on date-labelling and food waste. The first contribution is primarily theoretical. By improving our understanding of how consumers use date labels and the implications of date-label use for household dairy product waste, it supports the contention that food waste is best understood, not as a behaviour, but as the outcome of multiple behaviours. It argues that in order to understand why food waste is created, it is important to identify the factors that affect the individual behaviours that lead to it, such as date-label use, and how these behaviours relate to one another. These results also have implications for communications and campaigning around food waste reduction.

The second contribution has policy relevance. It provides evidence of the likely limited effect of increasing the number of dairy products labelled with a best-before date rather than a use-by date on food waste. This is an approach recently proposed to reduce household food waste. It finds that better knowledge of the best-before date is associated with a higher willingness to consume products after the best-before date has passed. However, perceived risks about consuming products beyond their best-before date, including not just safety but quality, freshness, and social acceptability, appear to interact with date-label knowledge and dampen its influence. It argues that to be effective, any changes in date-labelling should be accompanied by communication that goes beyond improving date-label knowledge, and addresses the multifaceted nature of related risk perceptions and conceptions of date-label trust.

Lay summary

One third of all food produced globally is lost or wasted. To address this, the EU aims to reduce its food waste by 30 per cent by 2025 compared to 2014 levels. In order to achieve this aim, household food waste across the EU will need to be reduced, since this is currently where the greatest volume of food waste is found. In the UK, household food waste decreased between 2007 and 2012, but the latest data indicates that progress may have stalled as household food waste in the UK remained fairly constant between 2012 and 2015. To date a large number of initiatives to reduce household food waste have focussed on raising awareness of the food waste problem. However, there is limited evidence that these campaigns have been effective in reducing food waste. More recently there have been proposals to streamline date labelling to reduce confusion about the meaning of dates and encourage manufacturers to evaluate whether their products could have a best-before rather than a use-by date. Dairy products are one product category where this is already being tried.

The objective of this thesis is to advance our understanding of how consumers use date labels and the implications of date-label use for household dairy product waste. Survey data was gathered from 548 Scottish consumers was analysed using statistical models. These models examined the psychological and social factors that influence our use of date labels while shopping and in our homes. They also tested how different types of date labels, as well as our knowledge, risk perceptions and trust, affect our willingness to consume dairy products in relation to their expiry date.

The results suggest that it is unlikely that labelling with products with a best-before (rather than a use-by) date, where it is appropriate to do so, will help to reduce food waste. Respondents to the survey who knew it was safe to eat products after the best-before dates were more willing do so. However, when social and psychological risk factors were also considered, this relationship was weakened. The results also suggest that checking date labels in shops is an action that we can all take to minimise the number of products we throw away because the expiry date has passed.

Acknowledgements

I would like to thank my supervisors Luiza Toma, Andrew Barnes, Cesar Revoredo-Giha, Marc Metzger, and Ron Wilson for their guidance. In particular I would like to express my gratitude to my main supervisor Luiza who listened to my rambles, gave me great encouragement, and has given me opportunities to expand my horizons with interesting work alongside my PhD.

I would also like to thank my colleagues at SRUC, in particular those in the Land Economy research group, who have made the last few years less lonely and more pleasurable. They have provided many laughs and much reassurance, as well as practical administrative support. It is a collegial research community that I am happy to be working in for a few more years!

I would like to thank my friends and family for all of their love and understanding. In particular to my parents for my daily decompression phone calls and not asking too often how it's going. My lovely Labrador, Denman, has also provided much emotional support!

Finally and most importantly, I thank my husband Rob, who makes everything possible.

Declaration of originality

I declare that the thesis has been composed by me and that the work has not been submitted for any other degree or professional qualification. I confirm that the work submitted is my own, except where work which has formed part of jointly-authored publications has been included. My contribution and those of the other authors to this work have been explicitly indicated below. I confirm that appropriate credit has been given within this thesis where reference has been made to the work of others.

Parts of the work presented in Chapters 1, 2, 6, and 7 has been published in Waste Management as "The effect of date labels on willingness to consume dairy products: Implications for food waste reduction" by Bethan Thompson (me), Luiza Toma, Andrew P. Barnes, Cesar Revoredo-Giha (supervisors). The study was conceived by me, the data was collected and analysed by me, and I was the lead author of the paper. As co-authors my supervisors provided guidance during survey development and data analysis. They also provided feedback on the manuscript before submission. A copy of the published manuscript can be found in Appendix 1.

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1   Introduction

1.1   The food waste context

One third of all food produced globally is lost or wasted (Gustavsson et al. 2011). The EU estimated that its members lost or wasted 88 million tonnes of food in 2012, equivalent to 20 per cent of the food it produced (Stenmarck et al. 2016). In response to this evidence a number of food waste reduction targets have been set. One of the targets, within UN Sustainable Development Goal 12.3, is to "halve per capita global food waste at the retail and consumer level, and reduce food losses along production and supply chains by 2030" (United Nations General Assembly 2015, pp. 22). To contribute towards this goal the EU has stated that they aim to achieve a 30 per cent reduction on 2014 levels by 2025 (European Commission 2014). Scotland has established a 33 per cent reduction by 2025, compared to a 2013 baseline (Zero Waste Scotland 2016). All of these targets exclude reductions in pre-farm gate waste and may exclude certain material flows along the supply chain, depending on the definition of food waste used. However, they all include food that is wasted by consumers.

In higher income countries, such as EU member states, it is consumer and particularly household food waste that has received the greatest attention. This is for three reasons. First, households have been found to generate the greatest volume of food waste relative to other stages of the food supply chain (Gustavsson et al. 2011): the EU estimates that 53 per cent of its food waste is produced by households (Stenmarck et al. 2016). Second, while the majority of environmental impacts of food occur during the production phase (FAO 2013), the environmental impacts of food waste add up along the food supply chain as it is transported, processed, and packed (Priefer et al. 2016; Beretta et al. 2013; Beretta et al. 2017). As a result, household food waste is seen to embody slightly larger environmental impacts than food wasted in primary production, processing or retail. Third, there is a moral dimension with the juxtaposition of households in higher income countries throwing away large quantities of food while 815 million people are undernourished (FAO 2017). As a consequence, food waste is often presented as a "missed opportunity to reduce food

insecurity" (FAO 2013 p. 8) even though the mechanisms linking food waste and undernourishment are poorly understood.

1.2   Understanding household food waste

In the context of these national and cross-national targets to reduce the quantity of food wasted by households in higher income countries, there is a growing body of research on the causes and determinants of household food waste (van Geffen et al. 2016). To date there have been broadly two approaches to modelling food-waste behaviour within the food waste literature. Studies taking the first approach have typically focussed on the socio-psychological determinants of the quantity of food waste generated. They have treated the quantity of food waste generated by a household (Russell et al. 2017; Stancu et al. 2016; Stefan et al. 2013; Visschers et al. 2016) or the quantity by which food waste is reduced over a given period (Graham-Rowe et al. 2015) as a behaviour to be explained. Studies taking the second approach have focussed on engagement in behaviours associated with the creation of household food waste (Quested et al. 2013; Block et al. 2016), alongside broader drivers (van Geffen et al. 2016). They conceptualise food waste as an outcome of multiple inter-related behaviours, where each behaviour has its own determinants, some of which might be shared (Quested et al. 2013).

Studies taking the first approach have frequently applied a version of the Theory of Planned Behaviour (TPB) (Ajzen 1991). The TPB is based on the earlier Theory of Reasoned Action (Fishbein, Ajzen 1980). It hypothesises that behaviour is determined jointly by intentions, representing an individual's motivation to engage in the behaviour, and ability to engage in the behaviour, or more specifically their perceived ability, represented by the concept of perceived behavioural control (PBC) (Ajzen 1991). Intentions is itself hypothesised to be influenced by PBC, attitudes towards engaging in the behaviour under study, and subjective norms which "refers to a person's perception that important others desire the performance or non-performance of a specific behaviour" (Fishbein, Ajzen 1980 p. 57).

The results of these studies (Graham-Rowe et al. 2015; Russell et al. 2017; Stancu et al. 2016; Stefan et al. 2013; Visschers et al. 2016) have provided useful insights into attitudes, social norms, and PBC over the quantity of food waste generated in households. They have also provided some evidence that the quantity of food waste generated by a household is under a degree of volitional control. Intentions not to waste food in all these studies are associated with lower (self-reported) food waste. However, the approach taken is problematic on a number of fronts.

First, Fishbein and Ajzen (2015) have argued that outcomes, such as weight loss (or in this case food waste) are the consequence of multiple behaviours and potentially extraneous factors. While the TPB can be applied to understand general categories of behaviour, it was designed with single behaviours in mind. Second, similar approaches have been criticised in the environmental behaviour literature for providing a limited understanding of which behaviours contribute to environmental outcomes (Steg, Vlek 2009). Since the behaviour of interest is measured using the quantity of food waste, it is not clear what exactly people did between expressing intentions not to waste food and actually wasting food (or not). Third, and relatedly, measuring behaviour with the quantity of food waste has been criticised for poorly conceptualising the process by which food waste is generated. Those studies taking the second approach (Quested et al. 2013; van Geffen et al. 2016; Block et al. 2016) have argued that food waste is the outcome of multiple inter-related behaviours and while socio-psychological determinants play a role, the overall model is likely to be more complex. Recent studies have highlighted the importance of understanding links between food waste associated behaviours and food waste outcomes (Setti et al. 2018).

The first contribution of this thesis to the food waste literature is theoretical. It uses the TPB to investigate the determinants of a subset of food waste associated behaviours. Little research has been conducted on the drivers of food waste associated behaviours. Such research is needed to increase the depth of our understanding and produce insights with greater practical application (Aschemann-Witzel et al. 2015). The subset of behaviours chosen for this study relate to date labels, since there is evidence that date-label use is

highly correlated with overall food-waste levels (Quested, Luzecka 2014; WRAP 2013; Toma et al. 2017). The behaviours chosen correspond to three stages of the food management model outlined by van Geffen et al. (2016): checking dates in shops (provisioning), checking dates at home (storing), and using the date label to choose whether to consume or dispose of a product (consuming).

Dairy products are used as a case study. In the UK dairy products represent about 10 per cent of avoidable household food waste (WRAP 2013). Equivalent estimates on the proportion of dairy products as avoidable food waste are not available for the EU as a whole, although Gustavsson et al. (2011) estimated that 7 per cent of dairy products were wasted by consumers in the wider Europe region. By tonne of product wasted in the UK, 54 per cent of milk, 78 per cent of yoghurt and 79 per cent of cheese are reportedly wasted because they pass their expiry date as opposed to other reasons such as too much being served (WRAP 2013). Furthermore, most yoghurts that are thrown away are unopened (WRAP 2010). For dairy products in general, it has been suggested that date labels are important in making disposal decisions and determining edibility (WRAP 2015). The first research question is therefore:

Research Question 1: To what extent does the TPB explain the date-label use in different contexts?

As an extension to Research Question 1 it is also interesting to consider how these behaviours are related and whether upstream date-label use (checking dates in shops and checking dates at home) increases or decreases the likelihood of individuals throwing away products because the date-label has passed.

Research Question 2: How are date-label behaviours related to one another? Are consumers who regularly check the date labels of products in the supermarket and at home less likely to report throwing away products because the date has passed?

1.2.1   Extending the TPB: generalised attitudes towards food waste and habit

There is debate in the environmental behaviour literature as to whether generalised pro-environmental attitudes have an impact on behaviours that contribute to pro-environmental outcomes. Some studies suggest that generalised pro-environmental attitudes have limited impact on pro-environmental behaviour. For example, Kollmuss and Agyeman found that, "comparing attitudes towards climate change and driving behaviour usually shows no correlation" (2002 p. 242). Other studies suggest that the effect of pro-environmental attitudes on behaviour depends on the behavioural domain (Barr et al. 2011), with pro-environmental attitudes being more influential on behaviour within the household than travel behaviour (Alcock et al. 2017; Barr 2007).

According to the TPB a clear distinction needs to be made between attitudes towards engaging in a defined behaviour and general attitudes which may be towards the target of, or one of the possible outcomes of, engaging in that defined behaviour (Fishbein, Ajzen 2015). This distinction between attitudes towards engaging in a defined behaviour versus general attitudes towards outcomes has been identified in other behavioural theories, such as Stern's (2000) Value Belief Norm theory, which distinguishes between attitudes that create predisposition to pro-environmental outcomes and those that are behaviour specific. According to Fishbein and Ajzen's (2015) principle of compatibility, general attitudes should not be expected to be strong direct predictors of specific behaviours, but like other background variables (e.g. socio-economic factors) might have some indirect influence on intentions and behaviour. The question as to the strength of the relationship between general food waste attitudes and food waste minimising behaviours is interesting not just from a theoretical but from a practical standpoint. A key component of many food waste reduction campaigns has been providing information to raise awareness of the food waste issue and change attitudes towards food waste (Shanes et al. 2018; Hill 2014). However, it is not clear how changing attitudes towards food waste is likely to affect behaviours contributing to food waste.

The third research question therefore asks:

Research Question 3: To what extent are attitudes towards food waste associated with engagement in date-label behaviours?

One of the alternative socio-psychological models to the TPB is the theory of interpersonal behaviour (Triandis 1977). An important difference between the TPB and the theory of interpersonal behaviour is that the latter incorporates the role of habit. Quested et al. (2013) argue that food waste associated behaviours are likely to be habitual since they are repeated frequently, often multiple times a day, making them more difficult to change. The only food-waste study so far found to have investigated the influence of habit is Russell et al. (2017) who found that past food waste outcomes were a significant predictor of current food waste outcomes. This study seeks to build on these findings by focussing on a specific behaviour rather than food waste outcomes, but also by considering habit as more than just the frequency of past behaviour. It uses an index of self-reported habit strength, developed by Verplanken and Orbell (2003), which considers aspects of identity and automaticity in additional to frequency. The fourth research question is therefore:

Research Question 4 asked: *To what extent is habit associated with date-label use?*

1.3   Initiatives to reduce food waste

As described above, a large number of initiatives to reduce consumer food waste have focussed on information provision and awareness raising (Shanes et al. 2018; Hill 2014). There is limited evidence of the effectiveness of initiatives such as WRAP's Love Food Hate Waste campaign (WRAP 2014). Household food waste did decrease in the UK between 2007 and 2012, but the latest data indicates that progress may have stalled as household food waste in the UK remained fairly constant between 2012 and 2015 (WRAP 2017d). Analysis of the initial reduction between 2007 and 2012 suggests some of it can be attributed to activity by WRAP, but some could have been due to price increases over that period (WRAP 2014).

With limited evidence of the effectiveness of approaches designed to change minds, there is also interest in approaches that change the context (Dolan et al. 2012). Other

proposals to address food waste have included streamlining date-label application and encouraging the use of best-before dates where possible (The Consumer Goods Forum 2017; WRAP 2017b). The attraction of such an approach is that it changes the material context within which consumers operate (Darnton, Evans 2013). WRAP (2017b) argue that working with companies to increase the number of products with best-before dates will give "consumers the confidence and option to make use of products after the best-before date" (pp. 9), thereby helping to reduce household food waste. However, at present little is known about how consumers interact with date labels (European Commission 2018) or the importance of motivational factors versus contextual factors in these interactions (Steg, Vlek 2009).

The second contribution of this thesis is therefore relevant to UK and EU policy development on date labelling changes where the objective is food waste reduction. It adds to the existing literature by investigating how consumers interact with date labels at home when making the decision to consume a product. It explores whether willingness to consume (WTC) dairy products varies by date type (best-before or use-by) as well as product type (milk, cheese and yoghurt) and whether the presence of a reduced label affects WTC. It also considers how a number of motivational factors affect WTC, including knowledge, risk perceptions, and trust.

1.3.1 Dairy products and date labels

In the UK dairy products, particularly yoghurt and cheese, have been identified as product categories which are often unnecessarily given a use-by rather than a best-before date (Better Regulation Delivery Office 2011). Date labelling in the UK is currently regulated at the EU level and all food must have either a minimum date of durability (translated as best-before date in the UK) or a use-by date unless they are listed as one of the fresh or highly durable products that are exempt (Regulation (EU) No. 1169/(2011). The minimum date of durability is a measure of food quality, "the date until which the food retains its specific properties" (Regulation (EU) No. 1169/2011; p. 26) whereas the use-by date is a measure of food safety: "food shall be deemed to be unsafe in accordance with Article 14(2)

to (5) of Regulation (EC) No 178/2002" (Regulation (EU) No. 1169/2011; p. 35). It should be noted that food safety is also dependent on compliance with specified storage conditions throughout the supply chain regardless of the date label applied (Newsome et al. 2014).

Determination of whether a product requires a best-before or a use-by date rests with food manufacturers (Department for the Environment, Food, and Rural Affairs (defra) 2011) and there is variation in how these date labels are applied (European Commission 2018). Studies have found that manufacturers of dairy products apply use-by dates for a wider range of reasons than microbiological ones as outlined in the EU regulation, including retailer specification, product quality deterioration, and desire for consistency across a range (Better Regulation Delivery Office 2011; European Commission 2018). Date labelling decisions are not always made on the basis of food safety; they are often the result of a default position (WRAP 2017b). While the decision as to whether a product requires a best-before or use-by date may have fine margins (Department for the Environment, Food, and Rural Affairs (Defra) 2011), recent work by the dairy industry on hard cheese has highlighted the opportunity for change: the number of products labelled with best-before dates increased from 75 per cent of products sold in the UK in 2009 to 97 per cent in 2015 (WRAP 2017b).

Evidence of the role of date labels across the whole of the EU is not available at present (European Commission 2018) although household food waste studies from Member States indicate that date labels play an important role in the waste of dairy products, and that misconception of the best-before date as an indicator of food safety is an issue. For example, a summary of studies from the Netherlands found that 26 per cent of household food waste was from dairy products and that around 61 per cent of people gave passing the best-before date as the reason for disposal (Netherlands Nutrition Centre 2014). A summary of studies from across the Nordic countries found that lack of date label understanding contributed to food waste, and in particular that products labelled with a best-before such as yoghurt and sour cream were most frequently reported as being thrown away because the expiry date had passed (Møller et al. 2014). The fifth research question is therefore:

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Research Question 5: How do date type, product type and presence of a reduced label affect consumers' WTC dairy products in relation to the expiry date?

1.3.2 Different types of knowledge and their influence on date label use

The overall influence of knowledge on behaviour, and the mechanism through which they are related, is heavily debated (Kollmuss, Agyeman 2002). There is some specific evidence for the influence of date label knowledge on date label use and food waste but the results are mixed (Broad Leib et al. 2016; van Boxstael et al. 2014; Toma et al. 2017; TNS European Behaviour Studies Consortium 2014; Visschers et al. 2016). In the context of being willing to consume a dairy product beyond its best-before date, it seems clear that knowledge of the meaning of best-before versus use-by dates is a necessary but by no means a sufficient condition. In addition to observing whether there are differences in WTC for the same product type with different date labels, it is also of interest to try to understand which factors facilitate or impede the translation of knowledge about the meaning of date labels into greater WTC dairy products beyond their best-before date.

One approach taken to explain the knowledge behaviour gap in the environmental and food-labelling literature is the idea that there are different types of knowledge which mediate the relationship between factual knowledge and behaviour. Procedural knowledge, knowledge of how to use and apply factual knowledge, and effectiveness knowledge, knowledge that a particular action is effective in achieving an outcome, are two types of knowledge that have been identified as important in relation to pro-environmental behaviours (Worsley 2002; Kaiser, Fuhrer 2003; Frick et al. 2004; Shi et al. 2016). Subjective knowledge, one's own perceived knowledge, has also been found to be important in making pro-environmental decisions relating to food consumption (Peschel et al. 2016). The sixth research question is therefore:

Research Question 6: To what extent are different types of knowledge (procedural, effectiveness and subjective knowledge) associated with factual knowledge and willingness to consume dairy products in relation to the best-before date?

1.3.3   Risk perceptions and trust in date-label use

The final contribution of this thesis is to investigate the motivational factors associated with consumers' WTC dairy products in relation to the best-before date, using yoghurt and cheese as examples. It explores how, in addition to knowledge of the best-before date, consumers' perception of food-related risk, and trust in date labels is associated with their WTC yoghurt in relation to its best-before date. These factors were chosen because the wider literature on food labels and food-safety information highlight the importance of perceived risk, trust in information and labels, as well as food system actors (Frewer et al. 1996; Hobbs, Goddard 2015; Lobb et al. 2007; Tonkin et al. 2016a; Tonkin et al. 2016b). The findings will contribute to building the evidence base on consumer engagement with date labels and their relationship with food-waste reduction (European Commission, 2018). The final research question is therefore:

Research Question 7: to what extent do consumers' risk perceptions and trust influence WTC dairy products in relation to the best-before date, and how do these interact with date-label knowledge?

1.4   Structure of thesis

This thesis consists of eight chapters outlined in Figure 1.1. This first chapter has contextualised the thesis and described its contribution to the food-waste literature. Chapter 2 summarises the relevant literature and provides further background to the research questions that were developed here. Chapter 3 is a methodological chapter. It presents results of focus groups conducted in order to test concepts from the literature review and create the basis for designing a survey. It also describes the survey data collection and the methods used for data analysis throughout results Chapters 4, 5, 6, and 7. Chapters 4, 5, 6 and 7 test hypotheses relating to the seven research questions outlined here. Chapters 4 and 5 test research questions 1, 2, 3, and 4. Chapter 4 uses the TPB (Ajzen 1991) to understand the use of date labels at three different stages of the food management lifecycle as described by van Geffen et al. (2016): in the shops (provisioning), checking dates at

home (storing), and choosing whether to consume or dispose of a product (consuming). Chapter 5 extends the TPB model to include food waste attitudes, the role of habit, and finally tests inter-relationships between the three behaviours. Chapters 6 and 7 address research questions 5, 6, and 7. The hypotheses and models tested in these two chapters draw on the food marketing, labelling, food safety, and behavioural economics literature. While Chapters 6 and 7 test different models they both use WTC dairy products in relation to the best-before date as their dependent variable. The inter-relationships between these chapters are represented by the dotted line in Figure 1.1. Chapter 7 further develops insights into the relationship between risk perception and knowledge identified in Chapter 6. The final chapter reviews the results of this thesis in relation to its research questions. It discusses its limitations as well as avenues for future research.
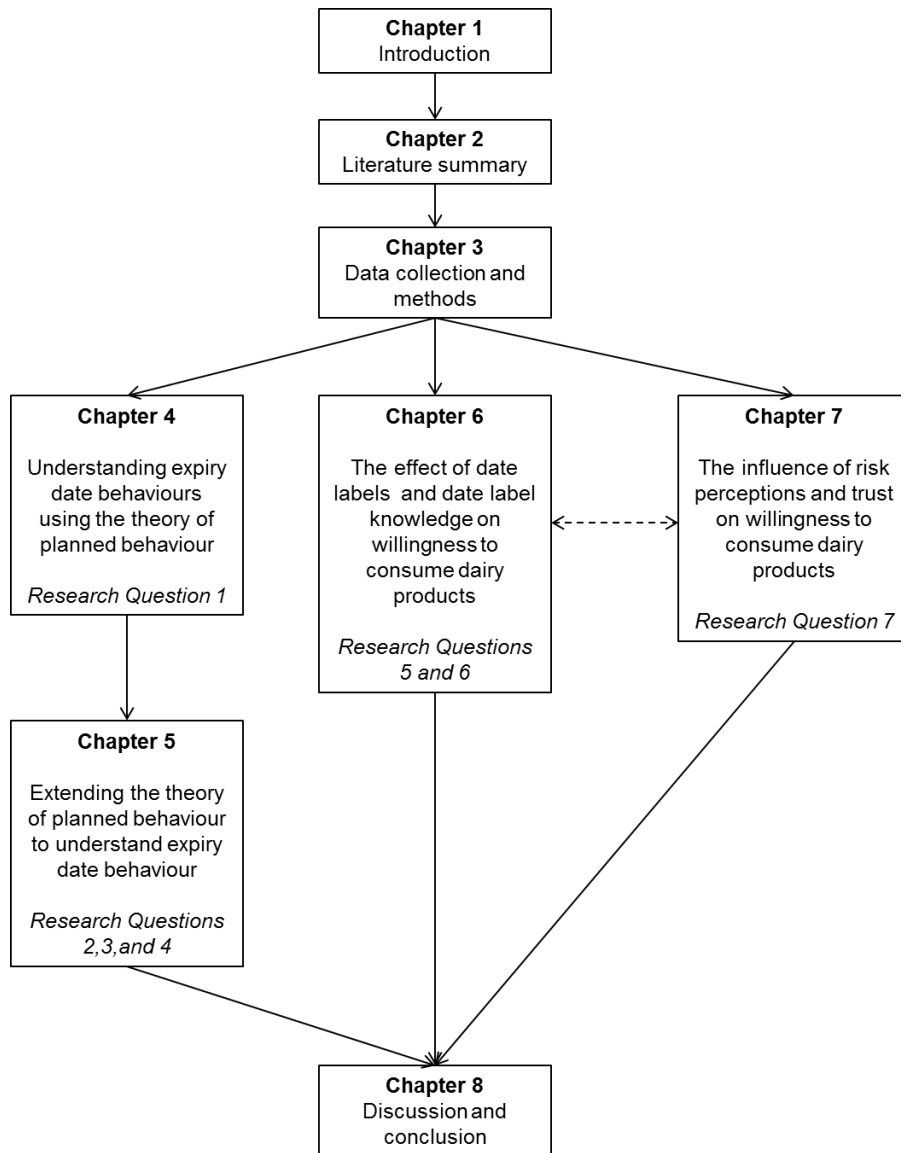
Figure 1.1 Thesis structure

2 Literature review

2.1 Overview

The objective of this review is to provide an in-depth analysis of studies which have been conducted on household food waste to date. It summarises current understanding of the factors which affect household food waste and in particular highlights the gaps in the literature that led to the development of the research questions described in Chapter 1. As described in section 1.2 there have been broadly two approaches to understanding household food waste. The first part of this review summarises the findings of those primary research studies which have taken the first approach and modelled the quantity of food waste generated by households within socio-psychological frameworks, particularly the TPB (Ajzen 1991). The second part discusses those studies which have taken the second approach and modelled food waste as the outcome of multiple-inter related behaviours. This includes a review of a number of secondary analyses, some of which have developed theoretical models for understanding food waste. Together these sections provide insights into the gaps and questions in the literature that generated research questions 1, 2, 3, and 4. As described in section 1.3, there is a growing interest in approaches to behaviour change that alter the behavioural context, such as the effect of date labels on date-label use, and how motivational and contextual factors interact. The third part of this review summarises the findings of those studies that have considered date label use and food waste. The fourth and fifth parts consider how the motivational factors and abilities that may affect date label use. These sections draw on the wider food labelling, food marketing, and food risk literatures and provide further insight into the development of research questions 5, 6, and 7.

2.2 Quantity of food wasted as a behaviour

Studies which have treated the quantity of food wasted, or the quantity by which food waste is reduced over a given period, as a behaviour include Russell et al. (2017), Stancu et al. (2016), Stefan et al. (2013), Visschers et al. (2016), and Graham-Rowe et al. (2015). Four of these (Russell et al. 2017; Stancu et al. 2016; Stefan et al. 2013; Visschers et al. 2016)

modelled the quantity of food waste as the behaviour of interest, while Graham-Rowe et al. (2015) used the quantity by which food waste was reduced (specifically fruit and vegetables). These studies which have all applied the TPB (Ajzen 1991), albeit with extensions, as the framework through which to understand food waste in households.

If we accept that measuring intentions and behaviour within the same survey is valid, then the balance of the results across these studies support the argument that there is an element of volitional control over the quantity of food waste households produce. Those who intended to minimise or reduce their food waste were found, on the whole, to report lower food waste. The only study that did not find a significant relationship between intentions and behaviour was Stefan et al. (2013). As Graham-Rowe et al. (2015) and Visschers et al. (2016) pointed out, this could be a consequence of the way in which planning and shopping routines were incorporated into Stefan et al.'s (2013) model. While Stefan et al.'s (2013) study can be criticised for not strictly following the TPB, their results give insight into the mechanisms by which food waste is generated. One could interpret that if household routines are not aligned with waste minimisation then they can usurp any intentions to minimise food waste. Notably Stancu et al. (2016) (same author different name) also regressed routines onto food waste but this time kept the TPB antecedents and routines separated. In this configuration the relationship between intentions and behaviour was significant and the introduction of routines slightly increased the amount of variance in household food waste explained by the model. However, what is lost between Stefan et al. (2013) and Stancu et al. (2016) is the idea that routines are frequently repeated behaviours (Darnton et al. 2011) which have their own antecedents, some of which may be shared. A stronger understanding of what drives engagement in those routines or behaviours is important.

All of the studies described above used the TPB as their basis, but all included additional variables and some made adaptations to even the core TPB variables: Visschers et al. (2016) had separate personal and financial attitudes and Stefan et al. (2013) included moral rather than subjective or injunctive norms. In terms of the variables that were associated with

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stronger intentions not to waste food, Graham-Rowe et al. (2015) found all three TPB variables (attitudes, subjective norms and PBC) to be significant. Table 2.1 summarises these relationships. Grahame-Rowe et al. (2015) additionally used variables measuring self-identify, anticipated regret and descriptive norms as these were key themes identified in their earlier qualitative study (Grahame-Rowe et al. 2014). They found both self-identity and anticipated regret were significant in their association with stronger intentions not to waste food but descriptive norms were not. Visschers et al. (2016) measured personal and financial attitudes separately and found that both had a significant relationship with intentions. In terms of the other TPB antecedents, PBC but not subjective norms also had a significant relationship with intentions. Visschers et al. (2016) also included personal norms, perceived health risks, food-storage knowledge, and date-label knowledge as additional variables. Both perceived health risks and personal norms were found to be significant, but food-storage knowledge and date-label knowledge were not. The questions used to measure the additional concepts used by both Graham-Rowe et al. (2015) and Visschers et al. (2016) appear to overlap significantly. Due to the statistical methods used (i.e. not factor analysis) it is not possible to see whether this is true empirically. However, it would be useful to know whether the concepts of personal norms and personal attitudes are really distinct.

Table 2.1 Summary of TPB antecedents and their relationship with intentions in previous food waste studies

Study	Attitudes	Subjective/ Injunctive Norms	PBC
Graham-Rowe et al. (2015)	Y	Y	Y
Visschers et al. (2016)	Y**	N	N
Stancu (2016)	Y	Y	N*
Stefan et al. (2013)	Y**	N	N
Russell et al. (2017)	N	Y	Y

Note * means that the variable had a significant direct relationship with behaviour rather than intentions
Note ** means that variable was significant but did not strictly adhere to TPB standard for variable is discussed in more detail in the main text.

In terms of the relationships between TPB antecedents and intentions in the remaining studies, Stancu et al. (2016) found that attitudes and injunctive norms had a significant relationship with intentions whereas PBC did not, though PBC did have a direct and

significant relationship with food waste. Stancu et al. (2016) also included moral norms in addition to injunctive norms but did not find this had a significant relationship with intentions. Stefan et al. (2013) found that only moral attitudes had a significant relationship with intentions; neither subjective norms nor PBC were significant. Stefan et al. (2013) also included lack of concern as an additional variable. This measured the level of concern respondents had for both the environment and their levels of food waste, but was not a significant predictor of intentions. In contrast to Visschers et al. (2016) due to the methods used it is possible to see that lack of concern was distinct from moral attitudes.

As discussed above, Stefan et al. (2013) tested whether these antecedents had relationships with both intentions not to waste food and planning and shopping routines. Those antecedents with an attitudinal slant (moral attitudes and lack of concern) had stronger relationships with intentions than routines, and PBC only had significant relationships with routines. This also provides useful insights into the mechanisms creating household food waste. We see that attitudes seem to matter in determining intentions, but intentions were ultimately not a driver of food waste outcomes for the households in this study. On the other hand, attitudes towards food waste and lack of concern had weaker (or insignificant) relationship with routines, but these routines had stronger relationships with household food waste outcomes.

Stefan et al.'s (2013) identification of weaker relationships between general attitudinal variables and more specific routines supports the line of argumentation set out in section 1.3. This is that general attitudes towards outcomes of behaviours are not expected to be good predictors of specific behaviours (Fishbein, Ajzen 2015), but that there is some evidence from the environmental behaviour literature that pro-environmental attitudes have a stronger influence in some behavioural categories than others (Barr et al. 2011). Other than the results of Stefan et al. (2013), only Diaz-Ruiz et al. (2018) was found to have tested the relationship between general attitudes and specific behaviours in a model relating to food waste. Diaz-Ruiz et al. (2018) found that respondents with stronger pro-environmental attitudes were more likely to engage in waste prevention behaviours. Although the

prevention behaviours were not specifically food waste prevention behaviours but waste and reuse behaviours more generally, such as purchasing reusable products, it is still interesting to see how general attitudes may in some circumstances have an influence on some types of behaviour.

Sociological food waste research has highlighted some of the reasons why the relationship between generalised food-waste attitudes and behaviour associated with minimising or reducing food waste may be weak. Evans (2011, 2012) found negative attitudes towards food waste in their participants but also found pressures from families to provide different food every day, which made serving leftovers difficult. Watson and Meah (2012) found that participants in their study expressed negative attitudes towards food waste overall, but did not necessarily view using leftovers positively because of concerns about food safety. This research has emphasised the extent to which household food waste can be considered the consequence of everyday household practices and the complexities involved in their coordination with competing priorities (Evans 2012, 2011; Watson, Meah 2012). It is therefore interesting to consider what influence attitudes towards food waste may have on date label related behaviours given competing concerns that may also be present about food safety.

The most recent study to have used the TPB (Ajzen 1991) extended with variables from the theory of interpersonal behaviour (Triandis 1977) is Russell et al. (2017). Russell et al. (2017) found that subjective norms and PBC had significant relationships with intentions but not attitudes. As additional variables they included negative emotions as a predictor of intentions and food waste, and habit as a predictor of food waste. All of these relationships were found to be significant. They found that habit had a strong, direct influence on behaviour and going by the coefficient relating intentions to behaviours, the relationship between habit and behaviour was stronger than between intentions and behaviour.

As highlighted in section 1.3, Quested et al. (2013) following Darnton et al. (2011) argue that food waste behaviours are likely to have a strong habitual element because of their frequency and automaticity. Russell et al. (2017) measured habit using past food waste

behaviour, combining the self-reported quantity of food waste created in the previous week with a generalised measure of frequency, i.e. how often food was wasted in their household. They found that the more frequently respondents reported wasting food in the past, measured at the first stage of their survey, the greater the quantity of food waste they were likely to report in the final stage of their survey. As previously discussed, as the outcome of food waste is not strictly a behaviour it is hard to understand how an outcome can be habitual. Even if we accept the idea that an outcome can be habitual, what is also missing from Russell et al.'s (2017) measure is an element of automaticity. The question of how to measure the extent to which a behaviour has become habitual has been debated (Verplanken, Aarts 1999): behavioural frequency is not thought to adequately capture what it takes for something to become a habit (Verbeke, Vackier 2005) since it does not incorporate some of the defining components of habits such as their cue contingency (Gardner et al. 2011), but there are other measures of habit such as Verplanken and Orbell's (2003) self-reported habit index which do. It is therefore of interest to see whether habit, when measured in a more nuanced way, still has a strong relationship to behaviour.

As an aside before moving on to the next section, a recent study that has moved away from using a quantity of food waste as the behaviour of interest is Mondéjar-Jiménez et al. (2016). This study used a composite measure of three positive food-waste behaviours (i.e. those associated with lower household food waste) as their dependent variable, rather than the quantity of food wasted. They found that intentions not to waste food were a significant predictor of behaviour, and that the TPB variables of attitudes, subjective norms, and PBC were significantly associated with intentions. From a statistical perspective the model was a good fit and the item measures for each latent construct were valid. However, from a logical perspective there are some questions about the consistency of latent variables. For example, one item in subjective norms asked about waste separation but neither the intentions nor behaviour latent variables contain equivalent items; date-label knowledge was also contained within their latent variable for behaviour. Mondéjar-Jiménez et al. (2016) emphasise that their study is exploratory and there is therefore opportunity for further development of their latent variables, however their composite behaviour approach certainly

addresses one of the challenges laid at the door of the other studies described in this section by using something akin to behavioural categories (Fishbein, Ajzen 2015).

2.3   Food waste as the outcome of multiple inter-related behaviours

This second section of the review discusses those studies which have taken the second approach and modelled food waste as the outcome of multiple inter-related behaviours. The first sub-section briefly summarises a number of studies that are exploratory in nature. These do not apply a particular theoretical framework but explore a range of factors identified from the literature. The second sub-section considers the results of a number of secondary analysis, particularly those that have developed theoretical models for understanding household food waste. Here we see a growing consensus in the literature for understanding food waste as the outcome of multiple inter-related behaviours, but as yet few empirical studies that have tested the models outlined.

2.3.1   Exploratory studies

In terms of quantitative exploratory studies both Secondi et al. (2015) and Principato et al. (2015) found that a greater level of concern about food waste was associated with lower self-reported food waste. Neither study is clear about how their variables are measured. For example, Secondi et al. (2015) links sorting recyclables to a commitment to waste reduction and efficient use of resources rather than waste prevention. Principato (2015) also considered prioritisation of food freshness and found that respondents for whom this was important were more likely to report higher food waste levels. This finding is supported by Neff (2015) who also found that one of the most common reasons given for discarding food were concerns about foodborne illness and a desire to eat only the freshest food. Leading motivations for waste reduction were saving money and setting an example for children, with environmental concerns ranked last. On the other hand (Herath, Felfel 2015) found that consumers who were interested in ethical and moral food attributes were less likely to waste food.

Koivupuro et al. (2012) and Parizeau et al. (2015) focussed on behaviours, some contextual factors and demographic variables. Koivupuro et al. (2012) found that the amount of food wasted was affected by the frequency of buying discounted food products, but also the respondent's own view of the potential to reduce food waste and the respondent's own view of the influence of purchasing food in particular packet sizes. On the other hand shopping, food preparation and eating habits were not found to be significant. Parizeau et al. (2015) found money spent on food, how often respondents reported eating out, and the extent to which they reported eating convenience food all had a significant association with food waste. Mallinson et al. (2016) also found that respondent clusters reporting higher consumption of convenience foods also reported higher food waste. They measured 27 lifestyle factors that they believe influence food waste, ranging from attitudes (e.g. willingness to try new foods) and time availability to kitchen skills. They use a cluster analysis, which means it is difficult to determine the strength of the various influences, but it does highlight some of the common traits that high wasters have in common. They created four clusters: epicures, casual consumers, food detached consumers and kitchen evaders, and find that epicures were the least wasteful and casual consumers the most. The strength of this study is that it highlights the different types of influences on food waste from work patterns and perceived stress to kitchen skills and attitudes. What is less clear, due to the clustering approach, is how these variables interact or the contribution of each factor to food waste.

Sociological research on food waste has emphasised the extent to which food waste is the consequence of everyday household practices (Evans 2011, 2012; Watson and Meah 2012). These also take an inter-related behaviours approach to food waste: Watson and Meah describe food waste as an "inherent part of the complex processes of coordination through which a household is kept well fed" (2012: p.116 - 117). Evans (2011) also highlights these complex interactions between household routines (or habitual behaviours) and how "food waste arises as a consequence of household juggling the complex and contradictory demands of day-to-day living" (p 436). Evans therefore argues that food waste might be best

addressed by changing the material context such as food types and packaging and/or normalising behaviours such as eating frozen foods.

2.3.2 Food waste models using composite behavioural measures and incorporating behaviour inter-relationships

There is a growing body of secondary research on causes and determinants of household food waste (Thyberg, Tonjes 2016; High Level Panel of Experts (HLPE) 2014; Stenmarck et al. 2016; Priefer et al. 2016; Aschemann-Witzel et al. 2015; Aschemann-Witzel et al. 2016; Grainger et al. 2018; van Geffen et al. 2016; Quested et al. 2013; Principato 2018; Shanes et al. 2018). These reviews have emphasised the importance of a variety of factors including: contextual factors, such as the modernisation of the food system (Thyberg, Tonjes 2016) and urban lifestyles (HLPE 2014); distal factors, such as socio-demographics and household composition (Stenmark et al. 2016); motivational factors, such as attitudes, expressions of concern; and finally skills and abilities around food management and cooking (Aschemann-Witzl et al. 2015). They have also tried to identify the most important factors (Grainger et al. 2018) or develop more appropriate theoretical models (van Geffen et al. 2016; Principato 2018).

Grainger et al. (2018) used WRAP data from face-to-face home interviews which has been re-analysed using machine learning techniques as part of the REFRESH[1] project. By not specifying a model a priori, the combination of techniques used identified key drivers of consumer waste including predominantly distal (socio-demographic) factors and some behavioural variables including disposing of food past the expiry date. The variables with the largest effect on food waste in the most parsimonious model were household size (positive effect), home ownership and being retired (negative effects). Grainger et al. (2018) argue for the benefits of their data-driven approach. Based on their findings it is clear that targeted interventions with large households could be beneficial. However, the criticism levelled at

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[1] Resource Efficient Food and dRink for the Entire Supply cHain. REFRESH is funded by the Horizon 2020 Framework Programme of the European Union under grant agreement no. 641933.

modelling food waste outcomes as the behaviour of interest also applies to this finding. It is not clear from their results what those households are doing that lead to higher food waste (Steg, Vlek 2009) or what contextual factors are at play. Parsimonious models such as Grainger et al. (2018) are clearly useful and refreshing after consideration of the wide variety of factors found to be related to food waste across the literature, but theory is also needed to make sense of those findings and develop interventions.

The two reviews that have gone on to develop theoretical models for explaining household food waste also identified some of the shortcomings, described in section 2.2, of the peer-reviewed primary research that uses the quantity of food wasted by a household as the behaviour of interest to be explained (van Geffen et al. 2016; Principato 2018). Instead van Geffen et al. (2016) and Principato (2018) suggest models which build on Quested et al.'s (2013) findings (in turn based on WRAP's primary research) that food waste is the outcome of multiple inter-related behaviours and that the range of factors (described in the paragraph above) influence the performance of some or all of these behaviours, which in turn increase the likelihood that food is wasted. Van Geffen et al. (2016) draw on Rothschild's (1999) framework for their model, which has a similarly broad scope to environmental behavioural models such as Stern's (1999) Value Belief Norm (VBN) model, or Darnton and Evans's Individual, Social, Material (ISM) tool (2013).

As yet there are few studies which have tried to test these types of models empirically. Diaz-Ruiz et al. (2018) and Setti et al. (2018) are two studies which have operationalised ideas similar to those outlined by van Geffen et al. (2016) and Principato (2018). Diaz-Ruiz et al. (2018) considered how waste associated behaviours (prevention and recycling) as well as motivational factors (materialistic values, environmental concern, price importance and diet importance), and purchasing discipline (which has similarities with measurement of habitual behaviour) relate to self-reported food waste. They found that purchasing discipline and prevention behaviours, but not recycling behaviour, had significant effects on food waste. They also found that materialism values were significantly associated with higher reported food waste. Environmental values did not have a direct influence on reported food

waste but they did have an indirect effect as they were mediated by prevention behaviours. Neither diet nor price importance were found to be significant. As with Mondéjar-Jiménez et al. (2016), the authors highlight the exploratory nature of this study. This goes some way to explain why materialistic values are hypothesised to have a direct relationship with food waste quantity, whereas environmental values have an indirect relationship through recycling and prevention behaviours. Nevertheless this study provides useful insights into the potentially complex relationships between food waste, food waste causing behaviours and motivational factors.

Setti et al. (2018) test a more structured model which takes some account of temporal precedence of behaviours across the food management lifecycle. It is also a more complex model where behaviours are associated with hypothesised drivers (primarily distal) as well as the previous and/or subsequent behaviours. While some of their behavioural measures lack clarity, what is clear is that provisioning behaviours right at the beginning of the food management lifecycle have a strong influence on the quantity of food wasted.

Setti et al.'s (2018) findings that behaviours temporally furthest away from the outcome of food waste were the most important contrast with previous research into the relationship between behaviours believed to cause food waste and the quantity of food waste reported by households. Quested and Luzecka (2014) and Toma et al. (2017) both found behaviours close to the end of the food management lifecycle were the most influential. Quested and Luzecka (2014) found the strongest correlations between households reporting using leftovers or throwing fewer items away because of the date label and lower avoidable food waste. Toma et al. (2017) also use survey data on food waste behaviours for Scottish households collected by WRAP. The survey was conducted in eight waves of the Love Food Hate Waste Household Tracker Survey data from Autumn 2012 through to Spring 2016. Toma et al. (2017) found that throwing away food due to the date-label was the behaviour that had the strongest influence on food waste. Use of food leftovers, food shopping habits and shopping frequency, meal planning and freezer use were also influential in some waves, but the effect sizes were smaller. The correlation between throwing fewer items away

because of the date label and food waste could be explained by the fact this is in a sense a sub-category of food waste as well as a behaviour in its own right.

Studies, following Setti's (2018) lead, should take care to identify the different behaviours by the temporal precedence and consider further the relationship between the behaviours and therefore the indirect as well as direct relationship to waste that each behaviour has. As emphasised by Setti et al. (2018), an important difference between models of waste behaviour and other environmental behaviours are the behaviour inter-relationships. It is not just that multiple behaviours lead to food waste, it is that engaging (or not) in each behaviour increases (or decreases) the likelihood of food being wasted. With regard to date-label use we can see how purchasing short-dated items might increase the risk that food is wasted, but can be mitigated by checking dates at home and using them up before the expiry date and/or being willing to consume products (with best-before dates) after the date has passed.

A WRAP (2011a) study touched on the relationships between date label use in different contexts. They conducted a cluster analysis and found one cluster of people who stated they were likely to check dates in shops, choose items with the longest shelf life, and check dates at home, but are unlikely to be willing to eat products past their best. In a second cluster people were much less likely to check dates in shops and at home, but were much happier to eat food past its best. One interpretation of these findings could be that those who check dates in shops and at home are more likely to report throwing away products because they are past their best-before date. However, the WRAP (2011a) study did not measure actual behaviour, only intentions and attitudes. Therefore it is also possible that, while checking dates in shops is associated with a lower likelihood of being willing to eat products past their best, the checking activity means that food is well managed and situations where products have passed their best-before date arise less frequently, ultimately resulting in fewer products being thrown away because the date had passed. Furthermore, the term "past their best" is somewhat ambiguous and therefore not clear about the date-label type or whether

this meant that the expiry date had passed. It seems important to consider the combination of date-label behaviours that consumers engage in across the food management lifecycle.

2.4   Contextual factors: a focus on date labels

The models proposed by van Geffen et al. (2016) and Principato (2018) highlight the importance of contextual factors (although described by van Geffen et al. (2016) as opportunity). To date few empirical food waste studies have assessed the influence of these contextual factors on food waste behaviours or decision making, and fewer have considered the interaction between contextual and motivational factors as well as knowledge, skills or abilities. Food packaging size received some attention and has been found to affect anticipated food waste (Wilson et al. 2017) and self-reported waste particularly in smaller households (Jörissen et al. 2015; Koivupuro et al. 2012). Finding packaging solutions that balance the environmental impacts of plastic with those of food waste across the product-packaging chain is another active area of research (Silvenius et al. 2014; Wikström et al. 2016; Williams, Wikström 2011; Williams et al. 2012). The shopping environment has also been investigated but with mixed results (Jorissen et al. 2015; Le Borgne et al. 2014) and a lack of clarity as to whether the shopping environment or broader lifestyle factors are more important. Nevertheless, as described in Chapter 1, with limited evidence of the effectiveness of approaches designed to change minds there is interest in approaches that change the context, in particular streamlining date-label application and encouraging the use of best-before dates where possible (The Consumer Goods Forum 2017; WRAP 2017b). The next section of this review focusses on the influence of one aspect of the material context: date labels. This is difficult to separate from another aspect of the material context, product type, and other product labelling such as the reduced label to indicate that a product is approaching its expiry date.

2.4.1   Association between product type, date type, and WTC

Wilson et al. (2017) was the only study found that looked at the impact of date label type on food waste in a systematic way, controlling for product type and date type. They found

that consumers' willingness to waste (WTW) for the same product was greatest when labelled with use-by and lowest when labelled with a sell-by. Their dependent variable was WTW, a multiplication of respondents' willingness to pay (WTP) for each product combined with amount of the product that they anticipated consuming. As discussed in the context of Setti's (2018) work there is significant temporal separation between purchasing and the point at which food becomes waste, and therefore it is not clear that such a WTW measure accurately captures the decision processes that go on at the point of disposal. Wilson et al. 2017 also found that product type made a difference to WTW. Product type has previously been found to affect WTP for products approaching their expiry date (Tsiros, Heilman 2005). Tsiros and Heilman (2005) assessed the impact of product type on WTP for products as they approached their expiry date: they found that for beef and chicken, WTP decreased exponentially; for lettuce, carrots, milk and yoghurt, WTP decreased linearly.

A larger number of studies have explored the association of product type and WTC in relation to the date shown on the products (Broad Leib et al. 2016; WRAP 2011a; van Boxstael et al. 2014). Some of these studies have included dairy products. Where date type was held constant, milk was found to be thrown away more often due to the use-by date than cheese (Broad Leib et al. 2016; WRAP 2011a). Of the dairy products studied by WRAP (2011a), cheddar cheese with a best-before date was the product that respondents were most likely to report being happy to eat any time after the expiry date passed, while yoghurt with a use-by date was the least (WRAP 2011a). Van Boxstael et al. (2014) used wider groupings of products such as ambient or refrigerated and did not distinguish between those that had best-before versus a use-by date label. Nevertheless they found a difference in WTC between product groups, and despite respondents claiming to know the difference between date types, around 50 per cent claimed not to take this difference into account when judging edibility. The results reported by WRAP (2011a) and van Boxstael (2014) were descriptive in nature and did not try to assess the strength of association of date label with WTC or other equivalent dependent variables. WRAP (2011a) also tested a number of variants of date label phrasing e.g. "use-by end of". Broad Leib et al.'s (2016) study was US-based, where they have a greater range of date labels.

2.4.2   Reduced labels

Expiry-date-based pricing and the use of a reduced label to indicate this is a common approach used by food retailers (Aschemann-Witzel 2018; Tsiros, Heilman 2005; Theotokis et al. 2012). As described above, WTP for products has been shown to decrease as the expiry date approaches (Tsiros & Heilman 2005). Estimated likelihood of consumption (as well as perceived quality) is an important factor in consumers' decisions to purchase food close to the expiry date (Aschemann-Witzel 2018).

Contextual factors cannot be isolated from motivational and competency factors, as highlighted by Steg and Vlek (2009). For example, Tsiros and Heilman's (2005) found that the differentiating factor between the group of products where WTP decreased linearly and the group of products where WTP decreased exponentially was perceived product quality. Motivational and competency factors can neither be isolated from one another. Studies have shown that improving knowledge about food risk (such as biotechnology or in this case date labels) is not sufficient to overcome perceived risks (Lusk, McCluskey 2018), but equally without it there is no basis on which to make a sound decision. The next two sections summarise studies that consider motivational factors and date-label knowledge and the extent to which these factors have been found to have an influence on food choice.

2.5   Motivational factors affecting date label use

2.5.1   Risk perception

Risk perceptions are known to affect consumer preferences for food (Lim et al. 2014; Loebnitz, Grunert 2018; Tsiros, Heilman 2005). Perceived risks have been found to explain consumer preferences for domestic over imported beef (Lim et al. 2014); preferences for abnormally-shaped vegetables (Loebenitz, Grunert 2018); and WTP for products as they approach the expiry date (Tsiros, Heilman 2005). To complicate matters, risk perceptions are multi-dimensional. This means that in the minds of consumers, risk perceptions might encompass both perceptions of food safety and food quality (van Rijswijk, Frewer 2008). Perceptions of freshness and healthiness might also contribute to perceived risk alongside

genuine concern for food safety (Wansink, Wright 2006). This is consistent with broader evidence that consumers do not tend to differentiate between different types of hazards, which can make assuaging concerns about food safety challenging (Verbeke et al. 2007). Tsiros & Heilman (2005) took this into account in their study and explored the association between two concepts of risk, product quality risk and personal risk, and WTP for products approaching their expiry date. As described in the previous section, they found that higher reported product quality risk, though not personal risk, was associated with lower WTP. Overall this implies that any measure of risk perception needs to be multidimensional.

Insights from behavioural economics show that people seldom evaluate risks of any kind on the basis of statistical information; rather, they apply rules of thumb known as heuristics (Tversky, Kahneman 1974) which in turn tend to be triggered by a particular context. One heuristic relevant to date-labelling behaviour is that of anchoring. This highlights the tendency for sometimes arbitrary information to set a standard against which subsequent judgments are made (Tversky, Kahneman 1974). In the case of best-before dates, the information is not arbitrary; it is advisory. Specifically, it is advisory as to product quality and it is not indicative of product safety. Elsen (2015) found in an experiment that best-before dates had anchoring effects that worked both for and against food waste, depending on which side of the date the condition lay. Prior to the best-before date, they found it was better to have the best-before date present on products as it prevented people throwing them away too soon, but once the date had passed the presence of a date increased the likelihood that people would throw something away.

Other relevant heuristics to date-label behaviours include the endowment effect and, potentially, optimistic bias. Sen and Block (2009) found that respondents in an experiment who were told that they owned a yoghurt were less likely to believe that they would be made ill by consuming the product after the expiry date than those who were told that they did not own the product. The owning group were also more likely to actually consume the product after the expiry date than the non-owning group. Sen and Block (2009) argue that the endowment effect lowered the perceived risk of getting sick. Redmond and Griffith (2004)

found similar optimistic bias effects where people perceived greater safety risks when food was prepared by others than when they prepared it themselves because of the "illusion of control" (pp. 313). However, these effects could also be interpreted as the endowment effect increasing aversion to waste and people have been shown to go against their self-interest to avoid appearing as wasteful (Arkes 1996).

While not explicitly identifying heuristics at work, Hooge et al. (2017) found that respondents to their survey had different sub-optimal product preferences in shops and at home, and that different factors were associated with sub-optimal product choice across the two contexts. First, they found that respondents asked to make choices as if they were in a supermarket chose suboptimal products less often than those asked to make choices as if they were at home. They found 6.5 per cent of their population would buy milk and 10.2 per cent would buy yoghurt close to the best-before date, but 42 per cent would be happy to drink milk and 46 per cent would be happy to eat yoghurt after the best-before date at home. Respondents in de Hooge et al.'s (2017) supermarket condition were asked to imagine that they would pay for products they were choosing, which may have acted as a deterrent compared to Sen and Block's (2009) scenarios that purely tested the ownership principle. On the other hand, de Hooge et al.'s (2017) scenarios may be seen as more realistic and serve to highlight the need to consider date-label use and related risk perceptions in different contexts. Second, they found that an egoistic orientation was associated with lower willingness to choose suboptimal products in supermarkets, but that commitment to environmental sustainability was associated with a stronger willingness to choose suboptimal products at home. They did not assess whether risk perceptions differed in their influence between the home and supermarket context.

2.5.2 Trust

The degree of trust that consumers have in information provision, including the providers of that information, is one factor that has been found to affect risk perceptions of food products (Frewer et al. 1996; Tonsor et al. 2009). As with risk perception, trust has been shown to be a multi-dimensional concept and a number of different types and sources

of trust have been identified in relation to food (Hobbs, Goddard 2015; Lobb et al. 2007). Concepts of trust in relation to date labels appear from this review to be under-researched, with most studies found focussing on trust in food safety information relating to food scares (e.g. Lobb et al. 2007), sustainability claims (e.g. Sirieix et al. 2013), brand (e.g. Lassoued, Hobbs 2015), or GM technology (Costa-Font, Gil 2009).

Two concepts of trust seem particularly pertinent to the case of date labels. The first concept measures trust in the date labels themselves as conveyers of information. This comes under the category of system trust, where people base their trust on established rules, such as the food safety guidelines described earlier, and the enforcement of those rules (Lindgreen 2003). The second type of trust is described as calculative trust, defined as the "rational evaluation that others are likely to be behave in a way that does not harm their own interests" (Hobbs, Goddard 2015, p. 71). This concept evokes encapsulated interest described by Hardin (2002) and constraints on future behaviour described by Earle (2010). This could mean that consumers perceive food manufacturers to be constrained by their need to avoid prosecution and/or for repeat business. By extension they trust date labels to the extent that products are safe to eat prior to the date, but they may also perceive them to have a buffer built in. This can also be seen as the food industry needing to protect itself from economic losses, and by proxy it is trusted to protect the interests of consumers (Frewer et al. 1996).

2.6   Abilities affecting date label use: knowledge

A number of studies have assessed consumer knowledge about date labels and discussed implications for household food waste (Broad Leib et al. 2016; van Boxstael et al. 2014; Toma et al. 2017; TNS European Behaviour Studies Consortium 2014; Visschers et al. 2016). Broad Leib et al. (2016) found diversity in the understanding of the six main date labels employed in the USA, although the impact of understanding on WTC products was not tested. In the UK the Food Standards Agency (2016) found that their respondents could benefit from better understanding of the difference between best-before and use-by date labels, but again the impact on food-waste outcomes was not clear. Only three of these

studies use objective measures of knowledge and go beyond assessing date-label

knowledge alone to explore the relationship between knowledge and date label use or food

waste (Toma et al. 2017; TNS European Behaviour Studies Consortium 2014; Visschers et

al. 2016). Their results are mixed. Visschers et al. (2016) found no link between date label

knowledge and self-reported food waste outcomes. Toma et al. (2017) found that consumers

who had better knowledge of date labels were actually less likely to engage in food-waste-

reducing behaviours, such as being willing to consume rice and pasta without a best-before

date being present. On the other hand, TNS found that "misconception of the 'best-before'

date as a safety limit is one of the strongest factors which drives consumers to throw away

outdated food" (2014, p.156).

The use of different measures of outcomes by these three studies is likely to be the

reason for their different conclusions about knowledge's relationship to food waste. However,

the mixed findings raise a number of important points. Toma et al.'s (2017) findings could

indicate that consumers with better date knowledge are also those that rely more heavily on

dates for decision making, and therefore when dates are absent those same respondents

will be uncomfortable consuming the product with no guidance. This raises the question as

to how knowledge and the perceived risks that consuming those products pose are linked.

The combination of Visschers et al.'s (2016) finding that knowledge of date labels had no

impact on household food waste and TNS's (2014) finding that date label knowledge and

throwing away outdated food were strongly linked, highlights the importance of choosing the

correct level of variable and earlier points about understanding relationships between

behaviours and outcomes.

WRAP (2011a) estimated that "misinterpretation and mis-use of the best-before date

has a systematic, direct effect on food waste outcomes for around one in six consumers,

rising to one in five among younger age groups" (p. 116). Specifically, 14 per cent of

respondents to their survey interpreted best-before as an indicator of food safety and 16 per

cent said stated that they would eat cheese only up until the best-before date (WRAP

2011a). The extent to which these populations overlapped was not investigated and so we

can only surmise that perhaps 2 per cent of those that knew the difference still would choose not to consume cheese after the best-before date. As indicated above, misinterpretation is likely to have stronger effects on the waste of some product types due to the mixed application of best before and use by dates on similar products, but also due to differences in product characteristics such as perishability. Van Boxstael et al. (2014) did investigate the distinction between knowing and acting on knowledge, and found that nearly 70 per cent of respondents claimed to know the difference between use-by and best-before dates, but just under half reported taking the difference into account when judging the edibility of products. While van Boxstael et al. (2014) measured only subjective knowledge, their results provide an indication of the size of the potential gap between knowing that the best-before date is an indicator of quality not safety and choosing to consume a product after the best-before date has passed. While sweeping statements are still made with regard to lack of knowledge about date labels (for example Grainger et al. 2018) less attention is paid to why those who do know the difference still choose not to apply it. The final two sections of this review further discuss the knowledge behaviour gap (Kolmuss, Agyeman, 2002).

2.6.1 Knowledge and the use of nutritional and environmental labelling

While the literature on date label knowledge and use is not large, there are two other relevant literatures to draw on. First the literature on nutrition and environmental labelling, and second the broader literature on environmental knowledge and behaviour. In a recent review of 32 studies, Miller and Cassady (2015) found evidence of a positive relationship between nutrition knowledge and nutrition label use. However, they argued that future research should consider the conceptualisation and measurement of nutrition knowledge. In particular they emphasise the distinction between declarative and procedural knowledge in order to better understand nutrition label use and the complexity of dietary behaviours. The importance of both declarative and procedural knowledge in nutrition and dietary behaviour is not new, for example Worsley et al. (2002). Nevertheless, it would seem to have been somewhat overlooked by subsequent empirical work.

In terms of environmental knowledge and label use, there is evidence of the positive influence of objective knowledge as well as a role for other forms of knowledge and interactions with other behavioural antecedents. For example, Peschel et al. (2016) found that pro-environmental choices (indicated by low carbon/water use) were more likely to be made by segments with high objective *and* subjective knowledge of climate-friendly production methods. For respondents with only high objective knowledge, price was the key factor determining whether knowledge resulted in a purchase. This led them to conclude that building subjective knowledge of consumers, so that they feel informed and able to make good decisions, is as important as increasing objective or technical knowledge. Grunert et al. (2014) also found a positive relationship between understanding of sustainability and sustainability labels and their use, but only when the level of concern for the environment was high. Where concern for the environment was low, the effect of better understanding on self-reported use changed from negative to positive.

2.6.2 Knowledge and environmental behaviour

Environmental knowledge has also been found to moderate the relationship between attitudes and environmental behaviour (Fraj-Andrés, Martínez-Salinas 2007). Shi et al. (2016) found that higher levels of knowledge about the causes of climate change were related to heightened concern. They used a number of different dimensions of knowledge (physical, causes and consequences) which they argue better takes into account the public's knowledge of climate change issues.

Kaiser and Fuhrer's (2003) model of ecological behaviour is an example of a model that takes into account the requirement for different forms of knowledge to converge in order to lead to the desired behaviour, but also that knowledge even in different forms is a necessary but not sufficient condition. They argue that other factors such as attitudes, intentions or values act as mediators.

Their model incorporates four different forms of knowledge: declarative, procedural, effectiveness and social knowledge. Declarative knowledge, sometimes called objective

knowledge, is knowledge of factual information, whereas procedural knowledge is often considered to be knowledge of how to use and apply factual information (Alexander et al. 1991). Effectiveness knowledge is described as knowledge that taking a particular action will be effective in achieving a desired goal, or which of multiple actions will be most effective. Finally, Kaiser and Fuhrer (2003) describe social knowledge as a combination of conventional social norms such as subjective norms and moral social norms referring to individual "self-referential standards" (p. 603).

No empirical testing of Kaiser and Fuhrer's (2003) model in full was found to have been undertaken during the course of this literature review, though some studies were found to have done so in part e.g. Redman and Redman (2014), and Frick et al. (2004). Redman and Redman (2014) found that higher levels of procedural, effectiveness and social knowledge were significant for predicting a range of pro-environmental behaviours. However, they did not find that declarative knowledge was a statistically significant predictor of behaviour. They argue that this "provides further empirical evidence to the case for de-emphasising declarative knowledge" in sustainability education (p.151). Redman and Redman's conclusion is somewhat strong given their choice of ordinary least squares (OLS) regression and decision not to investigate whether declarative knowledge was mediated by any of the other forms of knowledge, attitudes or intentions. This is because one of the central tenets of Kaiser and Fuhrer's (2003) thesis is that declarative knowledge is a "distal predictor of behaviour" (p. 600) and that methods such as OLS tend to "underestimate knowledge's behaviour-distal influence" (p. 604). Frick et al. (2004) also found that there was no direct relationship between declarative knowledge (termed system knowledge) and behaviour, but through their structural equation model approach found that declarative knowledge was a significant predictor of both procedural (termed action) and effectiveness knowledge, which in turn were significant predictors of behaviour.

3 Methods and data collection

This chapter describes the methods used to collect and analyse the data for this study. It is split into two distinct parts. The first part describes the procedures for, and analysis of, a series of focus groups (section 3.1). The results and discussion of results from these focus groups are also presented in this methods chapter, rather than in their own results chapter, because they were used, along with the literature review, as part of the survey and hypothesis development process. The process of conducting the literature review and focus groups was iterative. Insights from the analysis of transcripts drove further review of the literature and subsequent testing of these ideas in the groups. The results of the focus group are presented under headings that directly link to variables tested in the survey therefore the headings in section 3.1.5 are related to the variables from the survey described in section 3.2. The second part of this chapter describes the collection of survey data (sections 3.2 and 3.3) and outlines the main statistical methods used for analysis across Chapters 4, 5, 6, and 7 (3.4).

3.1 Focus groups

The objective of the focus groups was to understand how consumers use date labels and what factors influence their use. Focus groups were chosen as the method in order that participants could exchange experiences and generate new insights (Krueger 2014), thereby building on as well as confirming insights generated from the literature review. This is wider in scope than a typical elicitation study used for TPB (Fishbein, Ajzen 2015). The focus group approach therefore ran the risk of generating beliefs which are not readily accessible for some people since ideas raised by individuals are discussed and may not be those that come to mind for all. However, this was balanced with the need to explore a broader range of factors potentially pertinent to date-label use.

3.1.1 Procedure

The study comprised five groups of university students (26 participants in total) between December 2015 and February 2016. Students ranged from undergraduates who had only

completed a term of studies to doctoral researchers. They were told that they would be participating in a one-hour focus group discussing household dairy product consumption and waste. Participants were recruited through the university's part-time work portal and offered £10 as an incentive. All participants were over 18, currently students at the university, had whole or part responsibility for grocery shopping and were regular consumers of dairy products. Consent forms were signed by participants at the beginning of the session in line with University of Edinburgh Research Ethics Committee guidance.

3.1.2 Focus group characteristics

Participants were asked to complete a small questionnaire before the group started. This captured their attitudes towards the environment, risk and their thriftiness. Measures for environmental attitudes were taken from the New Environmental Paradigm (NEP) scale developed by Dunlap et al. (2000). Importantly for environmental behaviour it links to human activity and its influence on environmental degradation. This was measured on a 7-point Likert scale from strongly disagree to strongly agree. The four statements were: "Humans are seriously abusing the environment"; "The Earth has plenty of natural resources if we just learn how to develop them"; "The balance of nature is strong enough to cope with the impacts of industrial development"; "and The Earth is like a spaceship with very limited room and resources". The responses to the second and third statements were reverse coded during analysis to ensure higher scores corresponded to a more pro-environmental attitude. The measures for risk were taken from a general measure of risk attitudes developed by Zuckerman et al. (1978). This concept was also measured on a 7-point Likert scale from strongly disagree to strongly agree. The statements were: "I often wish I could be a mountain climber"; "I like wild parties"; "People should dress in individual ways"; "I can't stand watching a film that I've seen before". This measure was taken from Lastovicka et al.'s (1999) measure of frugality. It was measured on a 7-point Likert scale from strongly disagree to strongly agree. The statements were: "There are things I resist buying today so I can save for tomorrow"; "I discipline myself to get the most from my money"; "If you can re-use an item

you already have, there's no sense in buying something new"; "Making better use of my resources makes me feel good".

The highest maximum score for each of these concepts was 28 and the minimum score was 4. Table 3.1 displays the results. The mean scores indicate that thrift was the most dominant attitudes across the groups, as the mean of each group's scores was above 20 for this concept. This suggests that this might be a more important driver for reducing food waste across the groups. The willingness to take risks showed the greatest range of values across the groups suggesting that here willingness to take risks is likely to be more polarised in responses to whether they might risk consuming products after the expiry date.

Table 3.1 Results of pre-focus group attitudes survey

		NEP scale			Risk taking			Thriftiness		
Group	Participants	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
1	6	22	18	25	16	11	20	24	22	27
2	5	18	17	21	15	11	19	24	21	28
3	4	20	17	23	15	9	21	26	25	27
4	6	16	15	18	14	9	17	24	20	28
5	5	18	14	21	17	15	23	22	27	17

3.1.3 Focus group protocol

The focus groups were semi-structured in nature and the basic outline is described below.

- Prior to participants arriving, the table was set with a range of (empty) dairy products including milk, cheese and yoghurt which had different expiry date formats and were printed in different locations.
- The first question to each group asked them to reflect on how they used the expiry dates on dairy products in their normal shopping and food routines. They were invited to examine the expiry dates on the dairy products in front of them to stimulate discussion.
- Subsequent questions were based around:

- The TPB, seeking to elicit participant attitudes towards using expiry dates in different contexts, who influenced their use of expiry dates and to what extent they felt confident using expiry dates (PBC)

- Concepts identified as relevant from the literature review including trust, risk perceptions, and attitudes towards food waste in general.

- Only towards the end of the discussion were participants asked to share their understanding of different date labels (best-before, use-by, display-until/sell-by) and whether the type of expiry date made a difference to how they used it. For groups where they were very unsure or gave incorrect interpretations clarification was given. The reason for leaving this to the end was to see if the difference between their usage and attitudes to these dates was volunteered and therefore how important the distinction was for influencing participants' behaviour.

After each pair of groups I reflected on the sessions, listened to the recordings and updated the protocol.

3.1.4   Analytical procedure

The focus groups were recorded with permission from the participants. The recordings were transcribed verbatim.[2] The transcripts were read, re-read and coded in line with concepts of interest. The semi-structured natures allowed sub-concepts to be identified, for example waste attitudes were split into moral and financial aspects; PBC was split into perceived ability to use dates and perceived ability to engage senses to make a judgement about a product's edibility. The concept of trust was a key concept that was developed iteratively during the focus groups. During the initial groups participants were asked whether they had trust in date labels: their responses led to further investigation into different types of trust, in particular calculative trust (described later) relevant to the food system. The coding was conducted in NVivo 11 which is software for qualitative data analysis.

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[2] Copies of the transcripts are available on request

3.1.5   Results

The results of the transcript analysis are presented below with each section describing a key theme or concept. Sub-concepts are discussed and illustrated with quotations from the transcripts. Participants are identified with a letter, the focus group is identified with number and the page number from which the quote is taken is indicated pX e.g. E4 p3 refers to participant E from transcript 4 page 3.

Understanding date label use

There were two main settings where participants described engaging in date label related behaviours: in shops and at home. Participants clearly interacted with the dates differently in these two contexts. Participants that paid attention to expiry-dates in shops did not necessarily report paying attention to them at home and vice-versa.

Date label use in shops

A large number of participants reported that they paid attention to expiry dates in shops to some extent. Most of these reported taking actions such as reaching to the back of a display to ensure they got the newest product.

> "I pay attention to dates; I will pick something off the shelf at the furthest possible date..." (E4 p3)

While they were locating the furthest date, or simply reaching to the back of the fridge, they were not necessarily paying attention to what the date was. Some participants did mention specifically using the date to calculate whether the product they were selecting would be consumed in time. However, this was less common.

> "Yeah in the supermarket, yeah, I mean I kind of calculate them, and if I'm buying a litre of milk then it needs to last a week so I kind of calculate that the expiry date is 7 days from now...for me it's pretty important that I take it into account" (B3 p5)

Fewer participants reported they did not really look at the dates. Those that did not look at dates reported having an expectation that, for the most part, shops stocked products which

have a reasonable shelf life – one that would enable them to consume the product before it expired.

"I don't think I actually pay attention when I'm buying...I trust the shop to stock produce that has a shelf life" (2B, p.1)

"I pay close to no attention to these kinds of labels. Umm, I mean I realise now that there's like expiry dates and stuff like that on them but I don't really read any of them. I don't really read them for many other products either though, I just kinda like assume well it's on the shelf so it must be good for now." (B2 p2)

Two factors were identified that seemed to affect the level of attention that was paid to the expiry date. The first factor was the type of product. Milk was often cited as the dairy product where it was most important to select the product with the longest shelf life.

"For me I pay attention more to milk...same with you I choose the furthest thing. But for your other products I won't pay much attention. But milk is more" (F4, p.3)

"I definitely buy the milk with the longest life just because I don't drink it as quickly as I would eat yoghurt" (2C, p.1)

"I think for milk I definitely go for the one that's...that lasts the longest....With something like yoghurt, I wouldn't look at it too much" (2A, p.1)

The second factor that participants mentioned prompted them to pay more attention to the expiry date of the product was an item being in the reduced section of the supermarket or having a reduced sticker.

"I would probably check the dates on things if I was buying it in the reduced section. In case it did have a very short life and I wasn't going to be able to use that. "(B2 p2)

"The only time I'm realising I will ever look at the label is if it has one of those like 30% or 5% off stickers or like a significant reduction" (A4 p2)

"I really only buy it if I know I can use it before it expires. There I am somewhat more cautious" (C3 p15).

A few participants went further and reported that they wouldn't purchase dairy from the reduced section because the financial discount was not worth it for either the safety risk or risk of not consuming.

"With milk and things it's not that expensive. I mean whereas umm like meat or poultry that's more expensive so it counts more when you buy reduced items. You can just freeze it…but milk it's not that much so I won't be bothered to risk it" (F4 p16)

This suggests that not only did the reduced sticker prompt individuals to pay more attention to the date. It also caused them to re-evaluate their view of its value and safety.

Date label use at home

Compared to using expiry dates when shopping, fewer participants reported paying attention to expiry dates at home. In particular keeping on top of dates as part of active food management was not common.

"Umm, we don't really look at the dates once we've bought it, like." (E5, p2)

"No when I buy things I put them in the fridge and then I know it's been there for I don't know 4 days and I have to check that food but not because it has an expiry date on it. It's more because I know it's been there for a while." (E5, p3)

In terms of using expiry dates to determine edibility participants were split between those that used expiry dates in conjunction with their own senses: sight, smell and taste to determine whether or not a dairy product was edible and those that did not.

"As soon as I'm home, I don't consider it anymore. If there is something in my fridge which I know is there for a longer period of time, then I check it. But if it's due yesterday I don't chuck it away I just use senses." (C1 p1)

"If it doesn't smell badly then I don't have a reason to throw it out and not eat it" (C5 p3)

Some participants reported a reluctance to employ their own senses due to a sense of revulsion or a previous bad experience of tasting a product which was off.

"I feel a bit guilty saying it but, even if you have a sniff and it doesn't smell too funky but you've still got to put it in your mouth and that's not pleasant, you don't want to risk it" (E1 p4)

For a small number of participants there was no question of even trying to employ their own senses as they believed that to consume anything past its date was simply not worth the risk.

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"If I'm too cheap then maybe I can use it but usually I throw everything out instantly after its past the date for dairy products because it's way too risky in my opinion" (B4 p5)

There were a number of factors that seemed to affect the extent to which participants would use expiry dates to determine whether or not to consume a product. As in shops, the type of product was one factor that seemed to make a difference. Dairy products sit somewhere in the middle of meat and vegetable products in terms of the extent to which participants were willing or not to go by the date to determine if something has expired versus using their own senses.

"I feel like with dairy products (compared to meat) you can kind of, you can use your senses. You can kind of use the use by dates as milestones to see when it goes bad." (1A, p6)

"With dairy it's a bit easier because it it's if meat goes out you can get food poisoning I don't think it's that likely to happen with dairy" (A3, p1)

"I think dairy products are the only food that I'm actually looking at the dates. I've never looked at like other products. Like vegetables, that's nonsense. "(C5, p5)

Reliance on expiry dates to determine whether or not a product was edible varied within the dairy product category and was generally dependent on previous experience of how long a product lasted.

"It's the nature of the product that sort of determines whether I use the label of the date a lot." (1D p6)

"Wetter stuff with more liquid in it…I feel like I'm more cautious about those things." (1B p4)

"Once at home I know my fridge keep it (milk) for at least a week after the date anyway" (1F, p2)"

There was general agreement that they could be the most lenient with cheese but groups tended to be divided on whether they were more or less lenient with yoghurt or milk.

"If I have three things: milk, yoghurt and cheese with the same expiry dates it's the milk that will go off first, like the milk goes off sometimes before the expiry date as well" (D4 p 10)

"For me it would be yoghurt." (C4 p10)

Some participants appeared to have developed their own rules of thumb for the number of days that they could exceed the date label by depending on the product type.

> "I always look the expiring dates especially the dairy products, always. And I do use them after they have expired. But I pretty much always do the same thing. I mean I will not drink milk 2-3 days after, yoghurt 1 -2 days after, cheese maybe 1 week after." (C4 p7)

PBC

In order to engage or have control over the action of date checking people need to be able to easily access the information. When presented with a dairy product packaging a number of participants commented that some dates were not easy to see because they were blurred or printed at an awkward angle. This observation suggests that there are a least some physical barriers to using the dates both in shops and at home to make decisions on edibility.

> "I can't really read the date on that one. It's kind of printed on and then smudged" (B2, p1)

> "If all the important information on the same side of the product then that would be helpful." (D1, p9)

Other participants interpreted the question about the extent to which they have control over their date checking behaviour, meaning whether the dates controlled them or whether they gave them better control of their meal planning and consumption as a result of using expiry dates.

> "It's more like they're keeping control of me. I mean I've been eating yoghurt day and night just because I bought a pack of 8 and it was about to end and then I haven't noticed. So in order of eating it out of expiry date or throwing away I kept eating yoghurt all day. It was horrible…it was more like the other way round." (C4, p17)

> "I think sometimes like I'm afraid I can't eat it all before the date, even though I do actually eat a lot of yoghurt. It's like I buy the little ones instead, so I can control how many that I have and I like I know it'll be like one a day or maybe two a day. I know how quickly I can eat them." (C2 p13)

> "Sometimes it is giving you a little bit of control for example with milk. They're telling you when it's going to go off. Whereas you couldn't tell if it was 1 day or old, whether it was 8 days old…there's been times when I've changed my food plan to take into account an expiry date." (E4 p17)

"But still there is no guarantee that the product is not gone off before the date. Cos maybe something has gone wrong in the processes or maybe the packaging is dodgy." (D3 p11)

While some highlighted that they changed their behaviour e.g. eating up yoghurt or re-planning meals, most did not express significant concerns over their ability to make use of date labels in shops or at home. Only a few participants said that they found it difficult to check dates or that there did not feel it was within their control to do so.

On the other hand many participants expressed varying levels of confidence in their ability to tell whether or not a product was edible once it had passed its expiry date. As with risk perceptions, participants' perceived ability to judge whether a product was edible using their senses, varied by product type. Cheese was deemed relatively straight forwards because it had clear visual signs and again participants were split as to whether yoghurt or cheese was the next most difficult product to judge.

"Milk you cannot really see. I mean even if it goes off you won't know until you actually taste or smell it. But cheese you can see if there's mould. In that sense maybe the date doesn't matter so much." (D4 p19)

"I think with yoghurts as well, they're often quite flavoured and you maybe taste a hint of sourness but you're not sure if that's bad, or if it's ok or if it's fine to eat it. So I'm just more paranoid about that I think." (E1, p4)

When confronted with the idea of judging dairy products by their senses alone most were uncomfortable. However, when used in conjunction with the dates as an anchor point, many of the participants were comfortable engaging their senses.

"If it's due yesterday I don't chuck it away, I just use senses" (A1, p1)

"It's not that when the date is today that I'll chuck it already directly, but again with my sense I'm more cautious, like it it's slippery or if it changes colour." (C1, p6)

Many of the personal factors that made some individuals more willing to trust their senses than others were similar to those highlighted in section 2.3.7 relating to risk perception. These included previous experience of having food poisoning or tasting something unpleasant. Additionally the experience of eating food outside of normal context, for example

from a supermarket bin or having travelled and eaten food in other less hygienic situations also seemed to make participants more relaxed about consuming food in the UK after the expiry date.

> "Because I think I've been skipping and it's been totally fine, then I attribute less meaning to dates." (D3 p11)

Influence of others on date-label use

Participants reported consulting close friends and family when deciding whether a product was ok to eat in relation to the expiry date. They reported checking the opinions of others as to whether something was "off".

> "When in the office for example with colleagues…someone says hey. The milk is expired, look at the date and I'm like hey it doesn't matter or they say do you think it's still good…yeah or no…" (B3 p10)

Those students who had left home recently recognised the influence of their parents on their use of expiry date labels and how they would store different types of products.

> "I only just move away from home so like my parent's habits have really really affected me. Just that like my mom won't let us throw away milk it is still tastes alright" (2C p4)

> "I just do what my mom has done her whole life" (D2 p5)

Participants also recognised that sharing flats with people has started to change the way they think about using expiry dates.

> "So my one flatmate is, she shares your (another participant's) opinion, she will really eat it no matter not looking at the date….my other flatmate is extremely wasteful and would look a lot at the date…I try to be more like my more conscious flatmate. The other one puts me off. Or reminds me it's important not to be too wasteful." (C3 p8-9)

> "My flatmate is much more liberal. Because of him I eat things past the expiration date more now because he's like challenged my horizons." (B4 p14)

This has come about mostly through descriptive norms – seeing what other people do, rather than injunctive norms – feeling influenced to act on the basis of what you should do. In fact

as students some individuals thought different, lower standards applied in terms of food safety.

"I think cos we're students I think it's acceptable, you said like your mom cares and so does mine but it's different because we're students. Umm, so I think we don't judge" (D3 p9)

Or rather they were released from parental expectations about what can and can't be eaten:

"I think for me it was like when I moved out and started buying food for myself I thought well I'm not going to throw this out for the date…I think it was more like I can trust myself to know when it's ok to eat." (E5 p15)

Attitudes towards food waste

When participants were prompted about their attitudes towards food waste their answers seemed to be split between considering waste to be inherently bad, which sometimes took on a moral tone, and considering the cost of food waste. None of them volunteered consideration for environmental aspects. A few participants who's use of date labels was driven by a belief that waste is inherently bad and led them to somewhat extreme behaviour, including "dumpster diving" or "skipping". Participant E in focus group 3 and participant A in focus group 5.

"I've been skipping a few times and admittedly they don't have dairy products in the skips…because I think I've been skipping and it's been totally find that I attribute less meaning to dates." (E5, p11)

However, many participants reported being less concerned about wasting food and expressed that while waste was undesirable it was inevitable.

"I was just like you know quite annoyed that I hadn't been able to use it up but it wasn't a hard decision. If it's gone rubbish then just get rid of it but it was just annoying." (A2 p6)

Some participants described delaying tactics such that they may choose to leave food which might be at a stage that they're not quite prepared to eat, yet would feel guilty about throwing away. By leaving a product to deteriorate further before putting it in the bin seemed to assuage some of the guilt about not eating it.

"When I see a product and I know it's not good anymore I just put it away because I hate to do it (dispose of it). (C1 p7)

"…I definitely feel guilty when I have to throw out food."(B5 p14)

A sense of guilt about potentially creating waste extended to activity in the supermarket. One participant commented that they sometimes felt guilty about picking products with the furthest date as this possibly contributed to waste in the supermarket. However, this did not stop them from doing so.

"When I buy yes, as you I usually dig for the further one which is maybe a bit dodgy because you want to use up, you know the shop will end up wasting but I do the same" (C5, p2)

Financial considerations were brought up by a few students to explain why they might be willing to consume products after their expiry date, using their senses to determine whether it was safe. For the most part once something was deemed to be off, the majority of participants would not be willing to eat it no matter how much they had paid for the product, which is not surprising. Nevertheless the thought of wasting money did make them feel regretful after the fact.

"When we are students and our top priority is probably saving up on food as much as you can and then your priority is not as much safety" (B5 p11)

"If it's a really expensive product or like something I spent a lot of money on then I'll be more hesitant to throw it out and then I'll be upset that I didn't either eat it in time or that I left it out. It also depends how much it is. Like if you accidentally leave out an entire carton of milk that you just bought like that's a lot more upsetting than when you leave out the last little bit." (C2 P6)

"I don't think I would ever just because something was expensive and not it had gone off that I was just going to eat it out stubbornness anyway." (B2 p6)
"I'll do it if it's a really expensive product or like something I spent more money on, then I'll be more hesitant to throw it out and then I'll but upset that I didn't either eat it in time or that I left it out." (C2, p6)

"I find it's more just disappointment that I've wasted money and stuff." (A2, p6)

What was more surprising was that financial concerns did not seem to motivate participants to pay a great deal of attention to expiry dates in the shops, or to motivate them to regularly check the dates of products that were in their fridge i.e. to take a preventative measure.

"If it was much more expensive I think I would pay much more attention towards planning stuff. It doesn't really bother me just now it's' not often a problem for me unless I am away for something then it goes off but if I was paying £5 for a 4 pint bottle I would obviously be very careful" (A2 p7)

"It's like 45p (for a pint of milk) and so it would have to be significantly different for me to really care all that much" (D2, p7)

Risk perception

Participants use of expiry dates appeared to be related to the strength of their belief that a product would do them harm if consumed close to or after the expiry date.

"…with yoghurt, because of like the live bacteria I'm very cautious about, so I throw away the yoghurts that expire." (D3, p1)

However, risk perceptions or a desire not to consume products after the expiry date were wider than simply food safety concerns. They also related to product quality and whether it was going to be nice to consume.

"It's quality for me, it's quality and taste I'm not bothered about you know, ingesting a bit of bacteria, it's literally, it's just that it doesn't taste very nice." (A2 p5)

"I feel a bit guilty saying it but, even if you have a sniff and it doesn't smell too funky but you've still got to put it in your mouth and that's not pleasant, you don't want to risk it" (E1 p4)

There were a range of factors that affected participants' level of perceived food safety risk. These included personal circumstances, with one respondent giving an example of being more cautious prior to an exam, but also previous bad experiences.

"For example when I know I have something important coming up like an exam or an interview, I get more careful about it. Or then I wouldn't consume anything past the expiry date, just to be sure." (C3 p7)

"I think that once you have like bad milk by accident or something like that, I think you are much more kind of aware of it and you like almost get paranoid. Like when it gets close to the date, even though it's like still before the date like I will be like really sniffing my milk and be like if's it's like even just a day past I might be convinced that it's bad" (C2 p3)

Other participants highlighted factors related to the product itself that affected their risk perceptions. Reduced labels were mentioned in this context suggesting that the influence of

these on expiry date use extends from shops into the home. The brand or where the product was purchased from was another product related factor that participants mentioned affected their perception about whether a product presented a greater food safety risk in relation to the expiry date. Purchases from small stores tended to be perceived as more risky than purchasing from larger well known stores.

"If it's reduced I would definitely look at the date and get worried if it's past its date…" (C5 p11)

"I completely ignore sell by dates, the only time I would notice them is when that's why it's in the reduced section, or something like that." (B2, p2)

"If I'm buying from a small grocery store I tend to be more cautious" (D1 p5)

"I think it depends who it's by as well. I've found that some corner shop ones they go way before the best before" (E4 p10)

"I tend to trust the big companies because I believe the matter of quality is more like a factor of how much you risk by providing some groceries that might not be safe" (B5 p11-12)

"I think it's the sketchy products that you would buy…if you go to a small grocery shop or something like that." (A5 p11)

Some of the perceived risk around eating products after the expiry date from small stores was related to personal experience of products being "off" prior to or very close to the date. However, the idea that big companies would not risk loss of reputation came up a number of times across the groups and is developed further in section 2.3.8 relating to trust.

Many participants explained that they modified their expiry date behaviour depending on who the food was going to be consumed by. In general they were prepared to take greater food safety risks when it came to their own consumption compared to when they were preparing food for others.

"I am also a lot more cautious when it comes to serving others versus what I eat myself." (C3 p10)

"I guess I wouldn't cook with obviously spoiled milk like if I were to bring something somewhere else like for other people but like within my family at least it's not a huge deal" (C2 p4)

When children were brought into the equation the level of caution increased. This was primarily driven by an individual moral imperative, not to do harm to children.

"I work as a child minder…if it's even close to the expiration date I would be wary and I would use something fresher." (A4, p13)

"If I had my own child or somebody that I had to take care of I would be definitely much more cautious about the experience and the safety of food." (B5 p17)

However, there was also a sense in which there is a societal expectation not to risk products that are on or close to their expiry date on children.

"I think people would definitely judge if a mother gave her child something that had expired for example" (C3 p9)

On the contrary some participants also described a perceived risk of social stigma of being a person who cares too much about date labels.

"I do find it's more like picky people (who are bothered about dates)" (D5 p8)

"I wouldn't want to be the type of person that is overly cautious" (E5 p18)

"It seems like the best before stuff is playing towards people's…they're vain and they want the best product and everything…you're a snob is you go for best before."(A5 p7)

As a note, group 5 contained two members who claimed to have previously gone dumpster diving therefore may have had a tendency towards being lenient with dates. Although one of the dumpster diving participants still claimed to waste natural yoghurt because they would not get around to eating a large pot before the expiry date had passed.

Trust

When participants were asked to what extent they trusted date labels, a large number stated that they trusted the labels to keep them safe but this didn't necessarily mean trusting that they were accurate. They explained that they believed it was strongly in the interests of food companies to ensure that food was safe and prevent negative customer experiences. This further led to the belief by some participants that dates were set conservatively and that this was one reason why it was ok to eat products after the expiry date.

"I tend to trust the company's ability to keep themselves safe from being sued by people because they've got ill from eating something" (A2 p7)

"I don't really trust them; they kind of want you to consume more so they want you to throw it out as soon as possible so that you can buy more." (E5, p10)

A few participants expressed a lower level of trust in labels. For some this was related to prior experience of a product degrading before the expiry date, others stated that while they trusted the label they also trusted their own judgement.

"There is no guarantee that the product is not gone off before the date. Cos maybe something has gone wrong in the processes or maybe the packaging is dodgy (D3 p11)

"I think I had once or twice already a yoghurt which was mouldy before the best before date….so coming from there I don't trust it 100% but then on the other hand it's like, I just take it like a rough guideline" (C1 p5)

"I mean I don't trust the labels more than I trust my own eyes. You've got to trust your own ability to like smell and see things. Not only that there's oversight on the products you're buying." (D2, p7)

One individual, who had been brought up outside the UK, commented that they felt that the food production processes in the UK were more reliable than where they were brought up. Therefore they considered it fine to consume products after the expiry date.

"The feeling that I had when you are growing up is you can't really trust the products. The date is more accurate there because the processes are not that safe. That's, ahhh, here they're safer or they're supposed to be safer. So here I trust more in the product itself. So the date for me, if it's a little, a couple of days off I don't care, whereas in Latin America I would be more cautious...so…the empowerment thing is not really a deterrent for me." (B3, p11)

Knowledge

As described above the participants were not asked whether they knew the difference between best before and use by dates until about half way through the session. This was done to see whether the participants described treating best before and use by dates differently without prompting and therefore give some indication of whether the type of date was important to the way that they used it. None of the participants volunteered that their use of the expiry dates either at home in the in the shop was affected by whether it was a use by date or a best before date. This was interesting to observe given that the products in front of

them had both types of dates on and it was not something that they brought up. When

asked, a few participants admitted they didn't really know the difference between best-before

and use-by dates:

"Best-before, use-by is the same to me" (B1 p3)

"I don't think I ever looked at the distinction between the two. Maybe as an argument in a discussion, we have to eat it today, look at the date, but never for the sake of actually checking if it's still good or not." (B5 p6)

However, many others were able to demonstrate a working understanding of the difference

between these two types of expiry dates even if their definitions were not textbook.

"Use by is that it might be harmful after this point…whereas best before you might just not enjoy it so much" (1E p2)

"The amount of times I've found carers, other carers that have been in just throwing things away because they don't know the difference between use by and best by. Best by date just seems like a false friend really." (B2, p8)

Those that demonstrated a good knowledge of the difference between best before and use-

by dates said they did not necessarily apply this knowledge. When asked to expand on

reasons for this, they included the fact that they expected dairy products to be perishable

and therefore assumed the dates were a use by.

"I would always take it as a use by" (E4 p31)

It seems here that the type of product was more important than the type of date with regard

to how seriously they treated the expiry date on the product. For other participants the

reason for not interpreting these dates differently came back to the development or their own

rules and belief in their ability to judge the difference between them.

"The only think that use by and best before dates tell me is if you know it's past those dates the product I've bought is getting older and I should consume it faster…but it's not a hard and fast thing." (A1 p3)

"For me they've almost blended into the same thing (best before and use by) but either way I figure there's a plus or minus margin" (E3 p14)

During the examination of the products packaging supplied to the focus group it also became clear that it was sometimes hard to determine whether the date was a best before or a use by date as this additional information was sometimes in the small print elsewhere on the packaging.

3.1.6   Discussion

The results of the focus groups indicated that there are three main points at which participants engaged with expiry dates. First, in shops, second as part of food management (although this was less common) and third in order to make a decision about whether to eat or consume a product. This suggested that these should be considered as different behaviours and therefore could each potentially have their own TPB model associated with them. This would also be consistent with TACT criteria within the TPB (Fishbein, Ajzen 2015) which stands for Target, Action, Context and Time and ensures that the behaviour is singular and specific. It therefore divides "expiry date use" into "checking the expiry date when shopping in the next two weeks", "checking the expiry dates of products in the fridge in the next two weeks", and "using the date label to determine the edibility of a product". WRAP (2011a) identified two of these aspects of date label behaviour, using dates in shops and checking dates as part of ongoing food management. From their cluster analysis they found that their respondents behaved similarly with regard to these two behaviours, and therefore they might be difficult to distinguish empirically. The results also indicated that respondents engaged differently with date labels depending on the product type even within the dairy category. This suggests that different dairy products could be considered as different targets within the TACT framework.

When discussing participants' perceived control over expiry date use in shops or as part of food management one of the barriers that they identified as potentially limiting the ease of use was the size and positioning of the date label. Some claimed it was not clear or that they were not printed in an obvious place. However, they none indicated that it was out with their control to look, rather that this made it required more effort, and therefore indicate this aspect is related to self-efficacy rather than controllability within PBC (Ajzen 2002). With regard to

using expiry dates to make disposal and consumption decision, the picture was more complicated. Some participants described a feeling that the dates controlled them and took them as a rigorous cut-off date by which they should try to consume a product. For others the extent to which they felt that they could exceed the date was dependent on their perceived ability to tell with their senses if a product was suitable to eat. While many participants were confident using their senses in conjunction with dates and acknowledged they used them as an anchor, others who had experience of eating food outside the mainstream context e.g. dumpster diving were happy to use their own judgement about when food was suitable to eat or not. WRAP (2011a) found that most people reported in their survey that they used their sense in conjunction with dates to determine whether to eat or throw away a product. However, this is somewhat contradicted by evidence for dairy products such as yoghurt that some products are thrown away unopened (WRAP 2010).

Participants reported consulting others or the influence of others with regard to deciding whether to consume or dispose of products to a larger extent than might be expected given the findings of other research that food waste is a hidden behaviour (Cecere et al. 2014). It was descriptive norms, observing the actions of parents of flatmates that appeared to influence participants' behaviour. In terms of injunctive norms, it was mentioned that as students it was acceptable, if not expected that they would have little concern for eating out of date food. However, they acknowledged that expectations would change if they were in a caring role or responsible for feeding others. The extent to which others opinions or actions influenced behaviours of checking dates in shops or as part of food management was not a strong theme that emerged.

In addition to eliciting attitudes towards engaging in expiry date use behaviours the focus groups also elicited participants' attitudes towards food waste. Attitudes towards food waste appeared to be divided between viewing food waste as inherently bad and considering wasting food as a waste of money. Finding food waste to be inherently or to an extent morally bad was often associated with a sense of guilt after the fact; however this sense of guilt did not seem to be associated with taking action to prevent waste happening again.

Instead participants reported delaying tactics, allowing food that was suspect to deteriorate further until there was no question about its inedibility. This is a practice also observed by Evans (2011). And there was a sense in which some waste was inevitable. With regard to food waste being a waste of money, participants spoke about being less likely to waste more expensive items, although acknowledged that this was sometimes because more expensive items were bought with a specific purpose. Concern for food waste's negative environmental implications was not something that participants brought up when discussing food waste.

The main perceived risk of eating products after their expiry date was related to food safety, however the perception that products after their expiry date would taste bad and be of lower quality was also important. A number of themes emerged within the discussions of perceived risk. First it was related to personal circumstances and therefore participants were not consistent in their willingness to consume products across time. Second, previous bad experiences of food poisoning or even just consuming products that tasted "off" were very influential with regard to the risk that participants were willing to take. Third, the type of product was important to perceived risk and so was the presence of a reduced label. The presence of the reduced label seemed to have an influence on risk perceptions at home as well as in the shops, perhaps because it acted as a prompt to indicate that a product was close to or past its best. Finally, social factors such as whether the food would be eaten by others, particularly children. Related to injunctive norms participants felt that parents might be judged for giving their child outdated food. Conversely it emerged that participants did not wish to be too conscious of dates in order not to appear picky, which could be interpreted as a facet of social risk (Tsiros, Heilman 2005).

A strong theme in the discussion about trusting date labels was that they could be trusted because it was in the interests of the companies setting the dates to keep consumers safe. Participants highlighted that this belief led them to exceed the expiry date, assuming that companies would by extension build in a buffer. They speculated that not only were dates set earlier because food companies were conscious of safety; it was also driven by their desire to have consumers purchase more. Other participants were more sceptical about

the trustworthiness of date labels primarily based on their own experience of products being judged to be inedible prior to the date. Some recognised that this could be due to failures in the cold chain and others observed that it tended to happen to products from certain shops more than others. It appeared that many participants trusted the system on which the dates were based to the extent that dates were meaningful to them. At least one individual who had experience of food production systems other than those in the UK commented that they were more willing to exceed the expiry date in the UK where they would not in their home country since they trusted the way that food was produced.

One of the last topics to be discussed in the focus groups was knowledge. It was interesting to observe that unprompted most participants did not make a distinction between dates despite the fact that the products displayed on the table displayed products with both best-before and use-by dates. However, when prompted, many participants gave reasonable working definitions of best-before and use-by dates although some still claimed that they had never paid any attention to the difference. With particular reference to dairy products it emerged that some thought that since they were perishable products they would all have a use-by and therefore might not think to check otherwise. Overall it the participants responses indicate that even if they do have a good idea of the difference between best-before and use-by dates it is not always something that seems pertinent to them when considering their consumption of dairy products. This links to the idea that declarative knowledge, or knowledge of facts can be distinguished from effectiveness knowledge, defined as knowing which actions are likely to be effective in leading to a desired outcome (Kaiser and Fuhrer 2003); in this case reducing the number of dairy products thrown away which are actually safe to eat.

3.2   Survey

Following the literature review and focus groups a survey was developed that ran in two stages three weeks apart. The first stage measured respondents' willingness to consume products in relation to the date label and a range of concepts described through the literature

review and focus group, understood to affect expiry date behaviour. The second stage asked respondents about their behaviours over the intervening three weeks.

Table 3.2 provides a high level overview of the concepts used across the models and at which stage they were captured. Chapters 4, 5, 6, and 7 go into detail about the measures used for each concept and describe the sources from which the measures were adopted or adapted. A copy of the survey is included in Appendix 2.

Table 3.2 Overview of variables used in the models survey by stage and order they appeared in survey

Variables used from survey stage 1	Variables used from survey stage 2
Willingness to consume (WTC)	Frequency of checking dates in shops plus follow up barriers and enablers
Intentions	
	Frequency of checking dates at home (as part of food management) plus follow up barriers and enablers
Subjective knowledge	
Declarative knowledge	
	Frequency disposing dairy products because the use-by date had passed
PBC	
- Self-efficacy	Frequency of disposing dairy products because the best-before date had passed
- Controllability	
- Procedural knowledge	
	Habit
Attitudes (towards behaviours)	
Attitudes (towards waste)	
Risk Perceptions	
Trust	
- System trust	
- Calculative trust	
Subjective norms	
- Injunctive norms	
- Descriptive norms	
Effectiveness knowledge	
Sources of information and trustworthiness	

An early version of the online survey was tested with a small snow-balled sample of respondents (n = 30). Feedback from these respondents was sought on ease of understanding, time to complete, logic and flow. As a result of this feedback the survey was shortened, and a number of changes to item wording were made, as well as clarifications to some key terms e.g. using your senses.

3.3   Data collection

The survey was administered online between October 2016 and December 2016 using the Qualtrics platform. Respondents were recruited through the Qualtrics online panel to create a sample of the Scottish adult population stratified by age, income and gender. Respondents were told about the nature and source of funding of the research as well as how the results would be used on the first page of the survey. At this point they could then choose not to proceed. Respondents were screened to ensure that they were regular consumers of dairy products and that they were wholly or partly responsible for purchasing and disposal decisions in their household. A number of data quality checks were also performed. With the first 50 responses a median time to complete the survey was established. Those who took less than one third of the median time were excluded. We also included an attention filter half way through the first survey which required respondents to give a specific answer to the question "I live in Scotland". Only one person was excluded for failing this attention filter. We received 548 complete responses to the first part of the survey; the characteristics of which are outlined in Table 3.3.

Table 3.3 Sample demographics survey stage 1 (548 observations)

Household income	%	Age	%
Less than £14,000	14	18-24	7
£14,000 - £20,999	20	25-34	14
£21,000 - £27,000	13	35-44	13
£28,000 - £34,999	12	45-54	15
£35,000 - £41,999	11	55-64	26
£42,000 - £49,999	10	65+	25
£50,000 - £65,999	9		
£66,000 - or more	11	**Education**	
		Less than high school	1
		High/secondary school	41
Gender		University degree	30
Male	49	Postgraduate degree	13
Female	51	Professional qualifications	14
		Other	1

Due to sampling limitations[3], in the final sample respondents aged 25-34 are slightly under-represented and respondents aged 55-64 are slightly over-represented compared to the Scottish population. Those in the £14,000 - £20,999 were also slightly under-represented and those in the £42,000 plus income bracket were slightly over-represented compared to the Scottish population overall. The second part of the survey was sent to the same 548 people, 383 of which responded, a response rate of 70 per cent. The characteristics of the stage 2 sample are also displayed in Table 3.4.

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[3] Within the Scottish population Qualtrics could only commit to 300 completes in line with quotas on age, gender and income. The remaining contracted 200 completes with no quotas were allowed to fall out naturally.

Table 3.4 Sample demographics survey stage 2 (383 observations)

Household income	%	Age	%
Less than £14,000	12	18-24	3
£14,000 - £20,999	17	25-34	8
£21,000 - £27,000	14	35-44	13
£28,000 - £34,999	13	45-54	16
£35,000 - £41,999	12	55-64	30
£42,000 - £49,999	10	65+	30
£50,000 - £65,999	10	**Education**	
£66,000 - or more	11	Less than high school	4
Gender		High/secondary school	162
Male	51	University degree	108
Female	49	Postgraduate degree	45
		Professional qualifications	61
		Other	3

A series of chi-squared tests were conducted to establish whether the observed differences in responses to demographic questions were significant different from one another in the two samples. The results suggest that the responses were not significantly different for age (Chi-squared = 4.01, df = 5, p-value = 0.55), gender (Chi-squared = 0.02, df = 1, p-value = 0.89) or income (Chi-squared = 0.56, df = 7, p-value = 0.99).

3.4   Data analysis

Structural equation modelling with latent variables was chosen as the main technique for analysing the survey data because it facilitates the confirmation or disconfirmation of complex models (Schumacker, Lomax 2010) such as those proposed in the TPB (Ajzen 1991) or ecological knowledge (Kaiser and Fuhrer 2003). These models describe relationships between socio-psychological concepts such as attitudes, social norms and intentions which may not themselves be directly observed but may be measured by a number of indicators (Schumacher and Lomax 2010 p. 180).

Structural equation models consist of two parts: a measurement model and a structural model. In the case of latent variable modelling the measurement model specifies the relationship between latent variables and the indicator variables, which are the variables

measured in the survey. The structural model specifies the relationship between the latent variables. These relationships can be described by three equations. They are described using the notation from LISREL (Jöreskog, Sörbom 1996) as this is common across the SEM literature. The reference from which the description below was taken was Shumacker and Lomax (2010).

The two equations describe the measurement model and describe the relationship between the observed variables and the latent dependent (or endogenous) variables and the observed variables and the latent independent (or exogenous) variables.

$$Y = \Lambda_y \eta + \varepsilon$$

$$X = \Lambda_x \xi + \delta$$

Y is a (px1) vector of observed endogenous indicators

Λ_y is a (pxm) matrix of coefficients for y on η

η is a (mx1) vector of the endogenous latent variables

ε is a (px1) vector of the errors in the measurement model

X is a (qx1) vector of observed exogenous indicators

Λ_x is (pxn) matrix of coefficients for x on ξ

ξ is a (nx1) vector of the exogenous latent variables

δ is a (qx1) vector of the errors in the measurement model

The third equation describes the structural model i.e. the relationship between the exogenous and endogenous latent constructs.

$$\eta = \beta\eta + \Gamma\xi + \zeta$$

β is an (mxm) matrix of structural coefficients for the endogenous variables η

Γ is an (mxn) matrix of the structural coefficients for the exogenous variables ξ

ζ is an (mx1) vector of errors in the structural model

3.4.1 Model estimation

The data resulting from the survey consisted of primarily ordinal categorical variables on Likert scales. Therefore the models reported in Chapters 4, 5, 6, and 7 are estimated using a diagonally weighted least squared (DWLS) estimators. These were chosen because maximum likelihood (ML) estimates have been found to be inaccurate for ordinal measures particularly when there are five or fewer categories (Finney, DiStefano 2006). More recent studies have also found DWLS estimators to perform better across a range of conditions (e.g. least biased parameter estimates and accuracy of standard errors) when using categorical variables on ordinal scales compared to the most commonly used estimator of ML (Bandalos 2014; Mindrila 2010) although ML has been found to be acceptable under some circumstances (Rhemtulla et al. 2012). While many of the measures in the survey have 1-7 Likert scales, many also have 1-5 and some are binary. Furthermore many of the distributions are asymmetric. We therefore follow the Kline's (2016) advice and use a DWLS estimator to ensure that a suitable and consistent estimator is applied across all models.

The family of weighted least square (WLS) methods is based on work by Muthen (1984) and uses polychoric (or tetrachoric) correlations rather than Pearson correlations used for numeric variables (Rosseel 2017). This study uses a scaled (robust) DWLS estimator, WLSMV, from the lavaan package in R (Rosseel 2012). This uses the diagonal of the weight matrix (which is the asymptotic covariance matrix of the sample statistics) for estimation of the parameters and the full matrix is to calculate the standard errors and the test statistics (Rosseel 2017).

3.4.2 Model testing and fit

There is discussion within the SEM literature as to how to assess the fit of a model and as a result it is recommended that a range of goodness-of-fit indicators are reported and assessed (Kline 2016). It is also recommended to assess the convergent and discriminant

validity of the measurement model (Hair et al. 2009) and furthermore that alternative structural models are tested to assess the accuracy of the proposed models (Kline 2016).

The measurement models are assessed for convergent and discriminant validity. In order to determine the convergent validity only items that are statistically significant and have standardised loadings of .50 and ideally .70 or greater are retained (Hair et al. 2009). Where items have standardised loadings of .71 or less this indicates that less than 50 per cent of the variance observed is explained by the latent variable onto which they are loaded (Hair et al. 2009). Convergent validity is also assessed using the Average Variance Extracted (AVE). Proposed by Fornell and Larker (1981) the AVE considers the mean variance extracted for items loading on a latent variable. It is calculated by the squaring standardised factor loadings and dividing by the number of observations (i.e. average squared standardised factor loadings). The following equation is taken from Hair et al. (2009 p.619):

$$\text{AVE} = \frac{\sum_{i=1}^{n} L_i^2}{n}$$

L represents the standardised factor loadings and i is the number of items. Where latent variables have an AVE of < .50 this indicates that "on average more error remains in the items than variance explained by the latent factor structure imposed on the measure" (Hair et al. 2009; p 619).

In addition we also test the reliability and internal consistency of each latent variable using the Construct Reliability (CR) (sometimes called composite reliability). The CR takes the squared sum of the factor loadings and the sum of the error variances and divides them by the squared sum of the factor loadings. The following equation is also taken from Hair et al. (2009 p.619):

$$\text{CR} = \frac{\left(\sum_{i=1}^{n} L_i\right)^2}{\left(\sum_{i=1}^{n} L_i\right)^2 + \sum_{i=1}^{n} e_i}$$

In this equation the additional term e_i represents the error variance terms for a construct. Here it is desirable to have a score of .70 or above to indicate good reliability.

In addition to assessing the convergent validity of constructs in the measurement model it is equally important to assess their discriminant validity to ensure that latent variables are distinct from one another. Fornell and Larcker (1981) propose that the AVE of any two constructs in the model should be greater than the square of the correlation estimate between those two constructs[4]. This test captures the idea that "a latent construct should explain more of the variance in its item measures than is shared with another construct" (Hair et al. 2009 p. 620).

In terms of global model fit an insignificant (p-value > 0.05) Chi-squared value relative to the degrees of freedom is desirable implying that that the observed and implied variance-covariance matrices are similar. For a number of reasons e.g. its sensitivity to non-normality and tendency to produce a p-value <= 0.05 in larger samples, this is supplemented with a range of other measures (Kline 2016). This study also uses the root-mean-square error of approximation (RMSEA) and the standardised root mean square residual (SRMR) as measures of absolute fit and Bentler comparative fit index (CFI) as a measure of incremental fit (Table 3.5). In terms of reporting, this study also follows the recommendations of Kline (2016). This includes reporting both the unstandardised and fully standardised loadings of the key parameters calculated by the model.

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[4] This is sometimes reported as the square root of the AVE being greater than the correlation estimates of two constructs and will be done so here for ease of presentation.

Table 3.5 Measures of model fit and values reflecting a good fit

Fit measure	Values reflecting a good fit
Model chi-square	Ideally p value is not significant indicating replication of matrices
Root-mean-square error of approximation RMSEA	< .08 or better <.05
Bentler comparative fit index (CFI)	>.90
Standardised root mean square residual (SRMR)	< .10 or better <.05

Note. Choice of measures and cut offs are derived from Kline (2016) and Schumacher and Lomax (2010)

4   Understanding date-label behaviours using the TPB

This chapter addresses *Research Question 1: To what extent does the TPB explain the date-label use in different contexts?* It is structured as follows. Section 4.1 describes the hypotheses to be tested and outlines the structural models. Section 4.2 describes the measures used to construct each variable from the survey and provides their descriptive statistics. Section 4.3 presents the results of the analysis. This section is subdivided by behaviour, since behaviours are modelled separately in models A1, B1, and C1. The final section (4.4) is a discussion of the results and the limitations specific to this chapter.

4.1   Background and hypotheses

Three food-waste-associated behaviours are analysed in this chapter: throwing away products because the expiry date has passed (Model A1); checking date labels in shops (Model B1); and checking date labels in the fridge as part of ongoing food management (Model C1). It provides insights into the determinants of each of these food-waste-associated behaviours using the TPB (Ajzen 1991). As described in Chapter 1, little of the food-waste literature to date has tried to understand what drives food waste associated behaviours (section 2.2). This subset of date label behaviours was chosen on the basis of evidence that date-label use, as a general category of behaviour, has been found to correlate highly with overall food waste levels (section 2.3.2). The scope is limited to dairy products since differences in date-label use since date labels have been found to be particularly important for deciding when to dispose of dairy products (section 1.2). Reflecting on Ajzen (2015) the consumption of different food products would typically be modelled separately and therefore we apply the same to their waste.

4.1.1   Model and hypotheses

Figure 4.1 outlines the structure of the model to be tested. This will be run for the three separate behaviours: throwing away products because the expiry date has passed (Model A1); checking date labels in shops (Model B1); and checking date labels in the fridge as part of ongoing food management (Model C1). Following the TPB (Ajzen 1991) we hypothesise

for all behaviours that respondents will be more likely to report positive intentions to engage

in each behaviour if they: report more positive attitudes towards the behaviour

(H1a/H1b/H1c); perceive stronger social norms to engage in the behaviour (H2a/H2b/H2c) or

report stronger PBC over the behaviour (H3a/H3b/H3c). Finally, those respondents that

report stronger intentions to engage in the behaviours (H4a/H4b/H3c) or report stronger PBC

(H5a/H5b/H5c) will also be more likely to report actually engaging in the behaviours.
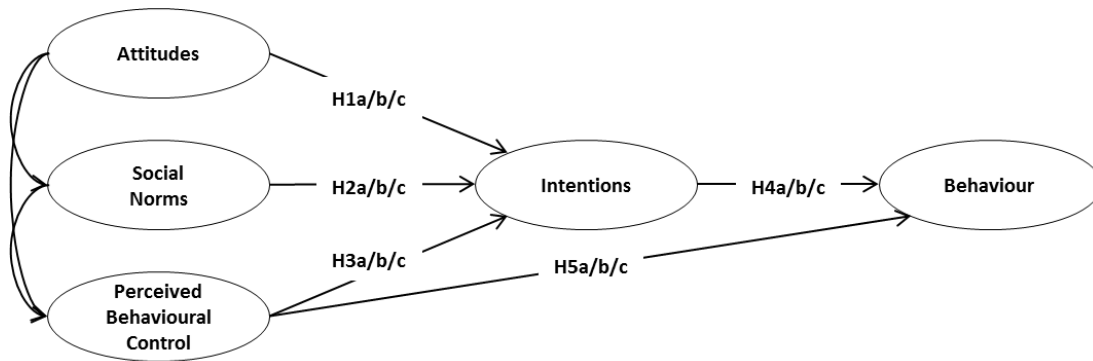
Figure 4.1 Diagram of structural model based on the TPB (Ajzen 1991)

4.2   Survey data, sample, and descriptive statistics

As described in Chapter 3, a survey was implemented using an online survey platform and panel. From survey part 1 this chapter uses measures for attitudes, social norms, PBC and intentions relating to checking expiry dates in shops, checking dates in the fridge as part of ongoing food management and using the expiry date to make disposal decisions. From survey part 2 which was conducted 3 weeks after survey part 1 it uses measures of reported behaviour; checking expiry dates in shops, in the fridge, and using the expiry date to make disposal decisions. 383 people responded to both survey part 1 and survey part 2. Respondents were given the option in part 2 to indicate that a particular behaviour was not relevant to them, for example they may not have purchased that type of dairy product in the intervening 3 weeks. This resulted in further reduction of the samples as those observations where they behaviour was NA had to be filtered out. Table 4.1 outlines the sample size for each of the models.

Table 4.1 Model and sample size

Model	Sample size
Model A1	331
Model B1	343
Model C1	330

4.2.1 Model A1: Throwing away products where the expiry date has passed

Model A1: Intentions

Intentions to dispose of products where the expiry date had passed were measured by using the following statements. *In the next two weeks how likely are you to:*

- Throw away dairy products because the use-by date has passed (Q9_5);
- Throw away dairy products based on the use-by date and your senses (Q9_6);
- Throw away dairy products because the best-before date has passed (Q9_7);
- Throw away dairy product based on the best-before date and your senses (Q9_8).

The responses were on a 7-point Likert scale of extremely unlikely [1] to extremely likely [7]. The questions were formulated based on guidance in Fishbein and Ajzen (1980) which emphasises the need to formulate questions for intentions as well as behaviour on the basis of target, action, context and time. These questions were designed to measure the respondents' intentions to engage in the narrow behavioural category of using date labels to make disposal decisions. Given evidence from the focus group outlined in Chapter 3 it was hypothesised that using date labels to make disposal decisions would form one factor and not separate factors for best-before and use-by dates[5]. As previously described date labels are understood to be important for making decisions about when to dispose of dairy products (WRAP 2015). However, some individuals also engage their senses and therefore statements reflecting this were also included (WRAP 2011a). Table 4.2 outlines the frequency of responses, mean and standard deviations of the responses given.

Model A1: Attitudes

Attitudes towards using date labels to determine whether to consume dairy products were measured by six items.

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[5] This hypothesis was strengthened based on the findings of Chapter 6 which indicated that respondents did not make a strong distinction between use-by and best-before date labels in terms of when in relation to the date they would be willing to consume them.

- Bad/Good (Q19_1)

- Unwise/Wise (Q19_2)

- Unsafe /Safe (Q19_3)

- Unnecessary/Necessary (Q19_4)

- Not Time Consuming/Time Consuming (reversed) (Q19_5)

- Inconvenient/Convenient (Q19_6)

A scale of 1-7 was given with the opposing words at either end of the scale where a negative response was coded as [1] and the most positive response was coded as [7]. The frequencies of responses are outlined in Table 4.2. Most respondents reported that disposing of dairy products because the expiry date had passed was both a good and wise thing to do. Fewer respondents reported that this action was strongly necessary and the spread of responses relating to time consumption and convenience were similar for both behaviours.

Table 4.2 Model A1: frequency, mean and standard deviations of responses to items from survey part 1 (n = 331)

Items grouped by concept	Scale							Mean	SD
	1	**2**	3	4	5	6	7		
Intentions									
Q9_5	52	33	49	30	42	54	71	4.28	2.15
Q9_6	24	15	22	28	66	73	103	5.20	1.83
Q9_7	68	37	51	40	42	41	52	3.85	2.12
Q9_8	37	27	32	38	58	66	73	4.64	2.00
Attitudes									
Q19_1	4	6	5	27	53	69	167	6.00	1.31
Q19_2	3	1	6	21	52	72	176	6.14	1.17
Q19_3	2	0	2	21	51	81	174	6.20	1.05
Q19_4	6	5	18	50	69	63	120	5.54	1.47
Q19_5	12	35	42	62	28	46	106	4.88	1.91
Q19_6	6	8	17	79	64	64	93	5.27	1.48
PBC									
Q15_3	0	3	5	40	44	115	124	5.92	1.13
Q15_8	0	3	5	40	44	115	124	5.92	1.13
Q15_6	2	3	11	28	50	121	116	5.86	1.19
Q15_7	1	5	16	23	47	131	108	5.82	1.21
Q15_11	1	2	15	15	45	124	129	5.99	1.14
Q16_1	0	1	5	15	51	95	164	6.19	0.99
Q16_19	4	5	15	37	91	100	79	5.48	1.28
Q16_2	6	13	22	46	83	91	70	5.24	1.46
Q16_21	4	6	22	34	87	95	83	5.45	1.35
Q16_3	24	35	53	39	85	48	47	4.38	1.79
Social Norms									
Q27_1	20	37	63	88	55	57	11	4.02	1.53
Q27_5	9	24	50	97	71	58	22	4.39	1.43
Q28_1	31	48	51	61	93	38	9	3.87	1.60
Q28_2	13	36	43	69	98	55	17	4.32	1.50

Model A1: PBC

PBC related to throwing away products because the expiry date had passed was initially conceived to consist of two different latent variables. The first concept intended to measure consumers' perceived ability or confidence regarding using and understanding the date label.

Please indicate the extent to which you find it easy or difficult to:

- Make use of the use-by date when deciding whether to throw away a dairy product (Q15_3);

- Make use of the best before date when deciding whether to throw away a dairy product (Q15_8).

A 7-point Likert scale was used with the scale between extremely difficult [1] and extremely easy [7]. The second concept measured the perceived ability of respondents to use their senses to determine whether a product is good to eat.

Please indicate the extent to which you find it easy or difficult to:

- Determine the quality of dairy products using your senses (Q15_6);

- Determine the safety of dairy products using your senses (Q15_7);

- Use my senses to tell if a dairy product is edible (Q15_11).

Please indicate the extent to which you agree or disagree with the following statements:

- The decision to dispose of dairy products is within my control (Q16_1);

- Using my senses is the best way to check if a dairy product is still good to eat (Q16_2);

- Deciding when a dairy product should be thrown away is not up to me, it is defined by the expiry date (Q16_3) (reverse coded);

- I am confident in my ability to determine if a dairy product is edible using only my senses (Q16_19);

- It is up to me to decide whether or not a dairy product is edible (Q16_21).

Questions coded with Q15 were on a 7-point scale of extremely easy [1] to extremely difficult [7]. Questions coded Q16 were on a scale of strongly disagree [1] to strongly agree [7]. The frequencies of responses again can be found in Table 4.2.

The majority of respondents reported finding it easy to make use of the expiry date in disposal decisions. Unfortunately the frequency of responses to items Q15_3 and Q15_8 proved to be identical and therefore this factor had to be excluded from further analysis.

Nevertheless it is interesting to observe that at a sample level there appears to be no difference in ease of use of best-before compared to use-by dates. Fewer respondents reported that they felt able to determine the edibility of dairy products using their senses. For each of the items measuring this construct there is a wider range of responses.

Model A1: Social Norms

A number of studies have proposed adaptations or additions to the TPB framework since its inception, particularly around the type of norms included. After evidence from Armitage and Connor (2001) that the relationship between subjective norms and intentions is often weak, a measure of descriptive norms is also included. Descriptive norms "reflect the perception of whether other people perform the behaviour in question" (White et al. 2009 p. 137). White et al. (2009) found that descriptive norms were significant predictors of intentions. The importance of descriptive norms was also recognised by Fishbein and Ajzen (2015). Here a combined measure of the subjective norms originally described by Fishbein and Ajzen (1980) as well as descriptive norms is used and henceforth refer to these as social norms. Social norms with regard to eating dairy products after the best before date were measured again by two items; the first measured subjective norms and the second measured descriptive norms with regard to eating dairy products after the best before date.

The subjective norms were measured by the following statements.

Thinking about people who are important to you; how do you think they would feel about performing the following actions?

- Eating dairy products after the use-by date (Q27_1);
- Eating dairy products after the best-before date (Q27_5)

The descriptive norms were measured by asking:

Thinking again about those people who are important to you; how often do you think they perform the following actions?

- Eat dairy products after the use-by date (Q28_1);

- Eat dairy products after the best before date (Q28_2).

Statements coded Q27 were answered on a 7-point Likert scale strongly disapprove [1] to strongly approve [7]. Statements coded Q28 were also answered on a 7-point Likert scale but were coded never [1] to always [7]. Descriptive norm responses have a slightly lower mean response than subjective norms indicating that people who are important to the respondents might not be believed to eat products beyond their expiry date that often, but the respondents did not believe they would be disapproved of for doing the same.

Model A1: Behaviour

Using the expiry date to determine when to throw away a dairy product was measured by asking respondents to report how frequently they recalled throwing away a dairy product where the main reason was that its best-before or use-by date had passed. Milk was not included in the best-before date condition since the vast majority of milk is purchased fresh and has a use-by date rather than a best-before date. Respondents were given five options ranging from never [1] to every day [7]. They were also given an "NA" option in case they did not have the product at home during the survey period or at least one that had a best before date.

The responses show that the majority of respondents reported not throwing away products during the time under study. Of the three products yoghurt was reportedly thrown away because it passed its expiry date more frequently than the other products. Because of the low number of responses in some categories, this variable was recoded as a binary variable. This means that if respondents reported no waste they were recorded as 0 and if respondents reported some waste (i.e. in categories 2, 3, 4, or 5) they were recorded as 1. The frequencies of responses are described in Table 4.3.

Table 4.3 Model A1: Frequencies of responses to expiry date use behaviour from survey part 2 (n = 331)

Behaviour	Not engaged in disposal behaviour (0)	Engaged in disposal behaviour (1)	Mean	SD
Q5.1_1 (Milk use-by)	240	91	0.27	0.45
Q5.1_2 (Cheese use-by)	259	72	0.22	0.41
Q5.1_3 (Yoghurt use-by)	230	101	0.31	0.46
Q5.3_2 (Cheese best-before)	274	57	0.17	0.38
Q5.3_3 (Yoghurt best-before)	246	85	0.26	0.44

4.2.2   Model B1: Checking expiry dates in shops

Model B1: Intentions

Intentions to check date labels in shops measured how likely respondents were to check date labels in shops within the next few weeks. It was measured by four items. *In the next two weeks how likely are you to:*

- When shopping, check expiry dates on dairy products are sufficient to use as planned (Q9_10)

- When shopping, choose dairy products whose expiry date is furthest into the future (Q9_11)

- When shopping, forget to check the expiry dates on dairy products (Q9_12)

- Check expiry dates when shopping (Q9_13)

As described in section 4.2.1 questions about intentions were recorded on a 7-point Likert scale of extremely unlikely [1] extremely likely [7]. Most respondents reported that they intended to check date labels on dairy products when they shopped in the next few weeks. There were slightly more responses in extremely likely for both choosing products furthest into the future (Q9_11) and simply checking date labels when shopping (Q9_13) than there were for checking that products had the shelf-life that was required to use the product as planned (Q9_10). The negatively worded statement (Q9_12) has a different profile to the other three after recoded to account for the negative wording. It is not clear whether the

negative wording resulted in respondents miss-reading the question or whether the change phrasing resulted in a genuinely different spread of responses. Table 4.4 outlines the results.

Model B1: Attitudes

Attitudes towards checking dates in shops were measured by five items. *Checking dates in the supermarket is:*

- Good/Bad (Q17_1)

- Wise/Unwise (Q17_2)

- Time Consuming/Not Time Consuming (reversed) (Q17_3)

- Convenient/Inconvenient (Q17_4)

- Necessary/Unnecessary (Q17_5)

The additional items around safety and waste were not included as they were not thought to be pertinent earlier in a products lifecycle. Many respondents reported that checking date labels in shops was a both a good action to take and a wise action to take. Many were also likely to believe it to be necessary (Table 4.4). Responses to attitudes that captured the effort (time consumption and convenience) show a greater spread of responses, although the most frequent answers were still that checking dates in shops was not time consuming and that it was convenient.

Table 4.4 Model B1: frequency, mean and standard deviations of responses to items from survey part 1 (n =343)

Items grouped by concept	Scale							Mean	SD
	1	2	3	4	5	6	7		
Intentions									
Q9_10	3	3	6	16	27	67	221	6.34	1.15
Q9_11	3	2	3	12	19	58	246	6.50	1.03
Q9_12	13	30	34	33	44	56	133	5.23	1.89
Q9_13	3	2	6	7	25	70	230	6.44	1.05
Attitudes									
Q17_1	0	1	1	9	26	47	259	6.61	0.80
Q17_2	0	1	2	8	18	50	264	6.64	0.78
Q17_3	24	32	38	55	30	45	119	4.88	2.02
Q17_4	6	9	19	64	59	62	124	5.46	1.53
Q17_5	2	1	10	28	41	74	187	6.13	1.20
PBC									
Q15_1	183	109	29	16	4	2	0	1.70	0.96
Q15_12	191	88	36	17	10	1	0	1.75	1.05
Q15_2	216	86	27	10	2	2	0	1.55	0.88
Q16_6	125	90	54	47	17	9	1	2.34	1.38
Social Norms									
Q27_6	0	2	2	24	57	113	145	6.08	1.01
Q28_4	6	8	15	40	63	110	101	5.57	1.40

Model B1: PBC

PBC over checking date labels in shops was measured by asking respondents how easy or difficult they find it to check date labels in shops. This was measured by three items.

Please indicate the extent to which you find it easy or difficult to:

- Find expiry date information on dairy products (Q15_1)

- Check expiry date information on dairy products when shopping (Q15_2)

- Remember to check expiry date information when shopping (Q15_12)

Again statements coded Q15 were answered on a 7-point Likert scale of extremely easy to extremely difficult. The frequency, mean and standard deviation of each item are described in Table 4.4. The results indicate that majority of respondents find it easy to check date labels in shops.

Model B1: Social norms

Social norms were measured by two items. A measure of subjective norms which measured approval or disapproval of others and second a descriptive norms which asked about the actions of others that respondents had observed. The subjective norms with regard to checking date labels in shops were measured by asking:

Thinking about people who are important to you; how do you think they would feel about performing the following actions:

- Checking the expiry date information in shops (Q27_6)

The descriptive norms was measured by asking:

Thinking again about those people who are important to you; how often do you think they perform the following actions?

- Checking expiry date information in shops (Q28_4)

The responses indicate that there is a positive social that supports checking dates in shops. Very few respondents thought that people would disapprove of them checking dates in shops. However, a few did indicate that people that were important to them might not themselves be likely to check dates in shops.

Model B1: Behaviour

Checking date labels in shops was measured by asking respondents how often they checked the date labels for milk, yoghurt, and cheese. Respondents were given five options ranging from "every time" to "not at all". They were also given a "not purchased" option which is coded as NA. The responses to the behaviour questions indicate that there were some differences in the frequency of expiry date checking by product type (Table 4.5). Respondents reported checking those products with a typically shorter shelf life (milk and yoghurt) more frequently than those with a longer shelf life (cheese).

Table 4.5 Model B1: Frequencies of responses to expiry date use behaviour from survey part 2 (n = 343)

Behaviour	Scale					Mean	SD
	1	2	3	4	5		
Q3.1_1 (Milk)	28	8	12	44	251	4.41	1.20
Q3.1_2 (Yoghurt)	21	20	18	57	227	4.31	1.19
Q3.1_3 (Cheese)	39	39	32	69	164	3.82	1.42

4.2.3   Model C1: Checking date labels in the fridge

Model C1: Intentions

Intentions to check dates on dairy products in the fridge were measured by the following statements. *In the next two weeks how likely they are you to:*

- Check the amount of time that a dairy product is open (Q9_2)
- Check expiry dates on products in your fridge (Q9_3)

Items were measured on the same scales outlined sections 4.2.1 and 4.2.2. The pattern of responses indicated in Table 4.6 suggest that respondents were slightly more likely to regularly check date labels in their fridges than check the remaining open life of products.

Model C1: Attitudes

Attitudes were measured using the same scales as detailed in section 4.2.2. Due to the low scores in categories 1 and 2 across all of the attitudes item measures, these were recoded as category 3 giving a 5 point, rather than a 7 point scale. The resulting response frequencies are described in Table 4.6. Attitudes towards checking date labels in fridges were overwhelmingly positive compared to the previous two behaviours where attitudes were more mixed.

Table 4.6 Model C1: frequency, mean and standard deviations of responses to items from survey part 1 (n = 330)

Items grouped by concept	Scale							Mean	SD
	1	**2**	**3**	**4**	**5**	**6**	**7**		
Intentions									
Q9_2	12	11	28	34	58	104	83	5.30	1.60
Q9_3	7	6	7	21	54	103	132	5.87	1.35
Attitudes									
Q18_1	-	-	7	25	38	57	203	6.28	1.07
Q18_2	-	-	1	24	24	70	211	6.41	0.93
Q18_3	-	-	3	20	37	67	203	6.35	0.96
Q18_4	-	-	19	50	46	61	154	5.85	1.31
Q18_5	-	-	168	60	38	39	25	4.07	1.33
PBC									
Q15_4	117	110	44	39	16	4	0	2.21	1.25
Q15_5	55	100	55	53	40	20	7	3.03	1.58
Q16_7	17	48	45	76	56	54	34	4.22	1.70
Social Norms									
Q27_3	0	3	4	43	64	130	86	5.73	1.08
Q28_5	7	6	28	60	82	93	54	5.12	1.40

Note. – indicates that these scales were condensed from their original 7 categories to 5 categories

Model C1: PBC

PBC was measured by three items. *Please indicate the extent to which you find it easy or difficult to:*

- Keep track of expiry dates at home (Q15_4)
- Keep track of when you opened dairy products (Q15_5)

Please indicate the extent to which you agree or disagree with the following statements:

- I have tactics to ensure I know how long products have been open in my fridge (Q16_7)

Again items coded Q15 were measured on a 7-point Likert scale of extremely difficult to extremely easy and items coded Q16 were measured on a 7-point Likert scale of strongly disagree to strongly agree.

Model C1: Social norms

Social norms were again measured by two items. Subjective norms were measured by asking: *Thinking about people who are important to you; how do you think they would feel about performing the following actions?*

▪ Regularly checking expiry dates on dairy products in my fridge (Q27_3)

The descriptive norms were measured by asking: *Thinking again about those people who are important to you; how often do you think they perform the following actions?*

▪ Regularly check expiry dates on dairy products in their fridge (Q28_5)

In a similar fashion to the social norms described in section 4.2.2 it seems that our respondents perceive checking dates in the fridge to be an action others would approve of, however they don't report the descriptive norms with quite the same strength.

Model C1: Behaviour

How often respondents reported checking the date labels on products in their fridges was measured on a five-point Likert scale with options never [1] to every day [5] as well as the option to choose NA. Table 4.7 outlines the responses after the NA responses were filtered out. The dates on milk and yoghurt appear to be checked more frequently than the dates on cheese.

Table 4.7 Model C1: Frequency of responses to date-label use behaviour from survey part 2 (n = 330)

Behaviour	Scale					Mean	SD
	1	2	3	4	5		
Q4.1_1 (Milk)	64	31	91	101	43	3.08	1.30
Q4.1_2 (Yoghurt)	51	42	100	110	27	3.06	1.19
Q4.1_3 (Cheese)	84	78	106	45	17	2.49	1.16

4.3   Results of structural models

This section presents the results of the structural equation models with latent variables used to test the extent to which the TPB can further our understanding of three expiry date behaviours. Details of the method used were described in Chapter 1.

4.3.1   Model A1: disposing of dairy products because the expiry-date has passed

Model A1 tested the extent to which the TPB can explain throwing away products because the expiry-date has passed. During the first stage of estimating the measurement model items Q19_5, Q16_3, Q16_2 and Q16_1 were found to have low standardised loading values of .5 or below and/or cross loadings with other latent factors upon inspection of the modification index. They were therefore dropped from further analysis. All items retained in the measurement model had significant standardised loadings of .5 or above (p < .001). The factor loadings (both unstandardised and fully standardised) are reported in Table 4.8.

As outlined in Chapter 3 the Average Variance Extracted (AVE) was used as a measure of convergent validity and the Composite Reliability as a measure of reliability. The AVE for each latent variable was .50 or above, and the CR was .70 or above for all constructs (Table 4.9) in line with recommended thresholds (Hair et al. 2009). Also as outlined in Chapter 3 the square root of the AVE was compared with the correlation of each latent pair as a measure of discriminant validity between the constructs (Table 4.10). Overall the convergent and discriminant validity of the constructs in the model was satisfactory.

Table 4.8 Parameter estimates Model A1

Parameter	Unstandardised			Standardised		
	Estimate	SE	p value	Estimate	SE	p value
Behaviour						
Q5.1_1	1.00	0.00	0.00	0.69	0.05	0.00
Q5.1_2	1.38	0.11	0.00	0.95	0.02	0.00
Q5.1_3	1.37	0.11	0.00	0.95	0.02	0.00
Q5.3_2	1.39	0.11	0.00	0.96	0.02	0.00
Q5.3_3	1.40	0.11	0.00	0.96	0.02	0.00
Intentions						
Q9_5	1.00	0.00	0.00	0.90	0.02	0.00
Q9_6	0.70	0.04	0.00	0.63	0.04	0.00
Q9_7	1.01	0.03	0.00	0.91	0.02	0.00
Q9_8	0.87	0.03	0.00	0.78	0.02	0.00
Attitudes						
Q19_1	1.00	0.00	0.00	0.96	0.01	0.00
Q19_2	0.99	0.01	0.00	0.95	0.01	0.00
Q19_3	0.93	0.02	0.00	0.89	0.01	0.00
Q19_4	0.89	0.02	0.00	0.86	0.02	0.00
Social Norms						
Q27_1	1.00	0.00	0.00	0.82	0.02	0.00
Q27_5	1.00	0.04	0.00	0.82	0.02	0.00
Q28_1	1.00	0.03	0.00	0.82	0.02	0.00
Q28_2	0.95	0.03	0.00	0.78	0.02	0.00
PBC						
Q15_6	1.00	0.00	0.00	0.85	0.02	0.00
Q15_7	0.99	0.03	0.00	0.85	0.02	0.00
Q15_11	1.05	0.03	0.00	0.90	0.01	0.00
Q16_19	1.01	0.03	0.00	0.87	0.02	0.00
Q16_21	0.71	0.04	0.00	0.61	0.04	0.00

Note. The standardised solution is completely standardised

Table 4.9 AVE and CR sores for each latent variable across models A1, B1, and C1

Variable	Model A1		Model B1		Model C1	
	AVE	CR	AVE	CR	AVE	CR
Behaviour	0.83	0.96	0.80	0.92	0.77	0.91
Intentions	0.66	0.88	0.64	0.88	0.52	0.68
Attitudes	0.84	0.95	0.68	0.89	0.84	0.95
Social Norms	0.66	0.88	0.45	0.62	0.43	0.60
PBC	0.67	0.91	0.59	0.83	0.55	0.78

Table 4.10 Test of discriminant validity latent variable correlations compared against square root of AVE for Model A1

Variables	Behaviour	Intentions	Attitudes	PBC	Norms
Behaviour	**0.91**				
Intentions	0.37	**0.81**			
Attitudes	0.10	0.28	**0.92**		
PBC	- 0.17	- 0.11	- 0.04	**0.82**	
Social Norms	- 0.14	- 0.27	- 0.37	0.32	**0.81**

Note. The square root of the AVE is bolded on the diagonal

Table 4.11 Direct effect estimates from structural Model A1

Direct effects	Unstandardised			Standardised		
	Estimate	SE	p value	Estimate	SE	p value
Intentions ~ Attitudes	0.20	0.06	0.00	0.21	0.06	0.00
Intentions ~ PBC	- 0.05	0.06	0.46	- 0.05	0.06	0.46
Intentions ~ Social Norms	- 0.20	0.07	0.00	- 0.18	0.06	0.00
Behaviour ~ PBC	- 0.10	0.05	0.05	- 0.13	0.06	0.05
Behaviour ~ Intentions	0.27	0.06	0.00	0.35	0.07	0.00

Note. The standardised solution is completely standardised

The regression coefficients are set out in Table 4.11. Attitudes had a positive association with intentions, supporting hypothesis H1a, and confirming that those expressing a positive attitudes towards throwing products when the expiry date had passed more likely to express stronger intentions to dispose of products because the expiry date had passed. Social norms had a negative influence on intentions. The negative relationship is explained by the coding of the question (disapprove of eating product after the best-before date = 1 approve = 7) indicating that those who felt that important others approved of them eating products after the expiry date or observed important other doing so were less likely to express intentions to throw away a product for the same reason. This supports hypothesis H2a. PBC had a negative association with intentions. Again the negative sign of the relationship is due to the coding of the measures, such that those with greater confidence in their ability to tell if a product was edible were much less likely to express intentions to rely on the expiry date alone. However, the p value does not indicate statistical significance and we cannot therefore claim support for hypothesis H3a. On the other hand we do find support for hypothesis H5a since PBC also has a negative association with behaviour and the p value

indicates statistical significance. Finally intentions were found to have a positive and significant association with behaviour which supports H4a. Overall we found that 15 per cent of the variance in behaviour and 11 per cent of the variance in reported intentions was explained by this model, as represented by the R-squared values. In terms of overall fit both the standard and scaled measures indicated an acceptable fit (Table 4.12) against the criteria described in Chapter 1.

Table 4.12 Global goodness of fit measures models A1, B1, and C1

Measure	Model A1	Model B1	Model C1
Chi-square	394.72	165.70	107.44
DF	200	85	49
P value	0.00	0.00	0.00
Chi-square scaled	424.38	270.28	164.06
DF scaled	200	85	49
P value scaled	0.00	0.00	0.00
Chi-square scaling factor	1.22	0.68	0.73
CFI	0.99	1.00	1.00
CFI scaled	0.98	0.97	0.99
RMSEA	0.05	0.05	0.06
RMSEA ci lower	0.05	0.04	0.04
RMSEA ci upper	0.06	0.06	0.08
RMSEA p value	0.18	0.34	0.13
RMSEA scaled	0.06	0.08	0.08
RMSEA ci lower scaled	0.05	0.07	0.07
RMSEA ci upper scaled	0.07	0.09	0.10
RMSEA p value scaled	0.04	0.00	0.00
SRMR	0.07	0.06	0.06

4.3.2   Model B1: checking date labels in shops

Model B1 tested the extent to which the TPB explained the frequency of checking date labels on dairy products when shopping. During the first stage of model estimation Q17_3 was dropped due to low standardised loading values. The remaining items retained in the measurement model had significant standardised loadings of .50 or above (p < .001) and are reported in Table 4.13.

Table 4.13 Parameter estimates Model B1

Parameter	Unstandardised			Standardised		
	Estimate	SE	p value	Estimate	SE	p value
Behaviour						
Q3.1_1	1.00	0.00	NA	0.91	0.03	0.00
Q3.1_2	0.98	0.05	0.00	0.89	0.03	0.00
Q3.1_3	0.98	0.04	0.00	0.89	0.02	0.00
Intentions						
Q9_10	1.00	0.00	NA	0.80	0.03	0.00
Q9_11	0.93	0.06	0.00	0.75	0.04	0.00
Q9_12	0.91	0.06	0.00	0.73	0.04	0.00
Attitudes						
Q17_1	1.00	0.00	NA	0.92	0.02	0.00
Q17_2	1.00	0.03	0.00	0.92	0.02	0.00
Q17_4	0.65	0.04	0.00	0.60	0.04	0.00
Q17_5	0.88	0.03	0.00	0.81	0.03	0.00
Social Norms						
Q27_6	1.00	0.00	NA	0.71	0.05	0.00
Q28_4	0.88	0.09	0.00	0.62	0.05	0.00
PBC						
Q15_1	1.00	0.00	NA	0.57	0.04	0.00
Q15_2	1.44	0.12	0.00	0.83	0.03	0.00
Q15_12	1.54	0.13	0.00	0.88	0.02	0.00
Q16_6	1.30	0.12	0.00	0.75	0.03	0.00

While the standardised loadings were acceptable, the AVE for the social norms construct was low at .45 and the CR was under the recommended .70 threshold (Hair et al. 2009). The AVE and CR for the remaining constructs were acceptable. On checking the discriminant validity of the constructs it is evident that social norms are not sufficiently distinct from the majority of other constructs and therefore this variable is dropped from the model. It is also noted that the PBC construct has a high correlation with intentions, however it is left in the model and subsequent regression coefficients in the structural model are interpreted with caution accordingly. These results are displayed in Table 4.14.

Table 4.14 Model B1 Correlation of latent variables with square root of AVE

Variables	Behaviour	Intentions	Attitudes	PBC	Social Norms
Behaviour	**0.89**				
Intentions	0.71	**0.80**			
Attitudes	0.59	0.78	**0.82**		
PBC	- 0.63	-0.87	-0.78	**0.77**	
Social Norms	0.49	0.68	0.71	- 0.75	**0.67**

Note. The square root of the AVE is bolded on the diagonal

Table 4.15 Direct effect estimates from structural Model B1

Parameter	Unstandardised			Standardised		
	Estimate	SE	p value	Estimate	SE	p value
Intentions ~ Attitudes	0.29	0.08	0.00	0.30	0.08	0.00
Intentions ~ PBC	- 1.03	0.14	0.00	- 0.64	0.07	0.00
Behaviour ~ PBC	- 0.06	0.25	0.81	- 0.04	0.15	0.81
Behaviour ~ Intentions	0.69	0.15	0.00	0.69	0.14	0.00

Those who reported a more positive attitudes towards checking dates in shops were more likely to express intentions to undertake this behaviour, supporting H1b. PBC was the strongest predictor of intentions, suggesting that those who find it easier to check dates in shops and easier to remember to do so were more likely to express intentions to check dates, which supports hypothesis H3b. However, as highlighted above there is a high level of correlation between PBC and intentions and therefore the high regression coefficient is likely inflated. PBC did not have an association with behaviour that was statistically significant and therefore we reject hypothesis H5b. Finally we found a positive association between intentions and behaviour supporting hypothesis H4b. Table 4.15 describes these results. Overall 52 per cent of the variance in behaviour and 78 per cent of the variance in intentions was explained by this model on the basis of the R-squared. Goodness of fit measures are reported in Table 4.12.

4.3.3   Model C1: checking date labels in the fridge

Model C1 tested the extent to which the TPB explained throwing away products because the expiry-date has passed. During the first stage of model estimation Q18_5 was dropped

due to low standardised loading values. The remaining items retained in the measurement model had significant standardised loadings of .50 or above (p < .001) and are reported in Table 4.16.

Table 4.16 Parameter estimates Model C1

Parameter	Unstandardised			Standardised		
	Estimate	SE	p value	Estimate	SE	p value
Behaviour						
Q4.1_1	1.00	0.00	NA	0.86	0.02	0.00
Q4.1_2	1.02	0.03	0.00	0.88	0.02	0.00
Q4.1_3	1.04	0.03	0.00	0.89	0.02	0.00
Intentions						
Q9_2	1.00	0.00	NA	0.66	0.04	0.00
Q9_3	1.19	0.10	0.00	0.78	0.04	0.00
Attitudes						
Q18_1	1.00	0.00	NA	0.93	0.01	0.00
Q18_2	1.07	0.02	0.00	0.99	0.01	0.00
Q18_3	0.99	0.02	0.00	0.92	0.01	0.00
Q18_4	0.89	0.03	0.00	0.82	0.02	0.00
Social Norms						
Q27_3	1.00	0.00	NA	0.73	0.04	0.00
Q28_5	0.80	0.08	0.00	0.58	0.04	0.00
PBC						
Q15_4	1.00	0.00	NA	0.76	0.05	0.00
Q15_5	0.96	0.09	0.00	0.73	0.04	0.00
Q16_7	0.96	0.09	0.00	0.73	0.04	0.00

The AVE and CR for social norms were again below the advised thresholds and therefore social norms was again dropped from the structural model. The CR for intentions was low but rounded to .70 and the AVE was just over the recommended threshold and therefore this variable was retained (Hair et al. 2009). Table 4.17 outlines the results of the discriminant validity test. In this model intentions and attitudes have a strong correlation and this sits just above the AVE of intentions although not of attitudes. These variables are retained as is and again the high correlation between these latent variables is taken into account in the interpretation of the regression coefficients.

Table 4.17 Model C1: correlation of latent variables with square root of AVE

Variables	Behaviour	Intentions	Attitudes	PBC
Behaviour	**0.88**			
Intentions	0.49	**0.72**		
Attitudes	0.39	0.74	**0.92**	
PBC	- 0.30	- 0.57	- 0.40	**0.74**

Note. The square root of the AVE is bolded on the diagonal

The results of the structural model indicate (Table 4.18) that attitudes have a positive relationship with intentions supporting hypothesis H1c. PBC also has a negative relationship with intentions supporting hypothesis H3c, confirming that respondents who were more likely to report finding this process easy and having tactics to do so were also more likely to express intentions to check the dairy products in their fridge for in the subsequent two weeks. There was a positive relationship between intentions and behaviour again; supporting H4c but there was there was no relationship evident between PBC and behaviour and therefore H5c is rejected.

On the basis of the R-squared 66 per cent of variance of the variable intentions was captured in the model and 26 per cent of the variance in behaviour. The overall model fit statistics were acceptable and were outlined in Table 4.12.

Table 4.18 Direct effect estimates from structural Model C1

Parameter	Unstandardised			Standardised		
	Estimate	SE	p value	Estimate	SE	p value
Intentions ~ Attitudes	0.43	0.05	0.00	0.62	0.06	0.00
Intentions ~ PBC	0.31	0.06	0.00	0.34	0.06	0.00
Behaviour ~ PBC	0.00	0.10	0.99	0.00	0.08	0.99
Behaviour ~ Intentions	0.68	0.11	0.00	0.51	0.07	0.00

4.4   Discussion

The objective of this chapter was to address *Research Question 1: To what extent does the TPB explain the date-label use in different contexts?* To do this is applied the TPB to understand three behaviours associated with food waste: throwing away products because the expiry date had passed (model A1), checking date labels in shops (model B1), and checking date labels in the fridge (model C1). Figure 4.2, Figure 4.3, and Figure 4.4 are included here to provide for ease of comparison.

In terms of variance explained, the TPB explained the greatest proportion of variance in model B1, checking dates in shops, where 52 per cent of the variance in behaviour and 78 per cent of the variance in intentions was explained. The TPB explained the least proportion of variance in model A1, throwing away products because the expiry date had passed, where 15 per cent of the variance in behaviour and only 11 per cent of the variance in intentions was explained. In model C1, 26 per cent of the variance in behaviour and 66 per cent of the variance in intentions was explained. A gap between the variance explained in intentions and behaviour is not unusual in TPB studies. This gap has been the source of discussion in the literature on human behaviour (Sheeran 2002), in particular in the environmental behaviour literature (Kollmuss, Agyeman 2002).

The values obtained by models B1 and C1 are comparable or greater than those of Russell et al. (2017) and Graham-Rowe et al. (2015), the two outcome based studies that used the TPB and multi-stage surveys. The values obtained by model A1 were lower than those of Russell et al. (2017). The value for intentions obtained by model A1 was also lower than that obtained by Graham-Rowe et al. (2015), although the value for behaviour obtained by model A1 was slightly greater. The values obtained for model B1 and C1 are also positively comparable to TPB studies in the wider literature; whereas the values obtained in model A1 are also a little low. Armitage and Conner (2001) found in a review of 185 studies that the TPB typically accounted for 27 per cent of the variance in behaviour and 39 per cent of the variance in intentions.

Making comparisons with previous food-waste studies is difficult due to the additional variables and different approaches used. Russell et al. (2017) for example used a path model and included two additional variables, habit and emotion, which both made significant contributions to their model and therefore the comparison. Graham-Rowe et al. (2015) used two separate regression models, one to model intentions and the second to model behaviour. Nevertheless in order to answer the research question above it is useful to consider whether, when the TPB is applied to behaviours associated with food waste rather than asked to predict outcomes of behaviours, whether it performs better. On the basis of the variance explained, it seems that it explains checking dates in shops and checking dates in the fridge better than throwing away products because the expiry date had passed. Its explanatory power seems to be stronger the further away the behaviour is from the point at which the outcome, food waste, occurs.

Had study been conducted over a longer period of time we may have seen a stronger relationship between intentions and behaviour in model A1. Due to the nature of the behaviour, there may have been limited times during the three-week period between surveys where the need to dispose of products in line with the expiry date arose. Whereas three weeks was sufficient to observe the checking dates in shops checking and checking dates in the fridge. While Fishbein and Ajzen (1980) postulated that that the predictive power of intentions would vary inversely with time they also highlighted the need to allow sufficient time "considering the context in which a behaviour may reasonably occur" (p.34), evidence from empirical studies is mixed. Hausenblas et al. (1997) found that the predictive power of intentions does not decrease with time whereas McEachen et al. (2011) found that particularly self-reported behaviour assessed in the shorter term tended to be better predicted. A longer gap between surveys combined might be an appropriate approach for future studies.

Figure 4.2 Attitudes → 0.21 → Intentions R² 0.11; Social Norms → - 0.18 → Intentions; Perceived Behavioural Control → - 0.05 → Intentions; Intentions → 0.35 → Behaviour R² 0.15; Perceived Behavioural Control → - 0.13 → Behaviour
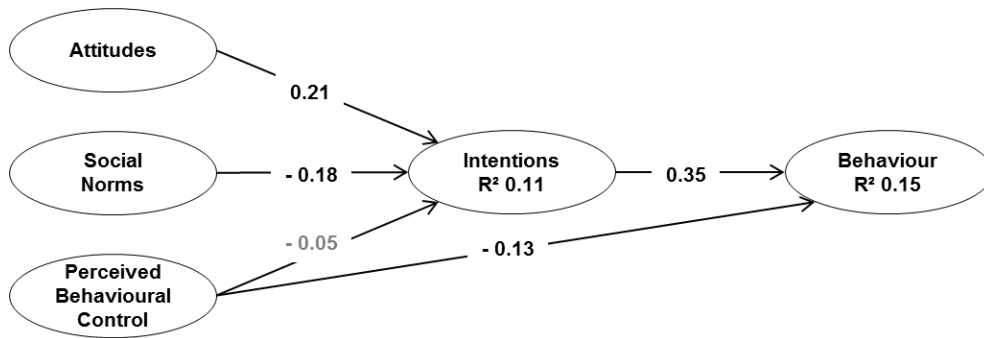
Figure 4.2 Structural Model A1 – throwing away products due to expiry date passed

Figure 4.3 Attitudes → 0.30 → Intentions R² 0.78; Perceived Behavioural Control → - 0.64 → Intentions; Intentions → 0.69 → Behaviour R² 0.52; Perceived Behavioural Control → - 0.04 → Behaviour
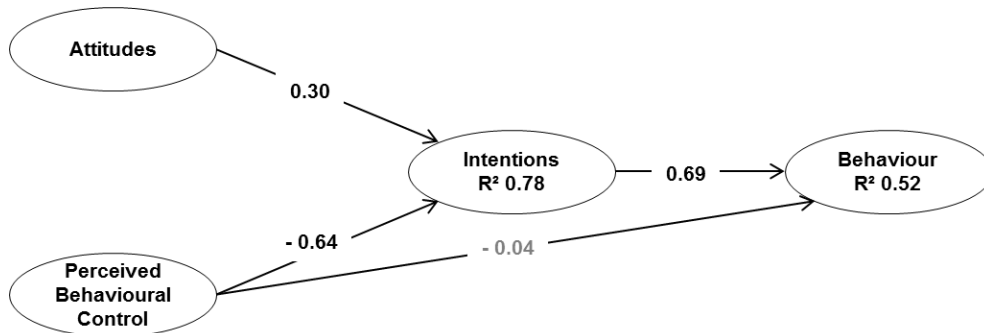
Figure 4.3 Structural Model B1 – checking dates in shops

Figure 4.4 Attitudes → 0.62 → Intentions R² 0.66; Perceived Behavioural Control → 0.34 → Intentions; Intentions → 0.51 → Behaviour R² 0.26; Perceived Behavioural Control → 0.00 → Behaviour
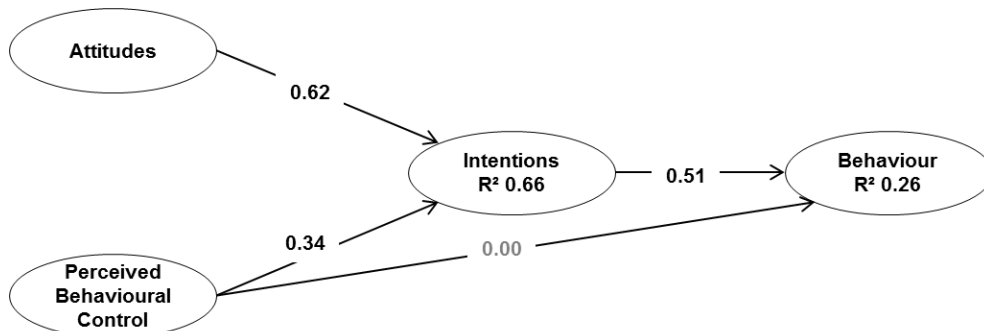
Figure 4.4 Structural Model C1 – checking dates in the fridge

On the basis of the variance explained, we saw that the TPB seems to explain some expiry date behaviours better than others. However, it is also important to consider the strength of the relationships between the variables. Social norms were a significant predictor of intentions in model A1. Three of the five TPB studies (described section 2.2) on food waste outcomes also found that subjective norms alone had a significant association with intentions not to waste food. Wasting food has previously been described as a hidden

behaviour that is not subject to influence of others unlike something like recycling or green consumption (Cecere et al. 2014). This study adds support to argument that at or near the point of disposal people seem to take the opinion and behaviour of others into account and it influences at least their intentions to engage in waste minimising or reducing behaviours. This could have important implications for communication and behaviour change in this area.

In model A1, PBC was found to have a significant association with behaviour but not intentions. This implies that those who were more confident in their ability to judge the edibility of food using their senses, and felt that it was up to them to decide that a product was edible were less likely to report throwing dairy products away because the expiry date had passed. On the other hand in models B1 and C1, PBC had a strong, significant association with intentions but not behaviour. This implies that respondents who found it easy to check and keep track of dates in shops and at home were much less likely to report intending to do so, however this factor appeared to have little to no direct influence on whether or not they reported engaging in those respective behaviours at follow up. The contrast between these effects is interesting. It seems to imply that while perception of control over edibility decision making did not have a strong effect on intentions not to dispose of products, they did have an effect on whether or not that decision was actually made. Intentions perhaps capture an element of intentions not to waste food, where confidence in judging is not important. Whereas perceived confidences in one's ability to judge edibility is important when it comes to making the decision to dispose, or not, of a product. This is in contrast to the other two behaviours in models B1 and C1 where the perceived ease of conducting the task makes respondents more likely to report intending to do it. Here we see quite strong positive relationships between intentions and behaviour, indicating that the relationship between PBC and behaviour is indirect.

Only two of the TPB food waste studies explored both the direct and indirect relationships between PBC and behaviour and they had different results. Stancu et al. (2016) found, in line with this study, that PBC with regard to minimising food waste was significantly associated with behaviour but not with intentions. Here it seems that perceived ease of

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minimising waste had a direct effect on reported food waste levels but not on intentions to minimise. On the other hand Graham-Rowe et al. (2015) found the opposite to this study that PBC had a significant relationship with intentions to reduce food waste but not behaviour. While there are clearly many differences between these studies, it is interesting to note the similarity in the pattern of relationships we see in model A1 and Stancu et al. (2016) and Graham-Rowe et al. (2015) and models B1 and C1. One reason for this is that the final behaviour is not goal-oriented (Barber 2011). This is not to say that the TPB assumes behaviour is rational (Fishbein , Ajzen 2015), rather that consumers may not intend to end up in a situation where they have to make a decision to eat or dispose of a product because the expiry date has passed. Gibbons et al. (1998) propose model for these types of unplanned behaviours which focusses on the concept of willingness rather than intentions to engage in those behaviour. Fishbein and Ajzen (2015) argue that this is the same concept as intentions, but as Barber (2011) points out, it at least emphasises that the relationship between attitudes, intentions and behaviours change over time. This line of argumentation highlights issues discussed in the behavioural economics on inter-temporal choice and multiple motives (Frederick et al. 2002).

This idea of goal orientation could also help us to understand the pattern of relationship we see between attitudes and intentions across the models. The relationship between attitudes and intentions was positive and significant across all three models, although the strength of this relationship was weakest in model A1 and strongest in model C1. Attitudes was also a significant variable across the other TPB food waste studies except for Russell et al. (2017) which might be related to their inclusion of variable accounting for emotion.

4.4.1   Limitations

One limitation relating to the analysis conducted in this chapter was the lack of convergent validity that was found for social norms in models B1 and C1 and the lack of discriminant validity between PBC and intentions in model B1. Social norms were dropped from models B1 and C1 due to a lack of convergent and discriminant validity. Out of interest these were tested in the structural model and in neither case was there a statistically

significant relationship between social norms and intentions. This was unsurprising given their properties. The lack of discriminant validity between PBC and intentions in model B1 could also have contributed to the high level of variance explained in intentions and therefore this value is probably somewhat inflated. One of the objectives of this chapter was to identify individual behaviours associated with food waste. However, in the process of trying to be specific about the behaviours there are limited statements that can capture the related concepts without being repetitive and therefore two statement latent variables become somewhat inevitable. It seems that there is a balance to be struck between identifying the motivations of individual behaviours vs categories of behaviour and effective statistical analysis.

A second limitation was our limited ability to conduct multi-group analyses, to test if the relationships we have found in this study vary with socio-demographic characteristics. While the sample size was adequate for the primary planned analysis, and was slightly larger than other recently published studies following a multi-stage approach (Graham-Rowe et al., 2015; Russell et al. 2017), this additional step would have been interesting. The sample sizes for models A1, B1 and C1 were too small to split into smaller groups for age, gender or income. We did conduct multi-group analysis with TPB models up to intentions using the stage 1 survey sample size of 548 – see Appendix 3 for results. However even here a number of variables had to have their response values condensed in order to fit the models e.g. from 7 point scales to 5 point scales.

A third limitation is the use of self-reported behaviour (Kormos, Gifford 2014) a common issue across consumer food-waste studies (Graham-Rowe et al., 2015; Russell et al., 2017; Stancu et al., 2016; Stefan et al., 2013; Visschers et al., 2016). WRAP (WRAP 2011b) research indicates that, while self-reported household waste estimations may not be accurate in terms of volume, self-reports and independently measured food waste tend to go in the same direction. Those that have higher self-report measures are also likely to have higher food waste when it is measured independently and so the direction and strength of relationship are likely to be reliable. We also chose to focus on dairy products and, as

highlighted in section 2, expiry-date use tends to vary by product type. Analyses focused on products with similar perishability characteristics are likely to produce similar results; date labels are less important drivers of food waste for products such as pasta (van Boxstael et al. 2014; WRAP 2013).

5 Extending the TPB and understanding the relationship between date-label behaviours

This chapter addresses Research Questions 2, 3, and 4. First, it addresses Research Question 3: *To what extent are attitudes towards food waste associated with engagement in date-label behaviours?* This is achieved through by extending models A1, B1, and C1 from Chapter 4 with an additional latent variable representing attitudes towards food waste. The extended models which include food waste attitudes are described as A2, B2, and C2 respectively. Second, it addresses Research Question 4: *To what extent is habit associated with date-label behaviour?* This is achieved by extending model A1 from Chapter 4. This extended model is described as A3. Third, it returns to answer Research Question 2: *How are date-label behaviours related to one another? Are consumers who regularly check the date labels of products in the supermarket and at home less likely to report throwing away products because the date has passed?* To do this, it considers whether engagement in upstream behaviours, checking dates in shops or in the fridge more frequently, decrease the likelihood that dairy products will be thrown away because the expiry-date has passed. This model is referred to as model D1. Finally this chapter reports on the reasons respondents gave for engaging in upstream date-label checking to better understand what encouraged or discouraged their use.

The chapter is structured as follows. Section 5.1 describes the hypotheses to be tested and outlines the additions to the structural models from Chapter 4. Section 5.2 then outlines the relevant measures used from the survey and the characteristics of the sample. Section 5.3 presents the results and the final section (5.4) discusses the results and limitations specific to this chapter.

5.1 Background and hypotheses

5.1.1 Association of food waste attitudes and date-label behaviour

In order to answer Research Question 3 two hypotheses are developed. The first hypothesis (H5.1) is that a single, attitudes towards food waste variable can be identified that is distinct from the specific attitudes towards engaging in each of the date label behaviours. As discussed in section 2.2, a range of variables with an attitudinal slant have been added to TPB models of food waste with mixed results. Further it was not always clear whether multiple attitudinal variables were distinct. This part of the study is somewhat exploratory in nature as the measures that form food waste attitudes are unclear. There are quite a variety of ways that attitudes towards food waste have been captured by the literature that we leave open the possibility that there may be one or more waste attitudes latent variables to identify.

The second hypothesis is that general attitudes towards food waste will have at most an indirect influence on behaviour (H5.2). As discussed in sections 1.2.1 and 2.2 is somewhat unclear as the to the extent that attitudes towards food waste are likely to have an influence on food waste related behaviours. Pro-environmental attitudes have been found to be more influential on pro-environmental behaviour in the home context compared to others. Given that some expiry date behaviours fall within the household domain we might expect an influence to be detected, but perhaps greater influence will be detected around the behaviours engaged in at home compared to behaviour while shopping.

5.1.2   Association of habit and date-label behaviour

In order to answer Research Question 4 this chapter assesses whether the addition of a variable measuring habit improves model A1 from Chapter 4. As highlighted in section 2.2 only one study has previously examined the influence of habit on food waste and habit in that study was measured simply as past behaviour. Here the self-reported habit index devised by Verplanken and Orbell (2003) is used to measure the extent to which the behaviour, throwing away products because their expiry date has passed, has become habitual in our sample population. Specifically it tests whether respondents who have a stronger habit with regard to disposing of product because the expiry date has passed are more likely to report engaging in this behaviour more frequently. Our third hypothesis is:

those who score higher on the self-reported habit index are also more likely to report disposing of product because the expiry date has passed more frequently (H5.3).

5.1.3 Behaviour inter-relationships

In order to answer Research Question 2, this chapter develops two further hypotheses. Hypothesis four those who check dates in shops more frequently are less likely to report having thrown away products because the best-before date has passed (H5.4). Hypothesis five: those who check dates in their fridge more often are also less likely to report throwing away dairy products because the expiry date has passed (H5.5). This builds on the arguments outlined in Chapter 2 that not only should we be interested in what drives food waste associated behaviours, but also how these behaviours are related.

5.2 Survey data and sample

As described in Chapter 3, an online survey was implemented in two parts. The measures, used for each of the TPB models A1, B1, and C1, were described in Chapter 4. Here only the item measures of the additional variables are described.

5.2.1 Attitudes towards wasting food

Attitudes towards wasting food were measured by fourteen statements in survey part 1. These were designed to test different aspects of attitudes towards waste that were identified during the literature review and focus group stages namely a moral aspect, an environmental aspect and a monetary aspect (i.e. equating food waste with a waste of money). The key sources from which statements were adapted are described in Appendix 4. Respondents were asked to complete the following statement. When I throw away dairy products I…

- Feel it is a waste of money (Q22_1)
- Don't really think about the cost (Q22_2)*
- Know that trying to reduce the amount of dairy I throw away would be time consuming (Q22_3)*
- I don't really have time to worry about the dairy products I'm wasting (Q22_4)*

- Think of the effort that went into making the product (Q22_5)

- Feel it is a waste of the earth's resources (Q22_6)

- Am bothered by my conscience (Q22_7)

- Don't give it a second thought (Q22_8)*

- Consider the effects on the environment (Q22_9)

- Think of those that don't have enough to eat (Q22_10)

- I have a moral obligation not to waste food (Q22_11)

- Am happy to be rid of older products that aren't likely to be of good quality (Q22_12)*

- Can't think of many benefits to reducing the amount of dairy I waste (Q22_13)*

- Don't feel it is a waste if the expiry date has already passed (Q22_14)*

Reponses were given on a 7-point Likert scale of strongly disagree [1] to strongly agree [7] and are reported in Table 5.1. Items coded * were coded in the reverse.

Table 5.1 Frequencies of food waste attitudes responses (n = 383)

Items	Frequency							Mean	SD
	1	2	3	4	5	6	7		
Q22_1	10	11	18	23	78	116	127	5.62	1.47
Q22_2	10	32	42	58	84	84	73	4.87	1.65
Q22_3	5	28	23	84	73	96	74	5.03	1.53
Q22_4	5	30	28	78	67	94	81	5.03	1.58
Q22_5	28	41	57	111	58	63	25	4.09	1.62
Q22_6	12	21	26	72	95	89	68	4.97	1.55
Q22_7	34	27	40	89	85	57	51	4.41	1.74
Q22_8	18	34	39	60	78	79	75	4.78	1.75
Q22_9	26	25	43	105	72	59	53	4.46	1.68
Q22_10	24	30	36	76	91	76	50	4.59	1.69
Q22_11	6	13	14	48	99	114	89	5.40	1.38
Q22_12	42	78	94	78	45	21	25	3.44	1.63
Q22_13	17	44	48	54	87	80	53	4.57	1.72
Q22_14	61	81	71	101	32	30	7	3.21	1.55

Note. The frequencies are reported for the full survey 2 sample of 383 and not for the individual models. Nevertheless models A2, B2, and C2 had the same sample sizes as models A1, B1, and C1 outlined in Table 4.1.

5.2.2 Habit

Habit was measured using the statements described by Verplanken and Orbell (2003). "Throwing away product because the expiry date has passed is something…."

- I do frequently (Q6.1_1);

- I do automatically (Q6.1_2);

- I do without having to consciously remember (Q6.1_3);

- That makes me feel weird if I do not do it (Q6.1_4);

- I do without thinking (Q6.1_5);

- That would require effort not to do it (Q6.1_6);

- That belongs to my routine (Q6.1_7);

- I start doing before I realise I'm doing it (Q6.1_8);

- I would find hard not to do (Q6.1_9);

- I have no need to think about doing (Q6.1_10);

- That's typically me (Q6.1_11);

- I have been doing for a long time (Q6.1_12).

The items were measured on a seven-point Likert scale strongly disagree [1] to strongly agree [7]. Table 5.2 outlines the responses received.

Table 5.2 Frequencies of responses to self-reported habit index (n = 331)

Item	Frequency							Mean	SD
	1	2	3	4	5	6	7		
Q6.1_1	109	58	47	44	26	33	14	2.92	1.88
Q6.1_2	85	57	43	51	38	37	20	3.27	1.93
Q6.1_3	85	51	44	54	41	44	12	3.29	1.88
Q6.1_4	97	63	42	61	30	28	10	2.96	1.78
Q6.1_5	82	59	62	43	38	29	18	3.17	1.84
Q6.1_6	81	53	40	80	29	39	9	3.23	1.78
Q6.1_7	84	55	48	63	35	34	12	3.18	1.81
Q6.1_8	94	68	44	70	20	27	8	2.90	1.71
Q6.1_9	77	57	39	60	41	37	20	3.37	1.90
Q6.1_10	48	39	37	73	41	50	43	4.03	1.95
Q6.1_11	93	63	42	55	29	32	17	3.08	1.88
Q6.1_12	89	59	30	54	33	46	20	3.31	1.99

Note. The sample size reported here is 331 because it relates only to model A3

5.2.3 Behaviour inter-relationships

The second part of this chapter uses measures exclusively from part 2. It uses measures of reported behaviour: checking date labels in shops, in the fridge and using the expiry date to make disposal decisions. As previously reported 383 people responded to survey 1 and 2. Since respondents were given the option in survey 2 to indicate that a behaviour was not relevant to them e.g. they didn't have that type of product in their house in a particular week the sample used for this chapter was further reduced to 307 due to removal of observations of respondents who stated NA to one or more of the behaviours.

The follow-up questions sought to elicit from respondents what had motivated them to engage or not in the various behaviours. Those that had reported they fully engaged in the behaviour e.g. reported that they checked dates on products every time they went shopping were directed to a slightly differently phrased question to those that reported that they checked less frequently.

5.3 Results

5.3.1 Attitudes towards wasting food: exploratory analysis

As outlined in section 3.4 attitudes towards food waste were measured by fourteen statements in survey part 1. While the measures captured different aspects of food waste attitudes (environmental/resources concerns, concerns about money, and moral concerns or lack thereof), we are interested to see whether a single factor could be identified or whether as in previous literature, a number of factors would more adequately capture the different aspects. An initial scree test on the fourteen items suggested a 3 factor structure. Factor analysis with oblique rotation[6] indicated that the third factor consisted of only two items (Q22_1 and Q22_2) where one of the items (Q22_1) cross loaded onto the second factor. Q22_1 was dropped and when the analysis was run again Q22_2 loaded in to one of two factors formed. This two factor structure was proceeded with. This grouping of two factors made sense from a theoretical perspective. Moral concerns about food waste e.g. waste of resources, guilt around others not having enough to eat formed one factor and those statements that reflected a lack of concern about waste or that they do not have time to worry about it, formed the second.

5.3.2 Model A2: measurement and structural models

Two food waste attitudes factors were combined with the latent variables from Model A1 to assess a confirmatory factor model. The confirmatory factor model tested was acceptable according the global fit statistics (RMSEA = 0.06; CFI = 0.97; SRMR = 0.07), however examination of the modification indices indicated high cross loading of item Q22_3 with the first food waste attitudes factor. Dropping this item somewhat improved model fit and reduced the correlation between the two waste factors although it was still reasonably high. The remaining two items in the second food waste attitudes factor were Q22_2 ("don't really think about the cost") and Q22_4 ("I don't really have time to worry about the dairy products

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[6] Oblique rotation was chosen as the rotation method since it allows for correlation of latent constructs and helps to identify more theoretically meaningful factors (Hair et al. 2009)

I'm wasting"). The negative posing of these statements raised the concern that their correlation could be explained by the way the items were worded rather than their content. It was decided to drop the second food waste attitudes factor and proceed with a single food-waste attitudes factor. The resulting confirmatory factor model had a better fit (RMSEA = 0.05, CFI = 0.98, SRMR = 0.06) and no concerning cross loadings indicated in the modification indices between items assigned to the food waste attitudes factor and other latent variables in the model. The pattern of item loadings is outlined in Table 5.3 and the AVE and CR values are listed in Table 5.4. Finally the test of discriminant validity was conducted (Table 5.5) and we see that food waste attitudes is a sufficiently distinct concept from the others in the model. In fact the correlation between food waste attitudes and the other variables in the model was quite low, the highest correlation being with social norms (0.31).

Table 5.3 Parameter estimates Model A2 grouped by latent variable

Parameter	Unstandardised			Standardised		
	Estimate	SE	p value	Estimate	SE	p value
Behaviour						
Q5.3_2	1.00	0.00	-	0.96	0.02	0.00
Q5.3_3	1.01	0.03	0.00	0.97	0.02	0.00
Q5.1_1	0.72	0.06	0.00	0.69	0.05	0.00
Q5.1_2	0.99	0.04	0.00	0.95	0.02	0.00
Q5.1_3	0.99	0.03	0.00	0.95	0.02	0.00
Intentions						
Q9_5	1.00	0.00	-	0.91	0.02	0.00
Q9_6	0.68	0.04	0.00	0.62	0.04	0.00
Q9_7	1.00	0.03	0.00	0.91	0.02	0.00
Q9_8	0.86	0.03	0.00	0.78	0.02	0.00
Attitudes						
Q19_1	1.00	0.00	-	0.96	0.01	0.00
Q19_2	0.99	0.01	0.00	0.95	0.01	0.00
Q19_3	0.93	0.02	0.00	0.89	0.01	0.00
Q19_4	0.89	0.02	0.00	0.86	0.02	0.00
PBC						
Q15_6	1.00	0.00	-	0.85	0.02	0.00
Q15_7	0.99	0.03	0.00	0.85	0.02	0.00
Q15_11	1.05	0.03	0.00	0.90	0.01	0.00
Q16_21	0.71	0.04	0.00	0.61	0.04	0.00
Q16_19	1.02	0.03	0.00	0.87	0.02	0.00
Social Norms						
Q27_1	1.00	0.00	-	0.81	0.02	0.00
Q27_5	1.03	0.04	0.00	0.83	0.02	0.00
Q28_1	1.01	0.04	0.00	0.82	0.02	0.00
Q28_2	0.98	0.03	0.00	0.79	0.02	0.00
Food Waste Attitudes						
Q22_5	1.00	0.00	-	0.63	0.03	0.00
Q22_6	1.34	0.08	0.00	0.84	0.02	0.00
Q22_7	1.26	0.08	0.00	0.79	0.02	0.00
Q22_9	1.16	0.07	0.00	0.73	0.03	0.00
Q22_10	1.17	0.07	0.00	0.73	0.03	0.00
Q22_11	1.20	0.07	0.00	0.75	0.03	0.00

Table 5.4 AVE and CR for Model A2, B2, and C2

	Model A2		Model B2		Model C2	
Latent Variable	AVE	CR	AVE	CR	AVE	CR
Behaviour	0.83	0.96	0.80	0.92	0.77	0.91
Intentions	0.66	0.88	0.64	0.87	0.51	0.67
Attitudes	0.84	0.95	0.68	0.89	0.84	0.95
Social Norms	0.66	0.88	-	-	-	-
PBC	0.68	0.91	0.59	0.85	0.55	0.78
Food Waste Attitudes	0.56	0.88	0.55	0.88	0.55	0.88

Table 5.5 Discriminant validity Model A2

Latent Variable	Behaviour	Intentions	Attitudes	PBC	Social Norms	Food Waste Attitudes
Behaviour	**0.91**					
Intentions	0.42	**0.81**				
Attitudes	0.08	0.29	**0.92**			
PBC	- 0.21	- 0.10	- 0.05	**0.82**		
Social Norms	0.01	- 0.31	- 0.37	0.33	**0.81**	
Food Waste Attitudes	- 0.04	- 0.15	0.07	0.08	0.31	**0.75**

In terms of the structural model food waste attitudes had a negative and significant association with intentions towards throwing away products because the expiry date had passed (Table 5.6). This suggests, for example, that respondents who reported thinking of the effort that went into making a product or were more likely to state that they were bothered by their conscience by food waste, were less likely to report an intention to throw away products because their expiry date had passed. However, both the direct and indirect relationship between food waste attitudes and behaviour were not statistically significant. The relationship between attitudes towards engaging in the behaviour and intentions was slightly stronger than between food waste attitudes and intentions suggesting that the attitudes towards engaging in the behaviour were slightly more important in determining intentions than food waste attitudes, although the difference in strength of the coefficients was not that great. Note the coefficients have opposing signs due to the way that measures are phrased: a score of 7 in food waste attitudes indicates a strong dislike of food waste

whereas a score of 7 in behavioural attitude indicates approval of throwing away products because the expiry date has passed.

Table 5.6 Direct effect estimates from extended Model A2

Parameter	Unstandardised			Standardised		
	Estimate	SE	p value	Estimate	SE	p value
Intentions ~ b*FWA	- 0.18	0.09	0.04	- 0.13	0.06	0.04
Intentions ~ Attitudes	0.22	0.06	0.00	0.23	0.06	0.00
Intentions ~ PBC	- 0.05	0.06	0.40	- 0.05	0.06	0.40
Intentions ~ Social Norms	- 0.15	0.08	0.05	-0.14	0.07	0.05
Behaviour ~ c*FWA	0.08	0.10	0.42	0.06	0.07	0.42
Behaviour ~ PBC	- 0.15	0.07	0.03	- 0.14	0.06	0.03
Behaviour ~ a*Intentions	0.39	0.08	0.00	0.37	0.07	0.00
Indirect (a*b)	- 0.07	0.04	0.07	- 0.05	0.02	0.06
Total c + (a*b)	0.01	0.11	0.90	0.01	0.07	0.90

Note. FWA = food waste attitudes

5.3.3   Models B2 and C2: measurement and structural models

The food waste attitudes latent variable established in model A2 was also added to the TPB models used to understand checking date labels in shops and checking date labels in the fridge. When the checking date labels in shops model was extended with the food waste attitudes variable it was relabelled B2 and when the checking date labels in fridge model was extended with the waste attitudes variable it was relabelled C2.

In model B2 food waste attitudes had a positive, significant relationship with intentions and the indirect relationship between food waste attitudes and behaviour was weak but it was significant (Table 5.7). This suggests that those with a greater concern about food waste were more likely to report intending to check dates in shops and that this influence was also detected in reported behaviour three weeks later. In model C2 there was not a significant relationship between food waste attitudes and intentions, however there was a significant direct relationship between food waste attitudes and behaviour (Table 5.8).

Table 5.7 Direct effect estimates from extended Model B2

Parameter	Unstandardised			Standardised		
	Estimate	SE	p value	Estimate	SE	p value
Intentions ~b* FWA	0.18	0.06	0.00	0.12	0.04	0.00
Intentions ~ Attitudes	0.29	0.07	0.00	0.30	0.08	0.00
Intentions ~ PBC	1.01	0.13	0.00	0.67	0.07	0.00
Behaviour ~ PBC	- 0.10	0.26	0.71	- 0.07	0.17	0.71
Behaviour ~ a*Intentions	0.77	0.17	0.00	0.78	0.16	0.00
Behaviour ~ c*FWA	- 0.14	0.08	0.09	- 0.10	0.06	0.09
Indirect (a*b)	0.14	0.06	0.02	0.10	0.04	0.02
Total c + (a*b)	0.00	0.08	0.97	0.00	0.06	0.97

Note. FWA = food waste attitudes

Table 5.8 Direct effect estimates from extended Model C2

Parameter	Unstandardised			Standardised		
	Estimate	SE	p value	Estimate	SE	p value
Intentions ~ b*FWA	0.01	0.06	0.81	0.01	0.06	0.81
Intentions ~ Attitudes	0.44	0.05	0.00	0.62	0.06	0.00
Intentions ~ PBC	0.31	0.07	0.00	0.34	0.06	0.00
Behaviour ~ PBC	- 0.02	0.10	0.83	- 0.02	0.08	0.83
Behaviour ~ a*Intentions	0.63	0.11	0.00	0.48	0.07	0.00
Behaviour ~ c*FWA	0.24	0.07	0.00	0.18	0.05	0.00
Indirect (a*b)	0.01	0.04	0.81	0.01	0.03	0.81
Total c + (a*b)	0.24	0.07	0.00	0.18	0.05	0.00

Note. FWA = food waste attitudes

The models B2 and C2 were checked for discriminant validity and show that attitudes towards engaging in each respective behaviour and food waste attitudes are distinct. Food waste attitudes were found to be a distinct from other all other latent variables in the model (Table 5.9 and Table 5.10). As discussed in sections 4.3.2 and 4.3.3, some of the values in model B2 between intentions and PBC in particular are on the edge of acceptability according to Fornell and Larcker's (1981) measure of discriminant validity. The global fit statistics were also acceptable (Table 5.11). Alternative models were also run to check the relationship between food waste attitudes and behavioural attitudes; however, in both cases the model where generalised attitudes had a direct relationship to intentions indicated a better fit as judged by the global fit statistics (RMSEA; CFI; and SRMR).

Table 5.9 Discriminant validity Model B2

Variables	Behaviour	Intentions	Attitudes	PBC	Food Waste Attitudes
Behaviour	**0.89**				
Intentions	0.72	**0.80**			
Attitudes	0.58	0.79	**0.82**		
PBC	- 0.63	- 0.87	- 0.78	**0.77**	
Food Waste Attitudes	0.08	0.05	0.15	- 0.16	**0.74**

Table 5.10 Discriminant validity Model C2

Variables	Behaviour	Intentions	Attitudes	PBC	Food Waste Attitudes
Behaviour	**0.88**				
Intentions	0.75	**0.71**			
Attitudes	0.59	0.40	**0.91**		
PBC	0.19	0.17	0.21	**0.74**	
Food Waste Attitudes	0.51	0.39	0.30	0.26	**0.74**

Table 5.11 Global goodness of fit measures: Model A2, B2, and C2

Measure	Model A2	Model B2	Model C2
Chi-square	515.45	294.35	211.84
DF	336	180	126
P value	0.00	0.00	0.00
Chi-square scaled	588.58	373.76	275.00
DF scaled	336	180	126
P value scaled	0.00	0.00	0.00
Chi-square scaling factor	1.25	1.01	0.97
CFI	1.00	0.99	1.00
CFI scaled	0.98	0.98	0.99
RMSEA	0.04	0.04	0.05
RMSEA ci lower	0.03	0.03	0.03
RMSEA ci upper	0.05	0.05	0.06
RMSEA p value	0.99	0.90	0.75
RMSEA scaled	0.05	0.06	0.06
RMSEA ci lower scaled	0.04	0.05	0.05
RMSEA ci upper scaled	0.05	0.06	0.07
RMSEA p value scaled	0.72	0.10	0.04
SRMR	0.06	0.06	0.06

Model A3: the role of habit in influencing behaviour

As outlined above disposing of dairy products because the expiry date had passed was measured using twelve items from Verplanken and Orbell's (2003) scale. An initial scree test confirmed the items formed a single factor and factor analysis with oblique rotation indicated high standardised loadings. Table 5.12 describes the standardised and unstandardised loadings from the measurement model.

Table 5.12 Parameter estimates Model A3

	Unstandardised			Standardised		
Parameter	Estimate	SE	p value	Estimate	SE	p value
Behaviour						
Q5.3_2	1.00	0.00	-	0.97	0.03	0.00
Q5.3_3	1.01	0.04	0.00	0.98	0.02	0.00
Q5.1_1	0.76	0.07	0.00	0.74	0.06	0.00
Q5.1_2	0.97	0.05	0.00	0.94	0.03	0.00
Q5.1_3	0.95	0.04	0.00	0.92	0.03	0.00
Intentions						
Q9_5	1.00	0.00	-	0.89	0.02	0.00
Q9_6	0.66	0.05	0.00	0.58	0.04	0.00
Q9_7	1.07	0.04	0.00	0.96	0.02	0.00
Q9_8	0.81	0.04	0.00	0.72	0.03	0.00
Attitudes						
Q19_1	1.00	0.00	-	0.95	0.01	0.00
Q19_2	1.00	0.02	0.00	0.95	0.01	0.00
Q19_3	0.92	0.02	0.00	0.87	0.02	0.00
Q19_4	0.88	0.02	0.00	0.84	0.02	0.00
PBC						
Q15_6	1.00	0.00	-	0.85	0.02	0.00
Q15_7	0.96	0.03	0.00	0.81	0.02	0.00
Q15_11	1.04	0.03	0.00	0.88	0.02	0.00
Q16_21	0.68	0.05	0.00	0.57	0.04	0.00
Q16_19	1.00	0.03	0.00	0.85	0.02	0.00
Social Norms						
Q27_1	1.00	0.00	-	0.77	0.02	0.00
Q27_5	0.99	0.04	0.00	0.76	0.02	0.00
Q28_1	0.97	0.04	0.00	0.75	0.02	0.00
Q28_2	0.94	0.04	0.00	0.72	0.03	0.00
Habit						
Q6.1_1	1.00	0.00	-	0.92	0.01	0.00
Q6.1_2	1.04	0.01	0.00	0.95	0.01	0.00
Q6.1_3	0.99	0.01	0.00	0.91	0.01	0.00
Q6.1_4	0.92	0.01	0.00	0.84	0.02	0.00
Q6.1_5	1.02	0.01	0.00	0.93	0.01	0.00
Q6.1_6	0.75	0.03	0.00	0.69	0.03	0.00
Q6.1_7	1.02	0.01	0.00	0.93	0.01	0.00
Q6.1_8	0.97	0.01	0.00	0.89	0.01	0.00
Q6.1_9	0.88	0.02	0.00	0.81	0.02	0.00
Q6.1_10	0.59	0.03	0.00	0.54	0.03	0.00
Q6.1_11	1.00	0.01	0.00	0.92	0.01	0.00
Q6.1_12	1.00	0.01	0.00	0.92	0.01	0.00

The AVE of the habit latent variable was 0.74 and the CR was 0.97. Table 5.13 compares the square root of the AVE of each latent variable with the correlation between each pair and indicates that the habit latent is satisfactorily distinct from the others.

Table 5.13 Discriminant validity of latent variables Model A3

Latent	Behaviour	intentions	Attitudes	PBC	Norms	Habit
Behaviour	**0.91**					
Intentions	0.37	**0.80**				
Attitudes	0.15	0.32	**0.90**			
PBC	- 0.14	- 0.15	0.12	**0.80**		
Social Norms	- 0.16	- 0.27	- 0.69	0.61	**0.75**	
Habit	0.46	0.58	0.30	- 0.20	- 0.25	**0.86**

The results of the structural model (Table 5.14) indicate that habit has a positive association with behaviour which is also statistically significant in this model. While intentions and PBC retain the positive and negative associations respectively with behaviour their relationships are not statistically significant, as they were in Model A1. Attitudes and social norms retain their respective associations with intentions and remain statistically significant. PBC, which did not have a statistically significant relationship with intentions in model A1 does have a statistically significant relationship with intentions in this model. The amount of variance explained in behaviour is 23 per cent. The global fit statistics were also acceptable (CFI = 0.98, RMSEA = 0.68, SRMR = 0.08, Chi-square = 1309.86, DF = 514, p = 0.00).

Table 5.14 Parameter Estimates Structural Model A3 Habit

Parameter	Unstandardised			Standardised		
	Estimate	SE	p value	Estimate	SE	p value
Intentions ~ Attitudes	2.37	0.89	0.01	2.53	0.96	0.01
Intentions ~ PBC	- 2.28	0.91	0.01	- 2.17	0.87	0.01
Intentions ~ Social Norms	3.22	1.37	0.02	2.79	1.19	0.02
Behaviour ~ Intentions	0.17	0.10	0.08	0.16	0.09	0.07
Behaviour ~ PBC	- 0.05	0.07	0.43	- 0.04	0.06	0.44
Behaviour ~ Habit	0.38	0.08	0.00	0.35	0.08	0.00

5.3.4   Model D1: results of behaviour inter-relationships structural model

As described in Chapter 4, respondents were asked to report how frequently they had engaged in each of the behaviours listed in the previous three weeks. For checking date labels in shops there were asked when shopping, how often they checked the dates of the various dairy products before buying them. These were recorded on a scale where 1 = not at all and 5 = every time. For checking date labels in the fridge, they were asked how frequently they checked the date labels of products in their fridge. These were recorded on a scale where 1 = never and 5 = every day. Finally there where two questions where respondents were asked to record how often they threw away dairy products due to 1) the use-by date passing and 2) the best-before date passing. These questions were originally recorded as a scale 1 = never and 5 = everyday but due to the low frequency of responses in categories 3, 4 and 5 they were recoded into binary variables such that never or no report of waste was coded as 0 and the report of any product thrown away due to the expiry date was recoded as 1. A summary of the frequency of responses, their mean and standard deviations are reported in Table 5.15.

Table 5.15 Frequency of responses to behaviour questions Model D1 (n = 307)

Items and Concepts	Frequency					Mean	SD
	1	2	3	4	5		
Shop							
Q3.1_1 (Milk)	26	7	12	40	222	4.38	1.21
Q3.1_2 (Yoghurt)	19	17	18	50	203	4.31	1.19
Q3.1_3 (Cheese)	36	33	27	63	148	3.83	1.43
Fridge							
Q4.1_1 (Milk)	60	28	85	95	39	3.08	1.30
Q4.1_2 (Yoghurt)	46	39	93	102	27	3.08	1.19
Q4.1_3 (Cheese)	79	71	99	41	17	2.50	1.17
Throw Away	No Waste (0)		Waste (1)				
Q5.1_1 (Milk)	221		86			0.28	0.45
Q5.1_2 (Cheese)	239		68			0.22	0.42
Q5.1_3 (Yoghurt)	208		99			0.32	0.47
Q5.3_2 (Cheese)	254		53			0.17	0.38
Q5.3_3 (Yoghurt)	225		82			0.27	0.44

The confirmatory factor model confirmed the viability of the three behaviours. All items had significant standardised loadings of .50 or above (p < .001). The factor loadings (both unstandardised and fully standardised) are reported in Table 5.16. The AVE and CR of each latent construct were over the advised thresholds and the latent variables were confirmed to be distinct concepts (Table 5.17).

Table 5.16 Parameter estimates Model D1 Behaviour Inter-relationships

Parameter	Unstandardised			Standardised		
	Estimate	SE	p value	Estimate	SE	p value
Shop Checking						
Q3.1_1	1.00	0.00	NA	0.85	0.03	0.00
Q3.1_2	1.10	0.05	0.00	0.93	0.02	0.00
Q3.1_3	1.09	0.04	0.00	0.93	0.02	0.00
Fridge Checking						
Q4.1_1	1.00	0.00	NA	0.88	0.02	0.00
Q4.1_2	1.00	0.03	0.00	0.87	0.02	0.00
Q4.1_3	1.02	0.02	0.00	0.89	0.02	0.00
Throw Away						
Q5.1_1	0.74	0.05	0.00	0.73	0.05	0.00
Q5.1_2	0.96	0.03	0.00	0.94	0.02	0.00
Q5.1_3	0.97	0.03	0.00	0.95	0.03	0.00
Q5.3_2	1.00	0.00	NA	0.97	0.02	0.00
Q5.3_3	0.98	0.03	0.00	0.96	0.02	0.00

Table 5.17 Convergent and discriminatory validity measures Model D1

Variable	AVE	CR	Shop Checking	Fridge Checking	Throw Away
Shop Checking	0.81	0.93	**0.90**		
Fridge Checking	0.77	0.91	0.54	**0.88**	
Throw Away	0.82	0.96	- 0.15	0.20	**0.91**

Note. Square root of AVE on diagonal in bold

From the regression coefficients we see that there is a significant negative relationship between checking dates in shops and throwing away products because the expiry-date has passed (Table 5.18). This suggests that the action of checking dates in shops makes it less likely that products will subsequently be wasted. On the other hand there is a significant positive relationship between checking dates in the fridge and throwing away products because the expiry-day has passed. This suggests that this action does not help to prevent

food from being wasted. This could imply that respondents who more frequently go through their fridge checking dates are more likely to be concerned about out-of-date products remaining in their fridge and/or consuming them after the date has passed. The behaviours of checking dates in the fridge and checking dates in shops are also positive associated (as described by their positive correlation in Table 5.18). This indicates that if a respondent reported checking dates in shops they were also more likely to have reported checking dates in their fridge but only one of these actions appears to result in fewer products being thrown away because the expiry date has passed. The R-square for the behaviour, throwing away products because the expiry date has passed, indicates that 13 per cent of the variance in behaviour is accounted for by this model.

Table 5.18 Direct effect estimates from structural Model D1

Parameter	Unstandardised			Standardised		
	Estimate	SE	p value	Estimate	SE	p value
Throw Away ~ Shop Checking	- 0.41	0.11	0.00	- 0.36	0.10	0.00
Throw Away ~ Fridge Checking	0.43	0.11	0.00	0.39	0.09	0.00

5.3.5   Motivators and barriers to checking dates in shops and in the fridge

As a follow-up, those respondents that did not report checking dates in shops every time they shopped or every day in their fridge, were asked whether they thought that engaging in the respective behaviours more frequently would help them to prevent them from wasting dairy products. The response was mixed and there did not seem to be a strong suggestion that engaging in the behaviour much more frequently would enable them to reduce their dairy product waste beyond what is was. The results are outlined in Table 5.19.

Table 5.19 Belief that actions would lead to waste prevention

	Frequency (reported as % of respondents)							Mean	SD	N
	1	2	3	4	5	6	7			
Infrequent Checkers										
Shops	25	24	27	38	33	35	22	4.09	1.88	204
Fridge	48	35	39	66	44	31	31	3.82	1.89	294
Frequent Checkers										
Shop	2	0	1	9	8	28	55	6.16	1.23	103
Fridge	0	0	0	2	2	2	7	6.08	1.19	13

Those respondents that reported checking dates every single time or checking date labels in the fridge every day across all categories of dairy products were asked basically the same question but worded to account for their response that they checked at every opportunity. They were asked whether they believed their actions had helped them to prevent some dairy product waste. Here the responses were swayed much more positively towards the belief that their actions helped to prevent dairy product waste. However, some of these beliefs about the outcome of their actions may be misplaced as highlighted in section 4.1 those who reported checking dates in the fridge more frequently were actually more likely to report throwing away product because the expiry date had passed.

Those respondents who checked less frequently were asked what had prevented them from doing so. The comprised of Likert style responses which are outlined in Table 5.20 and a free text question which was optional. With regard to the close ended questions for checking dates in shops respondents were asked how well a set of statements explained why they didn't check dates in shops more often. Options included: "I had other things on my mind (Q3.3_1)", "I didn't have time (Q3.3_2)", "Date labels were not easy to understand (Q3.3_3)", "There is little point as most dates are the same (Q3.3_4)", "I buy similar things each week so don't need to (Q3.3_5)", and "Date labels were not easy to find (Q3.3_6)". With regard to the closed ended questions for checking dates in the statements included: "I didn't have time to check more often (Q4.3_1)", "Checking dates of dairy products in my fridge was not a priority (Q4.3_2)", "date labels were not easy to understand (Q4.3_3)", and

"I know how long they last, so I don't need to (Q4.3_4)". Responses were on a 5 point scale where 1 = not well at all and 5 = extremely well.

Table 5.20 Reasons given for not checking dates more frequently in the shops and at home

	Frequency (reported as % of respondents)					Mean	SD	N
	1	2	3	4	5			
Shop Checking Infrequent								204
Q3.3_1	50	15	19	10	6	2.08	1.29	
Q3.3_2	66	10	12	9	3	1.75	1.18	
Q3.3_3	67	15	12	6	0	1.58	0.94	
Q3.3_4	54	18	18	9	1	1.84	1.07	
Q3.3_5	33	17	19	21	11	2.59	1.40	
Q3.3_6	61	18	15	5	0	1.66	0.95	
Fridge Checking Infrequent								294
Q4.3_1	65	15	11	8	2	1.67	1.06	
Q4.3_2	32	15	24	20	9	2.61	1.36	
Q4.3_3	76	9	9	4	2	1.47	0.95	
Q4.3_4	28	11	17	27	16	2.93	1.47	

The majority of respondents did not feel that the response options provided explained what prevented them from engaging in fridge checking and expiry date checking behaviours more frequently that they already did. For shop checking having other things on their mind and habitual nature of shopping (items Q3.3_1 and Q3.3_5) had slightly higher mean scores than the other items. For fridge checking a lack of time and date labels not being easy to find had the highest mean scores.

5.4 Discussion

5.4.1 Influence of food-waste attitudes on expiry date behaviour

The first objective of this chapter was to address Research Question 3: *To what extent are attitudes towards food waste associated with engagement in date-label behaviours?* The first step was to understand whether attitudes towards food waste could be detected distinctly from specific attitudes towards engaging in date-label behaviours. By Fornell and Larcker's (1981) measure of discriminant validity attitudes towards food waste were clearly

distinct from specific behavioural attitudes. This provides some support for the first hypothesis (H5.1). On other hand, early stages of exploratory factor analysis did indicate a potentially larger number of factors, or that differently phrased some items might represent dimensions of a food waste attitudes factor not captured by ours. The factor that was retained covered predominantly moral concerns: waste of effort and resources food waste represents and the juxtaposition of food waste with others not having enough to eat. The items that were dropped represented dimensions around food waste being a waste of money or something that people did not have time to worry about. Further research is needed to develop and establish a general measure of food waste attitudes in the same way that there has been the development of recognised environmental attitudinal scales such as the NEP (Dunlap et al. 2000).

The second step considered the relationships between food waste attitudes and date-label behaviours. The results of models A2 suggested that those with stronger (anti) food waste attitudes were more likely to express stronger intentions not to throw away products because the expiry date had passed. However, neither a direct nor and indirect effect on behaviour was detected. The results of model B2, also suggested that those with stronger (anti) food waste attitudes were more likely to report intending to check dates in shops. In this model a significant indirect relationship between food waste attitudes and behaviour was detected. Lastly, the results of model C2 indicated that (anti) food waste attitudes had a direct and significant impact on behaviour, whereas there was no direct (or indirect) relationship through intentions. This evidence provide mixed support for the hypothesis that general attitudes towards food waste will have at most an indirect influence on behaviour (H5.2). These results suggest that attitudes to food waste outcomes are more salient for engaging in date-label checking in some contexts than others. At the point of disposal food waste is perhaps not uppermost in people's minds. While food waste attitudes appear to influence intentions not to throw away products, when it comes to actual decision making the influence weakens. On the other hand food waste attitudes were a direct predictor of behaviour in model C2 indicating that checking dates in the fridge is directly motivated by an interest in minimising food waste. As previously discussed, some studies on the influence of

environmental attitudes on behaviour have found the influence of environmental attitudes to stronger in the context of home (Alcock et al. 2017; Barr et al. 2007). While all date-label behaviours are somewhat connected to the home we do not for example a weaker influence of food waste attitudes when shopping compared to the two behaviours conducted within the home.

As described in section 2.2 the only TPB study to investigate the relationship between food waste attitudes and specific food waste behaviours was Stefan et al. (2013). They found that moral attitudes towards food waste but not a lack of concern had a significant relationship with shopping and planning behaviours. We therefore see some similarities between their findings those presented here since our final food waste attitudes variable incorporated moral elements. On the other hand as outlined in Appendix 3, we did find some items measuring concern about resource waste, although not explicitly concern about the environment, corresponded to a single factor. Overall it seems that the moral aspects of food waste are influential on individual intentions and behaviour, but as discussed above more work on effective measures of food waste attitudes is required.

5.4.2   Influence of habit on expiry-date behaviour

The second objective of this study was to address Research Question 4 asked: *To what extent is habit associated with date-label use?* It found that those who scored higher on the self-reported habit index were also more likely to report disposing of product because the expiry date has passed more frequently, providing support to our third hypothesis (H5.3). It found that the introduction of the habit variable more than doubled the variance in behaviour explained from 11 per cent (Model A1) to 23 per cent (Model A3) and the relationship between intentions and behaviour was no longer statistically significant. This finding is consistent with other studies measuring habit, for example, Verplaken and Arts (1999) found that "when strong habits have developed, intentions may lose their predictive power" (p. 111). In their meta-analysis of health studies using the SRHI, Gardner et al. (2011) also found that the introduction of habits "typically reduce the predictive utility of reasoned intentions for predicting behaviour" (p. 186).

Russell et al. (2017) found that habit was strongly and positively related to the level of overall food waste reported by a household. Russell et al. (2017) did not discuss whether the introduction of habit changed the relationship between intentions and behaviour since the results of the model without the habit variable were not reported. The results of this model (A3) add to these findings and highlight the role of habit in at least one of the behaviours associated with food waste, throwing away products because the expiry date has passed. One point to note is that while habit has a significant relationship with behaviour, from the descriptive statistics in section 0 strong habits were not reported by large numbers of the survey population. Therefore while those who reported a strong, habitual element to this behaviour were much more likely to engage in it, the extent to which the behaviour was reported as strongly habitual within the population was not high.

Due to space and time limitation in the survey the influence of habit was not tested on checking date labels in shops or checking date labels in the fridge. These could be tested in future research.

5.4.3 Relationship between behaviours associated with food waste

The third objective of the Chapter was to answer Research Question 2: *How are date-label behaviours related to one another? Are consumers who regularly check the date labels of products in the supermarket and at home less likely to report throwing away products because the date has passed?* The results provided support to hypotheses four those who check dates in shops more frequently are less likely to report having thrown away products because the best-before date has passed (H5.4). However, it found contradictory evidence to hypothesis five which stated that those who check dates in their fridge more often are also less likely to report throwing away dairy products because the expiry date has passed (H5.5). Instead it found that those who reported checking dates in their fridge more frequently were more likely to report disposing of products because the expiry date had passed.

The importance of behaviour inter-relationships for understanding food waste outcomes is evidenced here. The finding that checking dates in the fridge is associated with a higher reported frequency of disposing of products because the expiry date has passed also highlights the importance of understanding which behaviours should be encouraged, or in this case potentially discouraged. In principle, keeping on top of date labels in the fridge as part of ongoing food management seems like an activity that would help households to minimise waste. However, at least in terms of the frequency with which products are disposed of because the expiry date has passed, it seems that this is not the case. One reason for this could be that the activity results in the identification of products which have already passed the expiry date, and only if it were conducted more frequently that it is currently would it likely contribute to waste minimisation. WRAP's (2011a) hypothesis that upstream checking activities are driven by sensitivity to food safety could provide some explanation. This potentially highlights something about the types of people that are likely to engage in fridge checking, i.e. they are typically more food-risk averse. On other hand the finding that checking date labels in shops is quite strongly associated with lower reported frequency of disposing of products because the expiry date has passed provides support for Setti et al.'s (2018) contention, that actions related to purchasing, at the beginning of the food management lifecycle, are important for minimising food waste. Future research could benefit from multi-group analysis of the behaviours by consumer food risk profile or similar to understand if the relationship changes across these different groups. It could also benefit from examining the drivers of other early food lifecycle behaviours such as planning and cupboard checking before shopping.

In terms of the variance explained, model D1 accounts for a similar amount of variance in the behaviour, throwing away products because the expiry date has passed, as model A1 which used the TPB antecedents; although it accounts for less variance in this behaviour than model A3 which incorporated habit. Nevertheless our results support the argument for developing a multi-level model to understand food waste as proposed by van Geffen et al. (2016), Principato (2018), and Setti et al. (2018). The idea is not inconsistent with the TPB in that it acknowledges that, "events occurring between assessment of intentions and

observation of behaviour can produce changes in intentions and unanticipated obstacles can prevent people from carrying out their intentions" (Ajzen 2014 p.2). Therefore between the time that even those who expressed intentions to dispose of products as soon as the expiry date had passed, simply may not find themselves in the situation where they need to make that decision since by checking the dates in shops they have been able to consume products well before the expiry date.

In terms of the follow-up questions we found that those who engaged in shop-checking and fridge-date-label checking behaviour the most tended to strongly agree that minimising food waste was a motivating reason for doing so. On the other hand those that did not engage in either behaviour as frequently gave very mixed responses as to whether they believed checking more frequently would help them to minimise their waste. Overall this highlights a research need to understand the patterns of behaviour that lead to lower levels of food waste but in particular improving peoples knowledge of what works in terms of minimising food waste. This element is picked up in Chapter 6 in the discussion of different types of knowledge and how campaigns can be clearer about the types of behaviours that should be promoted to minimise household food waste.

5.4.4   Discussion of results

In combination the results of this chapter have implications not only implications for our understanding of food waste behaviours and outcomes, but also for behaviour change programmes and communications targeted at food waste reduction. First it suggests that campaigns that try to change attitudes towards food waste may have limited success. Food waste attitudes affected only intentions but not actual behaviour with regard throwing dairy products away due to the expiry date. Those with stronger anti food waste attitudes were more likely to engage in checking dates in the fridge, however this behaviour was found to be associated with higher rates of disposing of products because the expiry date had passed. Although those with stronger anti food waste attitudes were more likely to report checking dates in shops and this behaviour was associated with lower rates of disposing of products because the expiry date had passed. There is therefore a need for caution: while

strong anti-food waste attitudes might result in greater engagement in this behaviour, the behaviour itself might not actually be contributing to lower food waste. Second, we should be aware that for at least a small section of the population the processing of disposing of products because the expiry date has passed has a strong habitual element. It is likely that changing these habits will take more than changing attitudes towards food waste.

6   Willingness to consume dairy products in relation to the best-before date: date-label knowledge

This chapter addresses Research Questions 5 and 6 as outlined in Chapter 1. First it addresses Research Question 5: *How do date type, product type and presence of a reduced label affect consumers' WTC dairy products in relation to the expiry date?* It does this by exploring the influence of date label type, product type and the presence of a reduced label on WTC dairy products in relation to their best-before date through a series of Chi-squared tests. Second, it addresses Research Question 6: *To what extent are different types of knowledge (procedural, effectiveness and subjective knowledge) associated with factual knowledge and WTC dairy products in relation to the best-before date?* It does this by developing a model, based on the ideas of Kaiser and Fuhrer (2003) but also date labelling literature to test the extent to which different types of knowledge influence WTC dairy products in relation to the best-before date.

Section 6.1 of this chapter develops the hypotheses to be tested referring back to the relevant literature from Chapters 1 and 2. Section 6.2 describes the measures that were used from the survey to construct the latent variables and provides descriptive statistics related to these measures. As in the previous chapter it does not cover the data collection procedures as these were described in Chapter 3. Section 6.3 provides the results of the analysis and the final section, 6.4 discusses the results.

6.1   Background and hypotheses

6.1.1   Association between product type, date type, reduced labels, and WTC

As described in section 2.4.1, few studies have systematically explored the relationships between product type, date type, and the presence of a reduced label on WTC, and while they have included some dairy products, the results have been mainly descriptive in nature. This chapter addresses this gap in the literature.

First, it compares products holding the date type constant. Milk is not included in the best-before condition because the majority of milk sold in the UK is fresh and currently carries only use-by dates. It therefore proposes the following two hypotheses:

H6.1: in the use-by date condition respondents' WTC yoghurt will be lower than respondents' WTC milk and WTC cheese will be higher than both WTC both milk and yoghurt.

H6.2: in the best-before date condition respondents' WTC yoghurt will be lower than respondents' WTC cheese.

Second it compares WTC for different date types holding the product type constant. Again milk is not included because the condition of milk with a best-before date would not be realistic for consumers in the UK.

H6.3: in the yoghurt condition, WTC yoghurt with a use-by date will be lower than respondents' WTC yoghurt with a best-before date.

H6.4: in the cheese condition WTC cheese with a use-by date will be lower than WTC cheese with a best-before date.

As described in section 2.4.2, expiry date based pricing indicated by a reduced label is a common approach used by retailers to move older stock, however little is known about the impact of these labels once a purchase has been made. It is therefore of interest to test whether once reduced items are brought into the home whether the presence of the reduced label is still pertinent to consumers (e.g. it prompts them to think about its approaching sub-optimality), in particular whether products with a reduced label are associated with a lower WTC compared to the same product without the reduced label. If reduced products are perceived as riskier in the home, then they may have a lower likelihood of being consumed, and not have the desired effect on household food waste. We therefore compare WTC for products with a reduced label holding both the product type and date type constant.

H6.5: in the reduced condition we hypothesise that WTC products with a reduced label will be lower than for products without a reduced label for all product/date type combinations.

6.1.2   Date label knowledge

As described in section 2.6, a number of studies have assessed consumer knowledge about date labels and discussed implications for household food waste, however their results are mixed. In light of these findings we develop a further hypothesis to test whether the relationship between expiry date knowledge and WTC differs by product type.

H6.6: consumers with better expiry date knowledge will have a higher WTC products in relation to the best-before date.

6.1.3   Different types of knowledge

As described in section 2.6.2, Kaiser and Fuhrer (2003) developed a model of knowledge and ecological behaviour that they argue bridges the gap that has often been identified between environmental knowledge and pro-environmental behaviour. It includes four types of knowledge, which include: declarative, procedural, effectiveness, and social knowledge. Declarative knowledge, sometimes called objective knowledge is knowledge of factual information whereas procedural knowledge is often considered to be knowledge of how to use and apply factual information (Alexander et al. 1991). Effectiveness knowledge is described as knowledge that taking a particular action will be effective in achieving a desired goal or which of multiple actions will be most effective. Finally Kaiser and Fuhrer (2003) describe social knowledge as a combination of conventional social norms such as subjective norms and moral norms or "self-referential standards" (p.603). Kaiser and Fuhrer (2003) are not prescriptive about the relationships between the various knowledge variables. Figure 6.1 outlines one permutation that they propose.
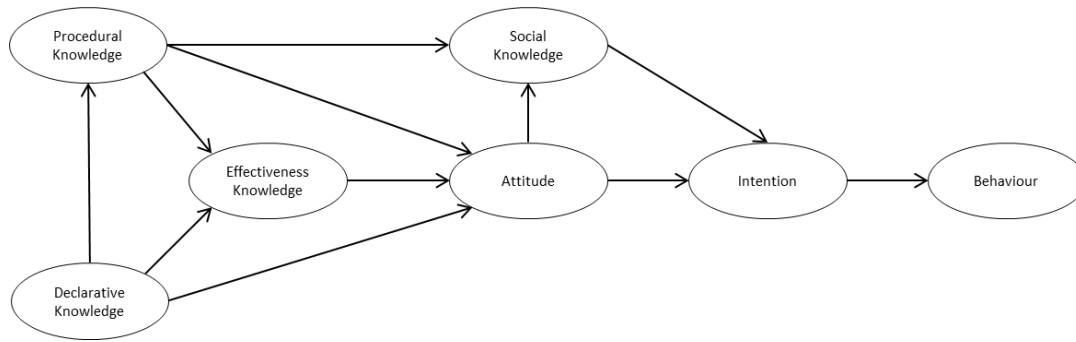
Figure 6.1 Conceptual model of knowledge's influence on behaviour from Kaiser and Fuhrer (2003)

As discussed in section 2.5.2 there are no empirical tests of this full model found in the literature. The measures used by those studies that have tested parts of it indicate that the concept of social knowledge is extremely similar to social norms (Redman and Redman 2014). Combined with the inclusion of attitudes and intentions it essentially forms an extended TPB. In this chapter, the interest is exploring the influence of knowledge on WTC products in relation to the best-before date. We therefore focus on the knowledge variables and include an additional type of knowledge, subjective knowledge. As discussed in section 2.6 subjective knowledge has also been found to be important in food choice and environmental behaviour.

We hypothesise that those with stronger subjective knowledge will also have stronger procedural knowledge (H6.7). We hypothesise that those with stronger declarative knowledge will have better procedural and effectiveness knowledge (H6.9, H6.10). Those with stronger procedural and effectiveness knowledge will have a greater willingness to consume products in relation to the best-before date (H6.8, H6.11). These relationships are outlined in Figure 6.2 and this model will be referred to as E1. Following Kaiser and Fuhrer's (2003) model this model includes the assumption that there will be a stronger indirect relationship from declarative knowledge to WTC through procedural and effectiveness knowledge than there will be direct relationship. This will also be tested.
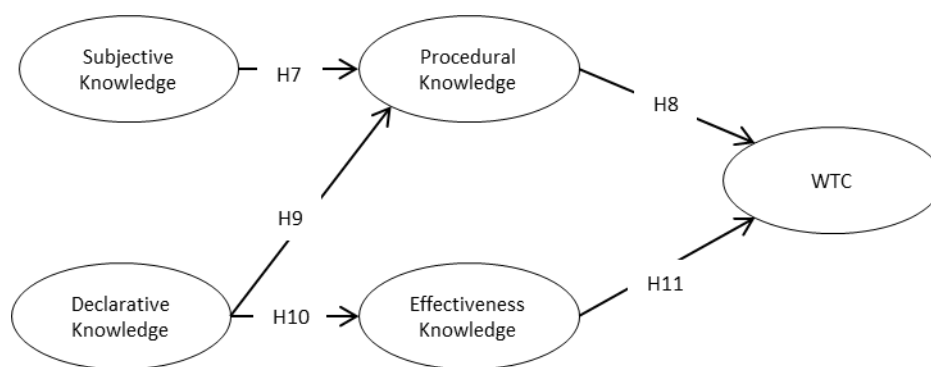
Figure 6.2 Structural model and hypotheses model E1

6.2 Measures, descriptive statistics and study design

6.2.1 Model E1: measures and descriptive statistics

Declarative knowledge

Declarative knowledge was measured through six statements two of which described the best-before and two of which described the use-by date and two of which described the 'sell-by'/'display-until' date. Statements were adapted from the text of Regulation (EU) No. 1169/2011 as well as WRAP (2011a) and TNS (2014). Two statements were chosen for each date type since they are described in different ways by different sources e.g. best-before dates are both described as a general quality label (WRAP 2011a; TNS 2014) and in terms of deterioration of certain properties e.g. taste (Regulation (EU) No. 1169/2011). Respondents selected a radio button next to each statement to indicate which date type they understood it to refer to. Respondents were given the option to choose either best-before, use-by, or sell-by/display-until. Where they selected the correct option this was coded with 1 and where they selected an incorrect option this was coded with 0. Table 6.1 describes how many respondents identified each statement correctly. The results suggest that respondents were best able to correctly identify display-until/sell-by dates with both of these questions receiving the highest number of correct answers combined. The use-by date definition that referred to a human health risk had more correct answers than the one that referred to food

safety. Both best-before date questions received a similarly low number of correct answers relative to other date types.

Table 6.1 Date-label knowledge descriptive statistics

Question	Incorrect [0]	Correct [1]	Percentage correct
Q13_1 Best Before Date	176	372	68
Q13_2 Use By Date	103	445	81
Q13_3 Best Before	160	388	71
Q13_4 Display Until/Sell By	134	414	76
Q13_5 Use By	160	388	71
Q13_6 Display Until/Sell By	115	433	79

For the purposes of the model only the items that measure knowledge of the best-before date were included since WTC in relation to the best-before date is the dependent variable. Declarative knowledge of the best-before date was therefore recoded as a single item measure: 0 if the respondent did not identify any best-before statement correctly, 1 if they got one correct and 2 is they got two correct. The results show that just over half of the respondents were able to correctly identify both statements pertaining to the best-before date (Table 6.2).

Subjective knowledge

Subjective knowledge was measured by asking respondents how confident they were in their understanding of the best-before date and was based on the approached used by Peschel et al. (2016). Responses were on a Likert scale 1 = not confident [1] extremely confident [5]; the frequency of responses are displayed in Table 6.2.

Procedural knowledge

Procedural knowledge is considered to be knowledge of how to use and apply factual information (Kaiser, Fuhrer 2003). It can be understood as a sub-concept of PBC. PBC is defined as the perceived ease or difficulty of performing the behaviour (Ajzen 2002) and includes both internal and external limitations. Procedural knowledge focuses on one internal limitation, specifically limited knowledge as a barrier to engaging in particular

behaviours. While this overlap is not something discussed by Kaiser and Fuhrer or others who have subsequently used their model (Redman, Redman 2014), it is apparent in the way that measures of PBC have been operationalised in those studies. Redman and Redman (2014) measured procedural knowledge by asking respondents, for example, how they would rate their ability to find organic foods and drinks in a grocery store or identify certified organic foods at the grocery store on a scale of poor to excellent. This therefore tests their perceived ability to make use of organic food labels when shopping. In this model procedural knowledge was measured on a 7-point Likert scale. Respondents were asked how easy or difficult respondents found it to: "Make use of the best before date when deciding whether to throw away a dairy product"; extremely difficult [1] extremely easy [7]. Due to the low number of responses in the categories 1 and 2 these were collapsed and the item was coded 1-5 (Table 6.2).

Effectiveness knowledge

Effectiveness knowledge was measured by asking respondents how effective they felt "Eating products after the best before date if they smell and look ok" was in terms of minimising dairy product food waste in their household. The structure of the measures followed examples from Redman and Redman (2014) and Frick (2004). The frequency of responses is outline in Table 6.2. A large number of respondents indicated that they felt that being willing to eat products after the best before date was an effective way of minimising waste in their household.

Willingness to consume

Willingness to consume (WTC) was measured by a series of questions that asked respondents when in relation to the expiry date they would be happy to consume a product. This was based on one of the approaches used by WRAP (2011a) although the response scale was adapted as respondents had already been screened as consumers of dairy products. An example of how this question was presented in the survey for one product type/date type combination is presented in Table 6.3. Different products were used for the use-by and best-before conditions in each case. This was done so that the product/expiry

date combinations were realistic and could be found in a UK shop. The item was coded with 1 if they were only willing to consume the product prior to the best-before date and 7 if they would be willing to consume the product any time after the best-before date. Based on results reported in section 0, there was no difference between WTC in the reduced and non-reduced condition. The responses of those allocated to conditions A and B were therefore combined and the full sample of 548 was used for the analysis in this chapter. The frequency of responses is outline in Table 6.2.

Table 6.2 Frequency of responses to items included in model E1 (n = 548)

Items	Frequency							
	0	1	2	3	4	5	6	7
WTC Yoghurt	-	96	156	90	74	45	61	26
Effectiveness Knowledge	-	15	16	30	56	157	159	115
Procedural Knowledge	-	-	-	21	78	88	157	204
Subjective Knowledge	-	4	6	3	175	277	-	-
Declarative Knowledge	69	198	281	-	-	-	-	-

Table 6.3 Willingness to consume (WTC) example question

Please look at the pictures of the products that follow. Indicated until when you would be happy to consume each product, relative to the date shown.

	Before the date shown (1)	One the date shown (2)	1 day after the date shown (3)	2 days after the date shown (4)	3 days after the date shown (5)	Up to a week after the date shown (6)	Any time after the date shown (7)
Yoghurt with this expiry date:							

 Condition A

 Condition B

Note. For each product/expiry date combination the respondent would either see the normal condition A or the reduced condition B.

6.2.2 Study design

Hypotheses H6.1 – H6.5 were tested using a simple Chi-square test. The WTC question was constructed as a mixed design that facilitated both within and between subject tests for H6.1-H6.4 (Charness et al. 2012). Only between subject tests were conducted for H6.5 which facilitated counterbalancing of order effects since respondents were randomly allocated to either the reduced or non-reduced condition for every product/date type combination; this resulted in 32 possible permutations of question order on average 17 respondents will have had the same questions order. The number of respondents per test is described in Table 6.5.

6.3 Results

6.3.1 Relationship between product type and WTC

We tested four conditions where respondents saw two different product types with the same date type. We tested these conditions both within and between subjects. The results of the within subject and between subject comparisons are outlined in Table 6.4. Where response categories 6 and 7 were low we also ran the Chi-squared test by merging these categories however this did not change which responses were significant. Both within and between subjects we found the same pattern emerged. We found evidence that WTC is different between milk and cheese as well as between yoghurt and cheese where both products have a use-by date. We did not find evidence of a difference when the products were yoghurt and milk or when both products (yoghurt and cheese) had a best-before date. The largest amount of variance observed was in the between subject yoghurt and cheese use-by date comparison and the smallest was amount of variance observed was in the within subject yoghurt and milk use-by date comparison. These findings suggest that some product differences were pertinent to respondents' WTC whether we compared the same people or different people. However, these product differences were only pertinent when the use-by date was present and not when the best-before date was present. These results partly support H6.1 as we find that WTC cheese is higher than WTC both milk and yoghurt where

use-by dates are present. However WTC yoghurt does not appear to be different to WTC

milk where both have a use-by date. We do not find evidence to support H6.2 as WTC

cheese and yoghurt with a best-before date appear to be similar.

Table 6.4 Comparison of WTC responses by product type, total subjects (n = 548)

Within subject	WTC							N	Chi square	DF	p value
	1	2	3	4	5	6	7				
Milk use-by	17	52	26	20	14	10	5	144	17.32	6	0.01
Cheese use-by	16	41	15	15	16	25	16				
Milk use-by	20	53	26	21	9	6	3	138	3.48	6	0.75
Yoghurt use-by	19	58	20	17	8	11	5				
Cheese use-by	18	46	17	16	12	25	9	143	13.57	6	0.03
Yoghurt use-by	22	61	26	10	9	11	4				
Cheese best-before	20	37	13	18	12	28	20	148	7.67	6	0.26
Yoghurt best-before	22	43	21	19	14	19	10				
Between subject											
Milk use-by	21	47	18	16	7	9	1	119	12.34	6	0.05
Cheese use-by	23	36	17	16	6	19	10	127			
Milk use-by	18	46	18	15	12	13	3	125	5.96	6	0.43
Yoghurt use-by	26	50	31	13	10	8	2	140			
Cheese use-by	21	31	15	15	10	19	17	128	20.75	6	0.00
Yoghurt use-by	23	47	25	20	9	8	3	135			
Cheese best-before	14	31	17	20	18	24	14	138	9.60	6	0.14
Yoghurt best-before	19	39	16	19	9	14	6	122			

6.3.2   Relationship between date type and WTC

We tested conditions where respondents saw the same type of products with a different

date type. We tested these conditions both within and between subjects. The results of the

within subject and between subject comparisons are outlined in Table 6.5. As above where

response categories 6 and 7 were low we also ran the Chi-squared test by merging these

categories however this did not change which responses were significant. We found

evidence that date type was pertinent to respondents' WTC yoghurt with a use-by date and

yoghurt with a best-before date. However, this was only found in the between subject

comparison. We found no evidence to suggest that respondents' WTC cheese was

associated with a difference in date type; the variance was slightly higher between

responses in the comparison made between subjects but it was not significant.

Table 6.5 Comparison of WTC by date type – total subjects (n=548)

Within subject	WTC							N	Chi square	DF	p value
	1	2	3	4	5	6	7				
Cheese use-by	17	45	14	16	13	20	10	135	2.7	6	0.85
Cheese best-before	19	34	14	17	13	24	14				
Yoghurt use-by	18	53	26	20	7	9	3	136	3.74	6	0.7
Yoghurt best-before	19	45	23	19	9	17	4				
Between subject											
Cheese use-by	22	32	18	15	9	24	16	136	4.95	6	0.55
Cheese best-before	15	34	16	21	17	28	20	151			
Yoghurt use-by	27	55	25	10	11	10	4	142	15.45	6	0.02
Yoghurt best-before	22	37	14	19	14	16	12	134			

Our observation of a different result for our within and between subject conditions could indicate that personal factors are important in determining a respondents' WTC whereas the same person responds similarly regardless of the date type. To see if these differences could be linked to the socio-demographic profile of the samples we checked using a Chi-squared test how similar the randomly allocated subject samples were for the between subject yoghurt use-by/best-before comparison and found that while there were similar in terms of age and income they were significantly more women in the yoghurt best-before condition. Across all other between subject comparisons the two randomly allocated subject samples were not significantly different in terms of age, income of gender.

These results partly support H6.3 as we find that WTC yoghurt with a use-by date is lower than WTC yoghurt with a best-before but only in the between subject condition and could be linked to the female dominant sub-sample. We find no evidence to support H4 and instead find that WTC cheese is similar regardless of the date type.

6.3.3   Relationship of reduced labelling and WTC

The reduced comparison was only made between subjects. The results of the comparisons are outlined in Table 6.6. For each product type/date type combination we found no difference in respondents' willingness to pay. These results provide no evidence to support H6.5 that respondents would have a lower WTC products with a reduced label.

Table 6.6 Comparison of WTC responses by reduced condition, total subjects (n = 548)

Between subject	WTC							N	Chi square	DF	p value
	1	2	3	4	5	6	7				
Milk use-by	38	99	44	36	21	19	6	263	10.24	6	0.11
Milk use-by reduced	46	105	70	25	21	16	2	285			
Cheese use-by	39	77	32	31	22	44	26	271	5.14	6	0.92
Cheese use-by reduced	33	96	42	27	19	38	22	277			
Cheese best-before	34	68	30	38	30	52	34	286	1.89	6	0.93
Cheese best-before reduced	36	59	34	33	22	48	30	262			
Yoghurt use-by	45	108	51	30	18	19	7	278	2.88	6	0.82
Yoghurt use-by reduced	44	106	38	30	23	23	6	270			
Yoghurt best-before	41	82	37	38	23	33	16	270	7.05	6	0.32
Yoghurt best-before reduced	55	74	53	36	22	28	10	278			

6.3.4   Model E1: results of structural model

The overall fit of model E1 was good as indicated by the fit statistics described in Table 6.8. The results of the path model indicate that declarative knowledge also has a positive, direct, relationship with WTC; the relationship is not indirect through procedural knowledge and effectiveness knowledge. Better knowledge of the best-before date is associated with a higher level of effectiveness knowledge and a lower level of procedural knowledge however, these relationships are not statistically significant in this model. This evidence therefore does not provide sufficient support for hypotheses H6.9 and H6.10. Subjective knowledge does however have a positive association with procedural knowledge, supporting hypothesis H6.7

and suggesting that a respondents' perceived knowledge is more influential than their declarative knowledge on their perceived ability use information. There is a weak, negative but not statistically significant relationship between procedural knowledge and WTC contradicting hypothesis H6.8. On the other hand, effectiveness knowledge does have a positive association with WTC and there is evidence in support of hypothesis H6.11. While there is some evidence of the indirect effect of declarative knowledge through effectiveness knowledge it is weak.

Table 6.7 Model E1 Direct and Indirect Parameter Estimates

Parameters	Unstandardised			Standardised		
	Estimate	SE	p value	Estimate	SE	p value
Direct effects						
Q31_5 ~ a*Q13_9	0.12	0.06	0.06	0.09	0.04	0.06
Q15_8 ~ c*Q13_9	- 0.08	0.07	0.22	- 0.05	0.04	0.22
Q15_8 ~ e*Q12_2	0.42	0.06	0.00	**0.33**	**0.04**	**0.00**
WTCYog ~ b*Q31_5	0.39	0.04	0.00	**0.39**	**0.04**	**0.00**
WTCYog ~ d*Q15_8	- 0.04	0.04	0.38	- 0.04	0.05	0.38
WTCYog ~ f*Q13_9	**0.16**	0.06	0.01	**0.11**	**0.04**	**0.01**
WTCYog ~ g*Q12_2	0.03	0.06	0.63	0.02	0.05	0.63
Indirect effects						
ab	0.05	0.03	0.06	0.03	0.02	0.06
cd	0.00	0.00	0.47	0.00	0.00	0.47
ed	- 0.02	0.02	0.38	-0.01	0.02	0.38
total1	0.21	0.06	0.00	0.15	0.04	0.00
total2	0.17	0.06	0.01	0.12	0.04	0.00
total3	0.01	0.06	0.83	0.01	0.05	0.83

Table 6.8 Model E1 Global Fit Statistics

Fit Statistic	Model E1
Chi-square	3.35
DF	2
P value	0.19
Chi-square scaled	3.35
DF scaled	2
P value scaled	0.19
Chi-square scaling factor	1.00
CFI	0.99
CFI scaled	0.99
RMSEA	0.04
RMSEA ci lower	0.00
RMSEA ci upper	0.10
RMSEA p value	0.55
RMSEA scaled	0.04
RMSEA ci lower scaled	0.00
RMSEA ci upper scaled	0.10
RMSEA p value scaled	0.55
SRMR	0.01

6.4   Discussion

The first objective of this chapter was to address Research Question 5: *How do date type, product type and presence of a reduced label affect consumers' WTC dairy products in relation to the expiry date?* We found no difference in WTC for products with a reduced label compared to identical products without a reduced label. This is positive for expiry-date-based pricing as these results suggest that consumers' WTC is not affect by the awareness that a product was purchased when it was already approaching the end of its shelf-life.

We found that product type did make some difference to WTC when date type was held constant but not in all cases. Product type did not seem to make a difference to WTC between yoghurt and milk, but they did between milk and cheese as well as between yoghurt and cheese where all of these products had a use-by date. However, there was no significant difference in WTC observed between yoghurt and cheese where both products had a best-before date. This suggests that physical differences between these products could be relevant to consumer responses i.e. cheese being relatively hard and dry compared to the yoghurt and cheese. In which case we might be able to make hypotheses about WTC different products, for example that WTC bread would be higher than WTC juice. On the other hand factors such as consumers' previous experience of how edible they have found these products after the expiry date in the past might be driving these observations. It is also important to note that the presence of the best-before date appears to have mitigated the perceived difference in WTC between yoghurt and cheese. In terms of understanding why product type seems to matter, future research should also include qualitative work to draw out the reasoning behind these responses. It should also pursue further quantitative work to systematically understand whether date type makes a difference to WTC other products that carry either a best-before or a use by date such as fruit juices.

The comparison of date types where product type was held constant found date type may be pertinent for WTC yoghurt but not for WTC cheese. Date type was only significant in the between subject comparison for yoghurt and not the within subject comparison and therefore it seems to be personal differences that matter when it comes to the interpretation

of date labels. Personal differences associated with WTC are discussed further below and in Chapter 7.

The second objective of this chapter was to address Research Question 6: *To what extent are different types of knowledge (declarative, procedural, effectiveness and subjective knowledge) associated with WTC dairy products in relation to the best-before date?* It investigated one potential dimension of these personal differences, date-label knowledge, and its association with date-label use. It found a direct relationship between better declarative knowledge of the best-before date and greater WTC yoghurt in relation to its best-before date. It did not find evidence that this knowledge was related to WTC yoghurt indirectly through procedural or effectiveness knowledge as hypothesised by Kaiser and Fuhrer (2003). Although, effectiveness knowledge did have an influence on WTC and there was a very weak relationship between declarative and effectiveness knowledge. The influence of effectiveness knowledge was also greater than declarative knowledge according to the parameter estimates; 0.39 and 0.11 from the standardised solution respectively.

These findings give support to those studies in section 2.2 that found that date-label knowledge is important date-label use and being willing to consume products after the best-before date. Pulling the findings relating to the two objectives together it seems that while at a population level no distinction between yoghurts with a best-before date, those with better knowledge of the meaning of best-before dates reported higher WTC. Improving date-label knowledge is therefore likely to reduce the waste of dairy products. Any move to increase the number of dairy products that have a best-before rather than a use-by date should therefore be supported by a programme to improve consumers' understanding of date labels. Given the strong influence of effectiveness knowledge, from a behaviour change perspective developing consumers' knowledge of the outcomes of their behaviour also presents an opportunity. As previously highlighted in section 5.4.3, highlighting the types of behaviours that reduce food waste is important as those that do not currently engage in these behaviours regularly may be unaware of the benefits.

While model E1 highlighted the importance of declarative, and to an extent, effectiveness knowledge, the descriptive statistics outlined in this chapter indicate that there are likely to be other factors affecting the relationship between knowledge and behaviour. 281 respondents got both questions correct but only 61 respondents indicated that they would be willing to consume yoghurt up to a week after the best-before date and only 27 respondents indicated that they would be willing to consume yoghurts any time after the best-before date. If these individuals were acting on their knowledge alone we would expect a greater proportion to be happy to eat the product any time after the date or at least a week after the date shown. Clearly those with better knowledge have a greater WTC but it will also be important to understand what holds people back from expressing an even greater WTC when they know that the date-label means it is perfectly safe to eat. This is the subject of the next chapter.

7 Willingness to consume dairy products in relation to the best-before date: risk perceptions and trust

This chapter addresses Research Question 7: *To what extent do consumers' risk perceptions and trust in date labels influence WTC yoghurt and cheese in relation to the best-before date, and how do these factors interact with date-label knowledge?* Building on the findings of Chapter 6, this chapter explores the potential motivational factors that might prevent consumers acting on their date-label knowledge and transforming it into WTC dairy products after the best-before date. It then explores how one of these motivational factors, perceived risk, might affect the relationship between knowledge and WTC. In addition to addressing this main research question it explores two additional avenues: the influence of gender, age, and income on the relationships between risk perception, trust, and WTC; and the relationship between trust in different sources of information and the trust concepts. Section 7.1 describes the background to this study and develops the hypotheses. Section 7.2 describes the measures used to capture risk perceptions and trust and outlines the structural models to be tested. Section 7.3 describes the results and section 7.4 is a discussion of the results.

7.1 Background and hypotheses

7.1.1 Risk perceptions

As discussed in section 2.5, there is a paucity of studies that have considered how consumers perceived risks might affect the food consumption preferences in the home, specifically with regard to date labels. This study adds to the few conducted previously by using a multi-dimensional concept of perceived risk and evaluating how this perceived risk affects WTC in relation to the best-before date. Higher perceived risk with regard to consuming products beyond their best-before date, whether perceived as social or physical risk, is thought to reduce WTC, therefore the first hypothesis is,

H7.1: respondents with higher perceptions of risk will report lower willingness to consume products in relation to the best-before date.

7.1.2   Trust

As described in section 2.4.2 two concepts of trust appear particularly pertinent to the case of date labels. We explore these and their association with risk perceptions and WTC. The first concept measures trust in the date labels themselves as conveyers of information. This comes under the category of system trust where people base their trust on established rules and the enforcement of those rules e.g. food safety guidelines described earlier (Lindgreen 2003). The second type of trust is described as calculative trust defined as the "rational evaluation that others are likely to be behave in a way that does not harm their own interests" (Hobbs, Goddard 2015, pp. 71). This concept evokes Hardin's (2002) encapsulated interest and the constraints on future behaviour described by Earle (2010). We interpret this to mean that consumers may perceive food manufacturers to be constrained by their need to avoid prosecution and/or for repeat business; by extension they trust date labels and may also perceive them to have a buffer built in. This can also be seen as the food industry needing to protect itself from economic losses and by proxy it is trusted to protect the interests of consumers (Frewer et al. 1996). We therefore developed the following hypotheses:

H7.2: consumers with greater trust in the label will have a higher WTC with respect to the best-before date

H7.3: consumers with stronger sense of calculative trust will have a higher WTC with respect to the best-before date

H7.4: consumers with a stronger sense of calculative trust will be more likely to have greater trust in the date label

H7.5: consumers with higher risk perceptions are likely to have higher trust in the date label

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7.1.3 Knowledge

The previous chapter found that better knowledge of the best-before date led to greater WTC products in relation to the best-before date. However the effect size was quite small and there was a gap between knowing the meaning of the best-before date and being willing to act on that knowledge. This chapter explores whether risk perceptions might explain this gap. Despite knowing the meaning of best-before dates, consumers may still perceive a risk in consuming products after the best-date has passed; since risk appears to be multi-dimensional, knowledge might allay some elements of this perceive risk, for example food safety, but not others, relating to food quality or potentially social risks. As has been found with regard to educating consumers about biotechnology, improving knowledge alone is unlikely to be sufficient to overcome perceived risks; social norms and subjective knowledge amongst other factors are important (Lusk, McCluskey 2018; Loebnitz, Grunert 2018). The final hypothesis considers how knowledge interacts with risk perceptions.

H7.6: Expiry date knowledge will have a negative association with risk perceptions and the inclusion of risk perceptions in the model will affect the relationship between knowledge on WTC.

7.1.4 Exploratory analysis

In addition to testing the hypotheses outline above, this chapter also contains two pieces of exploratory research. First, it investigates the influence of socio-demographic variables on model. It does this by conducting multi-group analysis and assessing the extent to which it is invariant when the population is split by gender, age and income. Second, it investigates which sources of information are trusted by consumers when it comes to understanding and interpreting date labels. This part of the analysis is built on an approach used by Lobb et al. (2007) to understand trust in information sources with regard to poultry food safety. Since there is very limited literature on this subject and there is not strong theory beyond Lobb et al.'s (2007) study on the number of content of factors that might be formed this analysis is also considered to be exploratory.

7.2   Method

This section describes the basis for the concepts and the questions used to construct each latent variable. As described in previous chapters measurement models were established for the key latent constructs risk, label trust and calculative trust. Items which had low standardised loadings, high cross loadings or shared error variance were removed. The frequencies of items retained are all reported in Table 7.1.

7.2.1   Survey measures

Willingness to consume (WTC)

Willingness to consume (WTC) was measured in the manner outlined in section 6.2.1.

Risk perceptions

Risk perception was measured as a multi-dimensional concept drawing on Tsiros and Heilman's (2005) two risk constructs: product quality risk and personal risk. The wording of Tsiros and Heilman's (2005) measures were adapted to the home and best-before date context. For example one of Tsiros and Heliman's (2005) measures of personal risk asked about "guests in your home thinking less of you for serving them a poor quality product" (p. 120) and we adapted this to date-label situation and asked whether it would be "appropriate to serve others dairy products after the best-before date". The first question asked respondents about the food safety risk perception and the second question drew on other forms of perceived risk. If I consumed my usual dairy products, I believe they would pose a risk of food poisoning if I ate them:

- After the best-before date (Q20_4)

This item was measured on a scale on a scale: strongly disagree [1] strongly agree [7]. How would you feel about eating, cheese, yoghurt or butter past their best-before dates?

- I can easily afford to buy fresh dairy products so I have no need to take this risk (Q23_1)

- It would be embarrassing if people knew I ate these dairy products past their best-before date (Q23_2)

- I would feel I was not providing well for myself/my family (Q23_3)

- I would worry they wouldn't taste very good (Q23_4)

- I would feel uncomfortable about eating them (Q23_6)

- It is better for health to eat the freshest products possible (Q23_7)

- Even if I'd eat it myself, it would not be appropriate to serve others dairy products after the best-before date (Q23_8)

- I would feel a little shameful (Q23_9)

These items were measured on a scale: does not describe my feelings [1] clearly describes my feelings [5]

Label Trust

Label trust was one of two concepts of trust measured by the survey drawing on the food-labelling literature. It was measured by a series of statements that asked respondents the extent to which date labels were credible, meaningful and protected their interests. These measures were developed by the authors but were based on the concepts described by (Tonkin et al. 2016a; Tonkin et al. 2016b) and partly adapted from the measures used by (Lassoued, Hobbs, 2015; Lobb et al. 2007). "Please indicate the extent to which you agree with the following statements about expiry dates on dairy products" on a scale strongly disagree [1] strongly agree [7] [7].

- Expiry date labels protect the interests of consumers (Q26_1)

- Expiry dates on the dairy products I buy (use-by and best-before) are credible (Q25_10

- Expiry date labels on dairy products are meaningful (Q25_7)

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[7] The items were recoded as 1-5 to due to 0 frequencies when multi-group analysis was conducted

Calculative trust

Calculative trust was the second of two concepts of trust measured by the survey and captures the idea articulated by Frewer et al. (1996) and Hobbs and Goddard (2015) that we trust date labels because we believe that the food system actors that set them would wish to protect their own interests. The measures themselves were adapted from some of the questions used in Frewer et al. (1996) e.g. whether food system actors seek to protect their own interests. We developed additional measures to test the idea that by extension, respondents may perceive dates to be set earlier than necessary to encourage the purchase of more products or that food companies are cautious in setting dates because they prioritise safety over waste. "Please indicate the extent to which you agree with the following statements about expiry dates on dairy products" on a scale strongly disagree [1] strongly agree [7].

- Expiry dates are set earlier than necessary to encourage us to buy more (Q26_4)
- Food companies are too cautious in setting expiry dates, they focus on safety at the expense of creating waste (Q26_8)
- It is in the interests of food companies to set expiry dates earlier than necessary[8] (Q26_6)

Knowledge

Knowledge of the best-before date was measured as previously reported in section 6.2.1. The frequencies were reported in Table 6.2.

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[8] This item was recoded as 1-5 to due to 0 frequencies when multi-group analysis was conducted

Table 7.1 Frequency, mean and standard deviations of measures used in the model (n = 548)

Items	Frequency							Mean	SD
	1	2	3	4	5	6	7		
Risk Perception									
Q20_4	62	94	136	87	81	60	28	3.59	1.68
Q23_1	62	94	136	87	81	-	-	2.60	1.47
Q23_2	192	81	111	81	83	-	-	1.94	1.30
Q23_3	321	68	68	55	36	-	-	2.35	1.41
Q23_4	234	80	99	80	55	-	-	2.76	1.35
Q23_6	129	124	113	113	69	-	-	2.52	1.45
Q23_7	195	114	76	87	76	-	-	3.78	1.17
Q23_8	29	58	101	174	186	-	-	3.21	1.43
Q23_9	100	85	95	137	131	-	-	1.98	1.29
Label Trust									
Q25_1	2	8	27	86	179	188	58	5.24	1.12
Q25_7	2	7	29	68	151	199	92	5.42	1.17
Q26_1	3	3	22	78	174	176	92	5.40	1.13
Calculative Trust									
Q26_4	16	53	94	152	108	79	46	4.28	1.51
Q26_6	9	19	68	127	141	122	62	4.80	1.39
Q26_8	12	37	75	140	135	102	47	4.54	1.44

7.2.2   Study design and analyses

Hypotheses H1 – H6 were tested by means of a structural equation model, outlined in Figure 7.1. As described in section 7.1.4, following these hypothesis tests, exploratory analysis was conducted. First, the effect of demographic variables was tested using a multi-sample analysis. Second, it the factor structure amongst trust in different sources of information was evaluated, as well as whether the source of information believed to be trustworthy, affected perceptions of date label trust.

The list of sources was developed based on Lobb et al. (2007) but was also expanded to consider other sources relevant to date labels and food waste e.g. professional training in food service or WRAP/Zero Waste Scotland. The list of sources included: internet/social media, TV/print/radio, supermarkets, other food shops, public information leaflets, education (school, college, and university), professional training, government agencies e.g. Food

Standards Agency, Love Food Hate Waste campaign (WRAP). Zero Waste Scotland (ZWS),

family, and friends. It also included the date label itself however this was excluded from the

analysis due to overlap with measures of label trust. It also included an option to select other

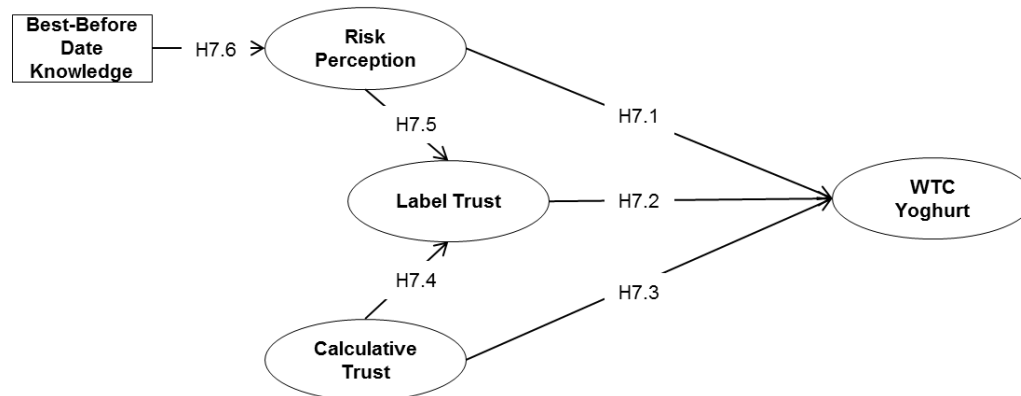and describe the source of information.

Figure 7.1 Outline of structural model F1

7.3 Results

7.3.1 Model F1: relationship between risk perceptions, trust, knowledge and WTC

The latent constructs of risk perception, label trust and calculative trust were tested by

means of confirmatory factor analysis. The standardised loadings of the latent variable item

measures retained were above .50 and statistically significant. Table 7.2 describes the

parameter estimates.

Table 7.2 Parameter estimates for risk trust model (n = 548) model F1

Parameter	Unstandardised			Standardised		
	Estimate	SE	p value	Estimate	SE	p value
Risk Perceptions						
Q20_4	1.00	0.00	-	0.66	0.03	0.00
Q23_1	0.95	0.06	0.00	0.62	0.03	0.00
Q23_2	1.04	0.06	0.00	0.69	0.03	0.00
Q23_3	1.24	0.06	0.00	0.81	0.02	0.00
Q23_4	1.19	0.06	0.00	0.78	0.02	0.00
Q23_6	1.28	0.06	0.00	0.84	0.02	0.00
Q23_7	1.01	0.06	0.00	0.67	0.03	0.00
Q23_8	0.98	0.06	0.00	0.64	0.03	0.00
Q23_9	1.11	0.06	0.00	0.73	0.03	0.00
Label Trust						
Q25_1	1.00	0.00	-	0.78	0.03	0.00
Q25_7	1.13	0.07	0.00	0.88	0.03	0.00
Q26_1	0.92	0.05	0.00	0.71	0.03	0.00
Calculative Trust						
Q26_4	1.00	0.00	-	0.84	0.02	0.00
Q26_6	0.83	0.04	0.00	0.70	0.02	0.00
Q26_8	0.78	0.04	0.00	0.66	0.03	0.00

The Average Variance Extracted (AVE) was at or above the recommended .50 for each latent variable and the square of the correlations between different latent variables was lower than either of their respective AVE scores. The composite reliability scores (CR) were also over the recommended .70 for each latent variable. The test of discriminant validity also holds and indicates that the correlation between each pair of latent variables is less than the square root of the AVE of each of respective latent variables in the pair. These results are described in Table 7.3.

Table 7.3 AVE and CR plus discriminant validity model F1

Variable	AVE	CR	Risk	Label Trust	Calculative Trust
Risk	0.52	0.90	**0.72**		
Label Trust	0.63	0.78	0.46	**0.79**	
Calculative Trust	0.55	0.83	0.00	- 0.53	**0.74**

Note. The square root of the AVE is bolded on the diagonal

Goodness of fit for the whole model was judged against a range of statistics including the Comparative Fit Index (CFI) and the Root Mean Square Error Approximation (RMSEA). Both of these items indicated a good fit as the CFI was over the recommended threshold of .95 and the RMSEA was under the threshold of .08. Table 7.4 outlines these and other commonly reported measures of model fit.

Table 7.4 Goodness of fit indicators for the risk trust model

Measure	Model F1
Chi-square	268.10
DF	113
P value	0.00
Chi-square scaled	272.64
DF scaled	113
P value scaled	0.00
Chi-square scaling factor	1.20
CFI	0.99
CFI scaled	0.98
RMSEA	0.05
RMSEA ci lower	0.04
RMSEA ci upper	0.06
RMSEA p value	0.48
RMSEA scaled	0.05
RMSEA ci lower scaled	0.04
RMSEA ci upper scaled	0.06
RMSEA p value scaled	0.42
SRMR	0.05

The results of the structural models are described in Table 7.5. The R-squared value indicates that 31 per cent of the variance in WTC yoghurt was account for by the model. They show that risk perceptions have a significant, negative relationship with WTC. This suggests that respondents that reported higher risk perceptions are less likely to indicate WTC yoghurt after the best-before date and provides evidence to support H7.1. Trust in the date label was not found to have a significant relationship with WTC and provides no evidence to support H7.2.On the other hand, calculative trust has a significant, positive relationship with WTC and provides evidence to support H7.3. This suggests that respondents who indicated that they trust date labels due to their view of self-interested

motives of those setting the dates, were more likely to indicate a WTC yoghurt after the best-before date. Knowledge of best-before dates did not have a significant direct relationship with WTC but it did have a significant, negative association with risk perceptions. However, the indirect and total relationships between knowledge and WTC were positive and significant. These results provide support for H7.6. Perceived risk had a significant positive relationship with label trust (H7.5) whereas calculative trust had a significant negative association with label trust (H7.4).

Table 7.5 Direct and Indirect Effect Estimates Model F1

Direct effects	Unstandardised			Standardised		
	Estimate	SE	p value	Estimate	SE	p value
WTC ~ a*Risk	- 0.80	0.09	0.00	- 0.52	0.05	0.00
WTC ~ Label Trust	0.09	0.11	0.38	0.07	0.08	0.38
WTC ~ Calculative Trust	0.32	0.09	0.00	0.27	0.07	0.00
WTC ~ b*Knowledge	0.10	0.06	0.09	0.07	0.04	0.08
Risk ~ c*Knowledge	- 0.16	0.04	0.00	- 0.17	0.04	0.00
Label Trust ~ Risk	0.54	0.06	0.00	0.46	0.04	0.00
Label Trust ~ Calculative Trust	- 0.49	0.05	0.00	- 0.53	0.04	0.00
Indirect a*c	0.13	0.04	0.00	0.09	0.02	0.00
Total b + (a*c)	0.22	0.06	0.00	0.15	0.04	0.00

Note. The standardised solution is completely standardised.

One criticism that could be levelled at the analysis reported in here is that it by introducing an exogenous variable the possibility for higher levels of measurement error is raised. As an alternative, in Appendix 5 the results of a multiple-sample analysis are presented. Here, instead of knowledge being an exogenous variable, the sample was split in two: a group of lower knowledge (n = 267) and a group of higher knowledge (n = 281). The lower-knowledge group contained the 69 respondents who answered zero questions correctly and the 198 who answered one question correctly. The higher-knowledge sample includes those 281 answered two questions correctly. A comparison of increasingly restricted models suggests that there is some structural variance. The direct effects of the configural model indicate that the relationship between risk and WTC is slightly weaker in the sample with higher date-label knowledge. The biggest observable difference was the

strength of the negative relationship between calculative trust and label trust; it was stronger in the higher knowledge group. This suggests that date-label knowledge interacts with perceived risk perceptions but also with trust.

7.3.2   Exploratory analysis: multiple-sample invariance analysis by gender, income, and age

Multiple-sample invariance analysis was conducted on model F1 to test for measurement and structural invariance across gender, income, and age. Given the finding that the slightly female dominant sample in 6.3 was different we were particularly interested to test the effects of gender on the model. The sample 548 was split the sample into two gender (female = 281 / male = 267); income (£27,999 and under = 256 / £28,000 and over = 292); and age (18 – 44 = 264 years and 45 and over = 284).

Table 7.6 presents a comparison of selected fit statistics of the models whereby an increasing number of parameter are constrained. The configural model refers to the model where the same model structure is imposed on groups but all parameters were allowed to vary (Kline 2016). The weak invariance model refers to the model which constrained the factor loadings and the strong invariance model, given that the data is ordered and the model is calculated using DWLS[9] constrains the thresholds. Strict invariance is not presented here, which restricts the residuals, since the lavaan package uses delta scaling (parameterisation) as default rather than theta scaling (Hirschfeld, Brachel 2014). Delta scaling is consistent with polychoric correlations rather than theta scaling which is consistent with the scaling in probit regressions (Kline 2016 p 326 - 327) and if run for this purpose would be inconsistent with previously reported models[10]. Finally the models are tested for structural invariance by constraining the regression coefficients to be equal across groups.

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[9] WLSMV was not used as the Anova comparison function in R does not work with the WLSMV estimator only the DWLS. I have contacted the lavaan authors to ask whether this is for statistical reasons or if this is a quirk in the code.
[10] I did check using the measurement Invariance Cat () function in the semTools package which uses theta scaling (parameterisation) for the measurement models only since this

Hirschefeld and von Brachel (2014) find that at present most studies use changes in CFI of less than .01 to indicate invariance rather than the chi-square comparisons. On this basis it seems that there is measurement and structural invariance between these groups as the CFI values remain constant or in fact slightly improve as more parameters are constrained. Kline (2016) uses a combination of the chi-square and CFI to confirm invariance. By Kline's (2016) standard it also seems that there is measurement and structural invariance between these groups.

Table 7.6 Values for selected fit statistics for testing measurement invariance between knowledge, gender, income and age groups for WTC yoghurt model (n = 548)

Models	CFI	RMSEA	DF	Chisq	Chisq diff	DF diff	p value
Gender							
Configural	0.99	0.05	226	368.71	-	-	-
Weak invariance	0.99	0.05	238	393.85	25.13	12	0.01
Strong invariance (thresholds)	0.99	0.05	291	413.47	19.62	53	1.00
Structural invariance (regressions)	0.99	0.04	298	450.79	37.32	7	0.00
Income							
Configural	0.99	0.05	226	381.67	-	-	-
Weak invariance	0.99	0.05	238	415.38	33.71	12	0.00
Strong invariance (thresholds)	0.99	0.04	291	423.50	8.12	53	1.00
Structural invariance (regressions)	0.99	0.04	298	427.38	3.88	7	0.79
Age							
Configural	0.99	0.05	226	363.42	-	-	-
Weak invariance (loadings)	0.99	0.05	238	393.32	29.89	12	0.00
Strong invariance (thresholds)	0.99	0.04	245	414.38	21.07	7	0.00
Structural invariance (regressions)	0.99	0.05	291	415.71	1.32	46	1.00

Note. Each model is run with DWLS estimator as the anova() or lavTestLRT() functions do not calculate the correct DF or Chi-squared differences using WLSMV.

Across multi-sample models there is no clear evidence for measurement or structural invariance. While there are significant differences in the Chi-square value across models, this is not supported by a corresponding deterioration in either the CFI or the RMSEA.

approach is recommended by Kline (2016). There was no evidence to reject the hypothesis of measurement and structural invariance across groups.

7.3.3   Exploratory analysis: trust in different sources of date label information

Table 7.7 outlines the frequency of responses to the questions regarding trustworthy sources of information about date labels. 236 observations remained after NA responses were removed. Most items indicate a left skew with the majority of sources listed being considered neutrally (neither trustworthy nor untrustworthy) or as trustworthy sources. The only exceptions were the media sources, in particular internet/social media.

Table 7.7 Frequency of responses to trustworthy sources of information (n = 236)

Information source	Not trustworthy at all	---		Very trustworthy		Mean	SD
	1	2	3	4	5		
Q33.2_2	55	25	111	41	4	2.64	1.07
Q33.2_3	29	19	127	52	9	2.97	0.97
Q33.2_4	11	22	96	86	21	3.36	0.94
Q33.2_5	10	23	107	79	17	3.30	0.90
Q33.2_6	10	3	83	94	46	3.69	0.94
Q33.2_7	14	4	95	85	38	3.55	0.98
Q33.2_8	8	6	49	104	69	3.93	0.95
Q33.2_9	2	6	49	104	75	4.03	0.84
Q33.2_10	14	6	98	83	35	3.50	0.98
Q33.2_11	12	6	97	84	37	3.54	0.96
Q33.2_12	8	4	94	93	37	3.62	0.89
Q33.2_13	13	11	116	79	17	3.32	0.89

A scree test indicated that the item responses formed five factors. However item 13 which formed a factor with item 12 indicated an ultra-Heywood case and were dropped from further analysis. Subsequent scree test indicated that either four of five factors were appropriate. A four factor model made most sense based on theoretical groupings (Hair 2009). A four factor model indicated that items 6, 7 8 and 9 formed one factor (public information leaflets, education, professional training and government agencies) which is labelled "public bodies"; 10 and 11 formed another factor (WRAP and ZWS) labelled "third sector"; 4 and 5 formed a third factor comprising supermarkets and other shops, labelled "shops" and finally 2 and 3 formed another factor relating to the media, labelled "media". An oblique method of factor extraction was used as previously discussed in section 5.3.1. It

indicated that the "public bodies" and "third sector" had a relatively strong correlation of 0.6; "public bodies" and "shops" a correlation of 0.3 and a correlation of 0.3 between "shops" and "public bodies".

Due to the high number of NAs the number of observations was low for running as confirmatory model (respondents were not required to answer all items on this question due to survey length). However, it was possible to examine the relationship between the different sources of trust in information and the label trust and calculative trust variables. The outline of the model tested is described in Figure 7.2.
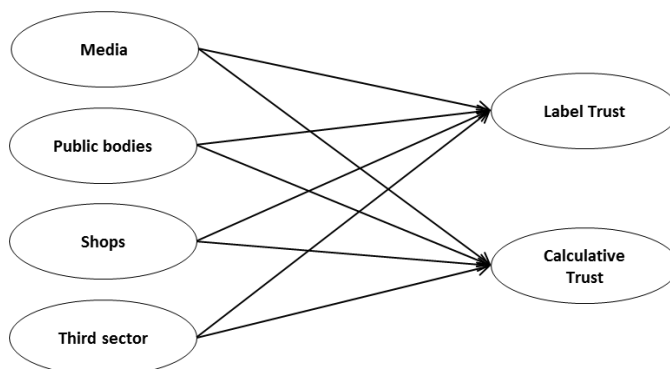
Figure 7.2 Model G1 outline of sources of trustworthy information about date labels regressed on label trust and calculative trust

The overall model fit statistics indicate that that fit is acceptable (RMSEA = 0.07, CFI = 0.98, SRMR = 0.71). The measurement model is good despite three of the factors only having two items. The factor loadings are all above .50 (p < .001) and the AVE scores are also above .50 indicating good convergent validity. A comparison of the square root of the AVE and latent variable correlations indicates that there is good discriminant validity between the constructs (Table 7.8).

Table 7.8 Table of latent variable correlations from model G1 with square root of AVE on the diagonal in bold

	Calculative Trust	Label Trust	Public	Shops	Third Sector	Media
Calculative Trust	**0.73**					
Label Trust	- 0.47	**0.78**				
Public	- 0.12	0.34	**0.75**			
Shops	- 0.16	0.43	0.45	**0.89**		
Third Sector	0.11	0.16	0.63	0.36	**0.89**	
Media	0.09	0.25	0.19	0.59	0.24	**0.82**

Note. The square root of the AVE is bolded on the diagonal

In terms of the structural model there does appear to be a pattern in the sources of information that are trusted and the level and type of trust exhibited. Those respondents who indicated a stronger level of trust in public information and information from shops were more likely to have indicated higher levels of trust in date labels. On the other hand those that indicated a higher level of trust in waste charities (WRAP and ZWS) as well as in media sources were more likely to have indicated higher levels of calculative trust. Trust in public bodies and shops were also negatively associated with calculative trust. The regression coefficients are reported in Table 7.9.

Table 7.9 Model G1 structural model coefficients describing relationship between sources trustworthy information and trust concepts

Relationship	Coefficient	p -value
Label Trust ~ Public	0.27	0.00
Label Trust ~ Shops	0.34	0.00
Label Trust ~ Third Sector	- 0.14	0.08
Label Trust ~ Media	0.03	0.71
Calculative Trust ~ Public	- 0.22	0.02
Calculative Trust ~ Shops	- 0.31	0.00
Calculative Trust ~ Third Sector	0.31	0.00
Calculative Trust ~ Media	0.24	0.01

Note. Coefficients are reported for the completely standardised solution.

7.4   Discussion

The objective of this chapter was to answer Research Question 7: *To what extent do consumers' risk perceptions and trust in date labels influence WTC dairy products in relation*

to the best-before date, and how do these factors interact with date-label knowledge? It found evidence to suggest that risk perceptions have a negative relationship with WTC. This suggests that those who perceived higher risk with regard to consuming dairy products, whether social or physical, had a lower WTC in relation to the best-before date. In terms of trust it found that calculative trust had a positive relationship with WTC, however we found no evidence to support the hypothesis that label trust has a positive association with WTC as this relationship was weak and not statistically significant. Finally we found evidence that higher date-label knowledge is associated with lower risk perceptions. However, in model F1, knowledge did not have a significant, direct relationship with WTC, but the indirect relationship was significant (through risk perceptions). As an alternative model, we tested a variation of model F1 where the sample was split into higher and lower knowledge. These results suggested that higher knowledge was associated with a weaker relationship between risk perceptions and WTC, but also that higher knowledge was associated with a stronger relationship between calculative trust and WTC.

The finding that respondents who reported higher risk perceptions were more likely to report lower WTC is consistent with Tsiros and Heliman's (2005) results where they found that higher perceived product quality risk was related to lower WTP. While the concepts of WTC and WTP are relevant to different contexts, the home and shopping contexts respectively, it appears that risk perception plays a role in both. We found that all risk perception item measures loaded onto a single latent factor. These item measures encompassed aspects of product quality risk and personal risk which were distinguished by Tsiros and Heilman (2005). This could indicate that in the home context these aspects of risk are not differentiated by consumers - not just across safety and quality aspects encompassed by product quality risk but also social aspects encompassed by personal risk.

This chapter also found that there was a weak, negative relationship between best-before date knowledge and risk perceptions. But that best-before date knowledge did not have a significant direct relationship with WTC in this model, instead the relationship appears to be indirect through risk perceptions. This finding indicates that understanding consumers'

perceived risk goes some way to explaining the gap between knowledge and WTC. When the overall difference in relationships was considered for those with higher and lower knowledge of best-before dates, there did appear to be a weaker relationship between risk perceptions and WTC in the higher knowledge group. However, the difference was not large.

This chapter also explored the association of trust with WTC: trust in date labels credibility and calculative trust related to the food system actors which set date labels. We found that only calculative trust had a direct, positive association with WTC whereas trust in date labels had a weak, negative relationship with WTC but this was not statistically significant. Referring to the multi-sample model the biggest difference between the higher knowledge group and the lower knowledge group appeared to be in the strengthening of the negative relationship between calculative trust and label trust. Those with higher levels of calculative trust in the higher knowledge group were much less likely to perceive the labels as credible or meaningful than in the lower knowledge group. This suggests that good knowledge of the best-before date, combined with a distrust of the credibility of the system reduces trust in date labels.

One exploratory aspect of the study investigated trust in information sources and the relationships between trust in labels and calculative trust and the sources of information that respondents reported trusting. The exploratory factor analysis found some similar groupings to Lobb et al. (2007) in that media, food chain (shops) and authorities were identified as factors. We also had an equivalent of Lobb's "Alternative" factor which consisted of the third sector WRAP and ZWS however; the "Other food shops" did not load onto this factor but was found to fit better with shops. Lastly our factor analysis did not detect a difference between sources of information such as public information leaflets, education institutions and government agencies such as the food standards agency.

Those respondents who reported trusting public institutions to provide information about date labels or shops to a greater extent were more likely to report trusting the label. Those that reported stronger calculative trust were less likely to report trusting public sources of information and more likely to trust the named waste charities or the media. This result

makes sense in that those who expressed a greater sense of calculative trust were likely to express a sense of scepticism about the accuracy of dates and believe that those that set them err on the side of food safety caution. There are similarities in these findings to those of Frewer et al. (1996) with regard to trusted information sources and food technology. Those that expressed higher levels of trust in the date label could be considered to be expressing trust in the system that sets the date label and therefore it also makes sense that those respondents were more likely to have a greater level of trust in information from public institutions.

Future research could investigate further the relationship between the trust and use of information sources and the levels and types of trust consumers have in labels. While the study here assumes the concepts of trust as the dependent variables and sources of information as independent, this could also be considered as vice versa as pre-existing notions of trust might affect which sources of information are accessed. Understanding these relationships would also be important for developing effective communications that help consumers to distinguish between date label types.

7.4.1   Limitations

One limitation of this study is that it is only a Scottish study. Concepts of trust do not necessarily translate across countries. Evidence from studies that have looked at trust in different countries found differences in relationships across the EU (Costa-Font, Gill 2009). Furthermore the concepts of trust included in these models were developed during this survey making this work both exploratory as well as confirmatory. Further work could be done to refine and test these concepts. Given that date labelling policy is directed by the EU it would be fruitful to test these trust concepts and models across multiple country samples.

8 Discussion

8.1 Discussion of results

The objective of this thesis was to advance our understanding of how consumers use date labels and the implications of date-label use for household dairy product waste. It did this by developing seven research questions which examined the effect of psycho-social factors on date-label use in different contexts; tested how different types of date labels and different types of products affect willingness to consume dairy products in relation to their expiry date; and how knowledge, perceived risk and trust also affect our willingness to consume products once they have passed their best-before date. The main results relating to each research question are outlined below.

Research Question 1 asked: *To what extent does the TPB explain the date-label use in different contexts?* In Chapter 4 we concluded that the TPB is useful in explaining the behaviours of checking dates in shops and checking dates in the fridge at home. In terms of the variance explained, and the strength of the relationships observed between attitudes, PBC, intentions, and behaviour, the models had good explanatory power. The TPB was less useful in explaining people's decision to throw away products because the expiry date had passed. The variance in both intentions and behaviour was lower in this case and the relationships between the variables were overall weaker. It seems that the TPB explained date-label behaviours further away from the point at which food is wasted better than those just prior to it. We could also infer that it explained better the two behaviours that were more goal-oriented and less decision-oriented.

Research Question 2 asked: *How are date-label behaviours related to one another? Are consumers who regularly check the date labels of products in the supermarket and at home less likely to report throwing away products because the date has passed?* In Chapter 5 we concluded that respondents who reported checking dates in shops more frequently were less likely to report disposing of products because the expiry date had passed; those who reported checking dates in their fridge more frequently were actually more likely to report

disposing of products because the expiry date had passed. We also observed that checking dates in shops and checking dates in the fridge were positively correlated. We can infer from this that while checking dates in the fridge presents, in theory, as a behaviour that would minimise food waste, it actually has a positive association with disposing of products because the expiry date has passed. However, we also need to exercise caution in the interpretation of this result since there may be underlying attributes of consumers who are highly engaged in both behaviours that explain this result. Nevertheless, consumer campaigns that promote food waste minimising behaviours need to take this on board and ensure that the behaviours they promote as food waste minimising are based on evidence.

Research Question 3 asked: *To what extent are attitudes towards food waste associated with engagement in date-label behaviours?* In Chapter 5 we found that attitudes to food waste were more salient for engaging in date-label checking in some contexts than others. At the point of disposal food waste did not appear to be uppermost in people's minds. We found that while food waste attitudes appeared to influence intentions not to throw away products, it did not have a significant relationship (either direct or indirect) on behaviour. On the other hand, food waste attitudes had a significant and direct relationship with behaviour in model C2, indicating that checking dates in the fridge is directly motivated by an interest in minimising food waste. We also found that food waste attitudes have an indirect effect on behaviour in model B2. This suggests that food waste attitudes are associated with more frequent date-label checking in shops, albeit indirectly. The incongruity of our finding that checking dates in the fridge is motivated by anti-food-waste attitudes while actually being associated with higher reported disposal of products because the expiry date has passed is discussed further below.

Research Question 4 asked: *To what extent is habit associated with date-label use?* In Chapter 5 we found that respondents who scored higher on the self-reported habit index (Verplanken, Orbell, 2003) were also more likely to report disposing of products because the expiry date has passed. This indicates that for those respondents for whom throwing away products because the expiry date had passed was more automatic, or they did so without

thinking, were more likely to report having thrown away dairy products for this same reason over the course of the three weeks under study. The introduction of the habit variable to the TPB model reduced the association between intentions and behaviour but increased the variance explained by the model. This suggests that date-label use, at least at the point of disposal, has a strong habitual element.

Research Question 5 asked: *How do date type, product type and presence of a reduced label affect consumers' WTC dairy products in relation to the expiry date?* In Chapter 6 we found that date type was pertinent for WTC yoghurt but not for WTC cheese. However, date type was only significant in the between subject comparison for yoghurt and not the within subject comparison. This suggests that personal differences between respondents in the two conditions could have been driving this result. We found that product type did make some difference to WTC when date type was held constant but not in all cases. We observed differences between WTC milk and cheese, and WTC yoghurt and cheese where both products had a use-by date, but not in WTC yoghurt and milk. We also did not observe differences in WTC yoghurt and cheese where both products had a best-before date. Lastly we found no difference in WTC for products with a reduced label compared to identical products without a reduced label.

Research Question 6: *To what extent are different types of knowledge (declarative, procedural, effectiveness and subjective knowledge) associated with WTC dairy products in relation to the best-before date?* In Chapter 6 we found that declarative knowledge and effectiveness knowledge both had positive, direct, and significant relationships with WTC dairy products in relation to their best-before date. Neither subjective nor procedural knowledge had a significant (direct or indirect) relationship with WTC. These results imply that improving declarative date-label knowledge, and knowledge that consuming products after the best-before date is an effective action to minimise food waste, could help reduce the number of products that are disposed of because the best-before date has passed.

Research Question 7: *To what extent do consumers' risk perceptions and trust in date labels influence WTC dairy products in relation to the best-before date, and how do these*

factors interact with date-label knowledge? In Chapter 7 we found that consumer risk perceptions are strongly associated with WTC dairy products in relation to the best-before date. Those who perceived higher risks (of various forms) tended to report lower WTC. We did not find evidence to support the contention that trust in date labels matters for WTC, though we did find that higher calculative trust was associated with higher WTC. Last, we found that date-label knowledge appears to interact with risk perceptions: higher date label knowledge was associated with lower risk perceptions. We also found in our multi-sample models that the sample with higher date-label knowledge had a stronger calculative trust/WTC relationship than the sample with lower date-label knowledge.

8.2   Contributions to knowledge

This thesis makes two main contributions to the literatures on date-labelling and food waste. The first contribution is primarily theoretical: it enhances our understanding of how consumers use date labels and the implications of date-label use for household dairy product waste. More widely, the results have important implications for how we conceptualise food waste and therefore for communications and campaigning for food waste reduction. The second contribution has policy relevance: it provides evidence as to the likely effectiveness of increasing the number of dairy products with a best-before date, an approach recently proposed by WRAP and others, on reducing the waste of dairy products.

8.2.1   Contribution to food waste behavioural theory

The results of Chapter 4 showed that the TPB explained different amounts of variance in both intentions and behaviours across the three behaviours tested. The behaviour closest to the point of waste, using the expiry date to determine whether to throw away a product, was explained less well than those behaviours further away from the point of waste, checking date labels in shops and checking date labels in the fridge. In addition, it found that TPB factors, attitudes, social norms, and PBC had different strengths of relationship with intentions depending on the behaviour examined. The strength of the relationship between attitudes and intentions was, for example, strongest in model C1 which investigated the

behaviour checking date-labels in the fridge, and weakest in model A1 which investigated the behaviour of throwing away dairy products because the expiry date had passed.

These results support the contention that, to better understand food waste, it is important to identify the drivers of the individual behaviours that contribute to it. They build on the work of previous studies (van Geffen et al. 2016; Principato 2018; Setti et al. 2018), which argued that food waste should be conceptualised as the outcome of multiple inter-related behaviours and that each of these contributing behaviours has their individual drivers (motivational, skills/abilities, contextual). These previous works presented conceptual models (Van Geffen et al. 2016; Principato 2018) or tested drivers that were socio-economic factors (Setti et al. 2018). This study therefore adds to the food-waste literature by testing socio-psychological factors through the TPB and finds that different waste-associated behaviours are explained to different extents by the TPB.

Previous food waste studies using the TPB modelled food waste outcomes, whereas this study applied the TPB to three expiry date behaviours associated with food waste. As discussed in Chapter 4, it is difficult to make direct comparisons between the variance explained by previous food outcome studies and this study since they all included additional variables. However, the amount of variance explained was higher for both checking dates in shops and checking dates in the fridge. The amount of variance explained for throwing away products because the expiry date had passed was very similar to other two-stage studies, albeit those had included additional variables.

While these contributions are primarily theoretical they are informative for improving communications aimed at reducing food waste. As described in Chapter 1, many initiatives designed to reduce consumer food waste have focussed on information provision and awareness raising (Hill 2014). And, while limited evidence of effectiveness (WRAP 2014) has led to approaches such as date labelling changes to be advocated, there is no doubt room for improvement in these communications. This study emphasises the importance of targeting communications to specific behaviours: targeting beliefs underlying attitudes towards checking dates in shops, for example, or control beliefs relating to PBC over using

the expiry date to determine whether to dispose of products. It also highlights that communications might be more effectively targeted at changing behaviour at the beginning of the food management lifecycle where the attitudes, intentions behaviour link appears to be stronger. This is also supported by Setti et al.'s (2018) argument that changing these upstream behaviours could have the biggest impact on reducing food waste.

In Chapter 5 we tested the relationship between food waste attitudes and intentions across each of the different models. Food waste attitudes were found to be indirectly influential on intentions to check dates in shops, and directly influential on date label checking behaviour at home. However, they did not appear to influence whether a product was thrown away because the expiry date had passed, though they did influence intentions to do so. General attitudes towards outcomes are typically conceived to be background variables in the TPB; that is, they are hypothesised to have at most an indirect relationship with behaviour. The results of this study suggest that the salience of generalised attitudes towards outcomes depends on the behavioural context. Specifically, attitudes towards food waste were more salient in the upstream behavioural models (checking dates in shops and checking dates in the fridge) than the behaviour closest to the point of food becoming waste, throwing away products because the expiry date had passed.

Chapter 5 also highlighted the importance of understanding the relationship between food waste associated behaviours and food waste outcomes. These findings are relevant for understanding more about the causes of household food waste and for developing more effective communications. The results relating to behaviour inter-relationships highlights the importance of understanding which behaviours are contributing to food waste within households and how they are related and what their drivers are. Combining this with the results regarding generalised food waste attitudes, we see it is important to understand both how behaviours are related to one another and what their drivers are. Generalised attitudes to food waste had the strongest, direct relationship to checking dates in the fridge, though it seems that engaging in this behaviour is not guaranteed to reduce food waste:

incongruously in this study, this behaviour was found to be associated with more frequently throwing away food because the expiry date had passed.

Previous research highlighted the link between negative food waste attitudes and lower food waste and argued for communications aimed at increasing the prevalence of negative food waste attitudes amongst consumers. The results of this thesis point to the likely limitations of this approach. Future research should consider food waste along with other proximal influences on behaviours associated with food waste. This could help to understand the trade-offs that are being made by consumers when they consider the likely outcomes of engaging in food waste associated behaviours.

In Chapter 5 the introduction of habit to explain why consumers might choose to throw away products because the expiry date has passed improved the explanatory power of the model (i.e., model A1 and A2 versus A3). The implication of this finding for behaviour change interventions is that there is a group of people for whom the habit of simply throwing away product because the expiry date has passed is strong, and they will have difficulty changing this behaviour. Gardner et al. (2011) argue that there are two related routes through which habits determine behaviour, and therefore in terms of developing interventions to break these habits at least one of these aspects must be addressed. First, habits develop where there is the perception that something is stable and regularly encountered. Second, habits develop where the behaviour is executed in familiar and unvarying settings. Reducing the frequency with which people have to make decisions about throwing away products because the expiry date has passed could help to address the first aspect. As described above, increasing expiry date checking in shops and potentially other upstream behaviours could reduce the likelihood of products being close to or beyond their expiry date, and therefore this situation is less regularly encountered. Addressing the second aspect is more challenging since it will be difficult to alter the setting in which consumers use date labels. Instead, consideration should be given as to how to make dates more salient when encountered; this could be a subject for further research.

These findings have contributed to our understanding of household food waste. However, many of the insights have come from going back to basics and considering how behavioural theories, such as the TPB, should be applied to new contexts. Therefore while they contribute to the food waste literature, many of the insights were drawn from outside the food waste literature to the environmental behaviour literature to see what lessons could be learned. The insight, for example, that that general food waste attitudes might not have an influence on specific behaviours came from both Fishbein and Ajzen (2015) but also studies such as Bamberg (2003) who investigated the relationship between environmental concern (general attitudes) and requesting an information brochure about green electricity.

8.2.2 Contribution to evidence base for date-labelling policy

The second contribution is relevant from a UK and EU policy perspective where there is a growing interest in the role of date labelling in food waste. It provides evidence of the likely limited effect of increasing the number of dairy products labelled with a best-before date rather than a use-by date on food waste. This is a change which has been advocated by the leading waste and resource management charity WRAP.

The findings of Chapter 6 highlighted that re-labelling a product with a best-before rather than use-by date is likely only to have a limited effect on reducing dairy product waste. This conclusion is drawn from the finding that WTC was only significantly different in the between subject comparison for yoghurt. Within subjects there was no significant difference in their WTC yoghurt with a best-before date versus as use-by date. For cheese, there was no significant difference in WTC in relation to the best-before date in either the between or within subject comparison. This implies that increasing the proportion of cheese or yoghurts with a best-before rather than a use-by date as proposed (WRAP 2017a; WRAP 2017b) is on its own unlikely to have a large effect on consumption beyond the best-before label and consequently a reduction in food waste. Given this and evidence of the anchoring effects of date labels (Elsen et al. 2015) a more effective approach might be to encourage companies to give the maximum amount of shelf life to products and challenge any dates which may be unnecessarily cautious (WRAP 2017a; WRAP 2017b). Options such as intelligent food

packaging might also be considered, though these might also present issues around initial consumer acceptance and longer-term behaviour as discussed by Raak et al. (2017).

The finding that there are between person differences in WTC indicate that it is personal differences in terms of how consumers interpret best-before dates that actually need to be addressed. Simply changing the date-label type is unlikely to address these factors. Chapter 5 therefore examined one of the most obvious personal differences that could explain differences in WTC: knowledge of what the best-before date actually means. It found that better knowledge of the best-before date was associated with a higher WTC, although the relationship was not strong. Two other knowledge concepts were tested, to see if they could help to bridge the gap between knowledge of the best-before date and WTC: effectiveness knowledge and procedural knowledge. Effectiveness knowledge was found to have a significant positive association with WTC, while procedural knowledge did not. However, the indirect relationship between declarative knowledge was stronger than the indirect relationship through effectiveness knowledge. While different types of knowledge go some way to explaining differences in WTC there is clearly more to understand. Chapter 6 therefore investigated two other personal, motivational factors – risk perceptions and trust – that could explain differences in consumers' WTC and might affect the relationship between knowledge and WTC.

Risk perceptions were found to have a strong positive association with WTC. The concept of risk perception was a multi-dimensional concept encompassing both food safety, but also quality and social risk. Knowledge of best-before dates was found to have significant, negative association with risk perceptions but in this model it did not have a significant direct relationship with WTC. This suggests that improving consumer knowledge of date labels is likely to make a positive contribution to increasing WTC through some reduction in risk perceptions with regard consuming products after their best-before dates. These findings have important implications for communicating with consumers alongside the proposed expiry-date streamlining (The Consumer Goods Forum 2017). If these changes are to be effective, communications need to go beyond stating that products are safe to eat

after the best-before date and address concerns about taste, quality, freshness, and social acceptability. It supports the contention that targeted action will be needed on other factors that may allay the wider scope of perceived risks such as social norms (Lusk, McCluskey 2018).

Chapter 6 also explored the relationship between two concepts of trust, trust in the label and calculative trust, and WTC. It found that only calculative trust had a direct, positive association with WTC, while trust in date labels themselves did not have a statistically significant relationship with WTC in the model. The implications of these findings for expiry-date policy are challenging. On the one hand, from a food waste reduction perspective, it is desirable to encourage consumers to have a healthy scepticism with regard to best-before dates. However, this is not desirable for a use-by date and as has been shown by this study, consumers currently appear not to distinguish strongly between the two. Overall it is desirable for consumers to trust the information they are presented with on a date label and to perceive it as credible, reliable and meaningful, otherwise these labels are not fulfilling their traditional economic role as reducing quality uncertainties and information asymmetries (Lusk 2013). However, it appears that in this model, the extent to which consumers trust labels does not have a direct impact on WTC and is strongly associated with perceived risk. Therefore trying to improve consumer trust and confidence in labels alone may not result in lower food waste. On the other hand, it seems that the more consumers perceive food companies to be protecting their own interests with regard to setting the expiry date, the more willing they are to consume products after the best-before date. Companies are now being urged to ensure they give the absolute maximum shelf-life to products (WRAP 2017a), which we also highlighted as being potentially effective in reducing food waste. The challenge may be that if companies do provide the absolute maximum shelf-life, individuals with high calculative trust may still be willing to exceed the date and be disappointed with a product's quality, which companies may wish to avoid. If the same were found to apply to use-by dates then this could also result in food safety issues.

The findings suggest that food manufacturers should weigh carefully the costs and benefits of investing in the tests required to move products from a use-by to a best-before date. For cheese it appears, at least for our respondents, that whether a product has a use-by date or a best-before date matters very little to their consumption and by extension waste decisions. For yoghurt it appears that the date label may make some difference to some people. If date label changes are to be effective in contributing to food waste reduction they will need to be combined with campaigns that address the range of perceived risks associated with products beyond their best-before dates. From the perspective of retailers having a greater volume of products on their shelves that have best-before rather than use-by dates is likely to increase opportunities for sales and/or redistribution, which may reduce waste at the retail level. Retail food waste aspects in relation to date labels are discussed more extensively by Aschemann-Witzel (2018). From the perspective of consumers we agree that moving products to best-before dates provides them with an opportunity to reduce food waste. Combined with effective communication over the long term more people could be persuaded to eat products which have passed their best-before date; however, encouraging people to eat and consider socially acceptable products which look or even taste slightly unpleasant (though are in fact safe) will be challenging.

8.3   Limitations

A limitation but also strength of this study was its focus on dairy products. Clearly this is a limitation in that these results are only directly applicable to a small group of products, and it could be argued that the results should not be extrapolated to other products. However, the fact that this study has demonstrated differences within this group of products show that it is important to consider that different factors may drive date-label behaviours and disposal decisions in other food groups. Given that there are differences observed between more liquid products (milk and yoghurt) and cheese, one approach for future studies could be to categorise products by observable properties as well as whether they are ambient or chilled. Van Boxstael et al. (2014) went some way towards using such categorisation, though as previously discussed their results were primarily descriptive.

Another aspect of this study that could be considered a limitation is that it does not include an accurate measure of total dairy product waste. While a question was asked in survey stage 2 about the percentage of dairy products wasted, this was not included for a number of reasons. First, the behaviour – throwing away products because the expiry date has passed – is itself a measure of dairy product waste. While it measures the frequency with which dairy products were disposed of over a three-week period, it is effectively a sub category or reason for overall food waste and the sub-category with which the upstream date label behaviours would be expected to be associated with. We would not, for example, expect checking dates in shops to have strong relationship with plate leftovers, which would be considered within an overall food waste measure. Second, from a behavioural perspective we are less interested in the quantity of waste that results from this action but rather understanding and preventing the behaviour. Third, the way the question was articulated was inaccurate both because greater than and less than symbols were not included, and second because it did not specify that the quantity should be related to the quantity of products thrown away because the date label had passed and not thrown away overall. Measuring household food waste accurately but also cost effectively is one of the biggest challenges in consumer food waste research and possible avenues for future research are discussed below.

8.4   Future research

In terms of future research, there are several avenues that have been identified in the course of this study. First, there is clearly scope to understand more about which behaviours are associated with food waste and the drivers behind those behaviours. To significantly improve on existing work identifying behaviours associated with food waste, better ways of measuring food waste will need to be developed. Existing methods are somewhat piecemeal, expensive, or rely on subjective self-reports. New methods will need to be able to link survey data on behaviours to food waste outcomes over adequate periods of time. Elimelech et al. (2018) recently reported on a possible sampling method, though as yet they have little to compare their results with to know whether this is likely to be cost effective.

A second direction that this thesis highlights for future research is the need to dig deeper into understanding why we do not pay sufficient attention to the type of date label. In a recent paper Handel and Schwartzstein (2018) highlight two "camps" of reasons why people do not use information available to them. The first consists of frictions which they describe as related to the assumptions that people use information that is worth processing, and that processing information is costly. The second camp, described as mental gaps, tries to understand why there is a gap between "what people think and what they should rationally think given costs" (Handel, Schwartzstein 2018). We can consider best-before date knowledge as a piece of information that people do not use, despite the fact that not using this piece of information costs them. They end up throwing away a product that in fact they could have eaten. The model of knowledge risk and trust made some advances to our understanding why this might be the case: people perceive risks in a wider way than the date-label could address. However, it did not consider the costs of processing this information and therefore understanding more about frictions associated with using date-label information could be a subject for future research.

A third and related line of research should also challenge the assumption made by many studies that in wasting food, "individuals make and repeat choices that reduce their utility" (Setti et al. 2018 pp. 2). Much of the messaging around reducing food waste, including household food waste, is that it will save them money. In the UK consumers are told that an average household effectively spend £470 per year on food that is wasted (WRAP 2017a). However, what is not taken into account is the opportunity cost of engaging in behaviours that would reduce food waste, or how the time spent engaging in those behaviours would otherwise be spent. Two recent studies have also highlighted this gap in the literature (Lusk, Ellison 2016; Landry et al. 2017). They argue for the application of household productions functions such as that described by Becker (1965) to better account for food waste production given the price of inputs (e.g. food price), income and time constraints. This approach is complementary to the findings of this study and the findings of studies using socio-psychological approaches. First, the insights generated could help to develop these models with aspects of uncertainty over inputs (e.g. risk perceptions/WTC in relation to date

labels) and attitudes towards engaging in behaviours which represent the weighing up of costs and benefits of engaging in particular behaviours (Landry, Smith 2017). Second, Landry and Smith's (2017) empirical results found a negative relationship between food waste and food input prices. This supports the findings of WRAP, who also attributed the drop in UK food waste between 2007 and 2012 in part to food price increases. Regressive food taxes to reduce food waste are unlikely to be implemented and therefore we return to the insights generated by socio-psychological models that can somehow increase the perceived social or moral costs of wasting food.

Finally, a fourth line of future research could concern trust and date-label use. This study limited itself to two concepts of trust, calculative trust and trust in the labels themselves as a measure of system trust, as the wider food safety and labelling literature indicated they were relevant to consumer interactions with labelling and perceptions of food safety. Future research could benefit from exploring other trust concepts identified in the literature (Hobbs, Goddard 2015), that go beyond the rational concepts of trust and include social and emotional aspects which have been shown to be influential (Dunning et al. 2012). This could form an interesting counterpoint to social and psychological aspects of risk that were found to be relevant alongside safety and quality aspects within our model. Trust bridges the gap between certainty and uncertainty and is essential in overcoming perceived risk (Botsman 2017). However if, as Botsman (2017) argues, trust is shifting from institutional to distributed trust, future research will need to consider what this might mean for date labels and other forms of food labelling which ask us to trust just those institutions.

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Appendix I.   Waste Management Article

The effect of date labels on willingness to consume dairy products: Implications for food waste reduction

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ARTICLE INFO

ABSTRACT

In the context of national and cross-national efforts to reduce the quantity of food wasted by consumers, there is growing interest in the role of date labelling. Recent proposals by policy makers and the food industry to address dairy product waste have included streamlining date-label application and encouraging the use of best-before dates where possible. In order for these measures to have a positive impact on food waste, consumers must not only know the difference between date types, but also be prepared to act on this information and consume products after the best-before date. Through a survey of 548 Scottish consumers we investigated the relationship between product type, date type, reduced labels and willingness to consume (WTC) dairy products in relation to the both the best-before date and the use-by date. We also examined the factors associated with different levels of WTC products in relation to the best-before date including knowledge, risk perceptions and trust. Our results suggest that on their own, the effect on food waste of applying best-before dates to dairy is likely to be small. In order for such changes to be effective, consumer communication that goes beyond improving expiry-date knowledge and addresses the multifaceted nature of related risk perceptions and conceptions of date-label trust will be required.

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1. Introduction

In the context of national and cross-national efforts to reduce the quantity of food wasted by consumers in developed countries (Gustavsson et al., 2011; High Level Panel of Experts (HLPE), 2014; Stenmarck et al., 2016), there is a growing interest in the role of date labelling (Milne, 2012; Newsome et al., 2014; Wilson et al., 2017; WRAP, 2011). Recent proposals to address food waste have included streamlining date-label application and encouraging the use of best-before dates where possible (The Consumer Goods Forum, 2017; WRAP, 2017a). Working with companies to increase the number of products with best-before dates could give, "consumers the confidence and option to make use of products after the best-before date" (WRAP, 2017a, pp. 9), thereby helping to reduce household food waste. At present there is little evidence on the effectiveness of efforts to influence consumer behaviour and avoid unnecessary food waste through date labelling (European Commission, 2018).

In the UK, dairy products, particularly yoghurt and cheese, have been identified as product categories which are often unnecessarily given a use-by rather than a best-before date (Better Regulation Delivery Office, 2011). Date labelling in the UK is regulated at the EU level: all food must have either a minimum date of durability (translated as best-before date in the UK) or a use-by date, unless they are listed as one of the fresh or highly durable products that are exempt (Regulation (EU) No. 1169/(2011)). The minimum date of durability is a measure of food quality, "the date until which the food retains its specific properties" (Regulation (EU) No. 1169/2011; p26); the use-by date is a measure of food safety, where "food shall be deemed to be unsafe in accordance with Article 14(2) to (5) of Regulation (EC) No 178/2002" (Regulation (EU) No. 1169/2011; p35). It should be also be noted that food safety is also dependent on compliance with specified storage conditions throughout the supply chain regardless of the date label applied (Newsome et al., 2014).

Determination of labelling requirements rests with food manufacturers (Department for the Environment, Food, and Rural Affairs (defra), 2011). As a consequence there is variation in how best-before and use-by date labels are applied (European Commission, 2018). Studies have found that some manufacturers of dairy products apply use-by dates for reasons broader than microbiological

specifications outlined in EU regulation, including retailer specification, product quality deterioration, and desire for consistency across a range (Better Regulation Delivery Office, 2011; European Commission, 2018). This evidence suggests that date labelling decisions are not always made on the basis of food safety: use-by dates are the default position (WRAP, 2017b). While the decision on labelling may have fine margins (Department for the Environment, Food, and Rural Affairs (defra), 2011), recent work on hard cheese with the dairy industry in the UK, has highlighted the opportunity for change: the proportion of products labelled with best-before dates increased from 75% of products sold in the UK in 2009 to 97% in 2015 (WRAP, 2017a).

In the UK, dairy products represent about 10% of avoidable household food waste (WRAP, 2013). Equivalent estimates are not available for the EU as a whole, though Gustavsson et al. (2011) estimated that 7% of dairy products were wasted by consumers in the wider Europe region. In the UK, 54% of milk, 78% of yoghurt and 79% of cheese are reportedly wasted because they pass their expiry date, versus other reasons such as too much being served (WRAP, 2013). Furthermore, some research suggests that yoghurt pots are often thrown away are unopened (WRAP, 2010); for dairy products in general it has been suggested that the date label is important in making disposal decisions. (WRAP, 2015).

Evidence of the role of date labels across the whole EU is not available at present (European Commission, 2018), though household food waste studies from various Member States indicate that date labels play an important role in the waste of dairy products and that misconception of the best-before date as an indicator of food safety is an issue. A summary of studies from the Netherlands found that dairy products made up 26% of household food waste, with 61% of people giving best-before date expiry as their reason for disposal (Netherlands Nutrition Centre, 2014). A summary of studies from across the Nordic countries found that a lack of date label understanding contributed to food waste, in particular that products labelled with a best-before (such as yoghurt and sour cream) were most frequently reported as being thrown away because the expiry date had passed (Møller et al., 2014). Overall these findings indicate that for the outlined date labelling changes to contribute to reducing household food waste, consumers must first know the difference between best-before and use-by dates, but must also act on this knowledge and be prepared to consume products after the best-before date.

A number of studies have highlighted consumer misunderstanding of date labels as an issue and have discussed the implications for household food waste (TNS European Behaviour Studies Consortium, 2014; van Boxstael et al., 2014; Toma and Font, 2017). However, few studies have investigated the association of factors beyond knowledge and use of date labels (European Commission, 2018) and explored personal factors such as biospheric values associated with consuming products after the best-before date (Hooge et al., 2017). Studies have investigated the association of factors such as product type, expiry date based pricing, and other product characteristics on consumer interaction with date labels outside the home, in particular willingness to pay (WTP) (Tsiros and Heilman, 2005; Theotokis et al., 2012) and willingness to waste (WTW) (Wilson et al., 2017). However, there are differences in how consumers consider suboptimal foods inside and outside the home, and further research is required to distinguish which factors are important in each context (Hooge et al., 2017).

This study adds to the existing literature by investigating how consumers interact with date labels at home when making a decision whether to consume a product. First, it explores whether WTC dairy products varies by date type (best-before or use-by) as well as product type (milk, cheese and yoghurt), and whether the pres-

ence of a reduced label affects WTC. Second, it differentiates itself from previous literature by investigating factors associated with consumers' WTC dairy products in relation to the best-before date, using yoghurt and cheese as examples: in addition to knowledge of the best-before date, it explores how consumers' perception of food-related risk and trust in date labels are associated with their WTC yoghurt in relation to its best-before date. These factors were chosen because the wider literature on the use of food labels and food-safety information highlights the importance of perceived risk, trust in information and labels, as well as food system actors (Frewer et al., 1996; Hobbs and Goddard, 2015; Lobb et al., 2007; Tonkin et al., 2016a; Tonkin et al., 2016b). We hope our findings will contribute to building the evidence base on consumer engagement with date labels, and on efforts towards food waste reduction (European Commission, 2018).

2. Background and hypotheses

2.1. Association between product type, date type, reduced labels, and WTC

A number of studies have explored the association of product type on WTC a range of products, including dairy products, on or after the expiry date (Broad Leib et al., 2016; WRAP, 2011; van Boxstael et al., 2014). As the results reported by these studies were descriptive in nature, tested a number of variants of date label phrasing e.g. "use-by end of" (WRAP, 2011) and Broad Leib et al. (2016) study was US based it is valuable to test whether willingness to consume for our respondents were significantly different by date or product type.

First we compare products holding the date type constant. Milk is not included in the best-before condition because the majority of milk sold in the UK is fresh and currently carries only use-by dates.

H1. In the use-by date condition we hypothesise that respondents' WTC yoghurt will be lower than respondents' WTC milk and WTC cheese will be higher than both WTC both milk and yoghurt.

H2. In the best-before date condition we hypothesise that respondents' WTC yoghurt will be lower than respondents' WTC cheese.

Second we compare WTC for different date types holding the product type constant. Again milk is not included because the condition of milk with a best-before date would not be realistic for consumers in the UK.

H3. In the yoghurt condition we hypothesise that WTC yoghurt with a use-by date will be lower than respondents' WTC yoghurt with a best-before date.

H4. In the cheese condition we hypothesise that WTC cheese with a use-by date will be lower than WTC cheese with a best-before date.

Expiry-date-based pricing, and the use of a reduced label to indicate this, is a common approach used by food retailers (Aschemann-Witzel, 2018; Tsiros and Heilman, 2005; Theotokis et al., 2012). Willingness to pay (WTP) for a product has been shown to decrease as the expiry date approaches (Tsiros and Heilman, 2005), since estimated likelihood of consumption (as well as perceived quality) is an important factor in consumers' decisions to purchase food close to the expiry date (Aschemann-Witzel, 2018). It is therefore of interest to test whether, once reduced items are brought into the home, the presence of the reduced label is still pertinent (e.g. it prompts them to think about its approach-

ing sub-optimality). If it is, we hypothesise that a product with a reduced label would be associated with a lower WTC compared to the same product without the reduced label. This would not have the desired effect on household food waste. We therefore compare WTC for products with a reduced label holding both the product type and date type constant.

H5. In the reduced condition we hypothesise that WTC products with a reduced label will be lower than for products without a reduced label for all product/date type combinations.

2.2. Date label knowledge

A number of studies have assessed consumer knowledge about expiry dates and discussed the implications for household food waste (Broad Leib et al., 2016; van Boxstael et al., 2014; Toma and Font, 2017; TNS European Behaviour Studies Consortium, 2014; Visschers et al., 2016). Three of these studies go beyond assessing knowledge alone and explore the relationship between knowledge and date label use or food waste (Toma and Font, 2017; TNS European Behaviour Studies Consortium, 2014; Visschers et al., 2016). Their results are mixed: Visschers et al. (2016) found no link between expiry-date knowledge and self-reported food waste outcomes; Toma and Font (2017) found that consumers who had better knowledge of expiry dates were actually less likely to engage in waste-reducing behaviours (such as willingness to consume dry products such as rice and pasta without a best-before date). On the other hand, TNS found that "misconception of the 'best-before' date as a safety limit is one of the strongest factors which drives consumers to throw away outdated food" (2014, pp.156). The use of different measures of outcomes by these three studies is likely to explain their different conclusions about knowledge's relationship to food waste; nevertheless, the relationship between expiry date knowledge and WTC is not clear. In light of these findings, we develop a further hypothesis to test whether the relationship between expiry date knowledge and WTC differs by product type.

H6. Consumers with better expiry date knowledge will have a higher WTC a product in relation to the best-before date.

2.3. Risk perception

Despite knowing the meaning of best-before dates, consumers may still perceive a risk in consuming products after the best-before date has passed. As has been found with regard to educating consumers about biotechnology, improving knowledge alone is unlikely to be sufficient to overcome perceived risks; social norms, amongst other factors, are likely to be important (Lusk & McCluskey, 2018). We are nevertheless interested in testing whether there is an association between knowledge and risk perception, and therefore develop a seventh hypothesis:

H7. Respondents with better knowledge of best-before dates will have lower perceived risk with regard to consuming products after the best-before date.

Risk perceptions are known to affect consumer preferences for food, including their WTP (Loebnitz and Grunert, 2018; Tsiros and Heilman, 2005). Risk perception with regard to food products is not simply about food safety: in the minds of consumers, food safety, food quality, freshness and healthiness are interlinked (van Rijswijk and Frewer, 2008; Wansink and Wright, 2006). More broadly, consumers do not tend to differentiate between different types of hazards, which can make assuaging concerns about food

safety challenging (Verbeke et al., 2007), though consumers have been found to judge product risk differently depending on the context (Sen and Block, 2009; Redmond and Griffith, 2004; Arkes, 1996). Hooge et al. (2017) emphasised that different factors are associated with sub-optimal product preferences in shops and at home. We therefore develop an eighth hypothesis to test whether higher risk perceptions are associated with lower WTC products in relation to the best-before date in the context of home, or if the context of home means that risk perceptions have a negligible association with WTC.

H8. Respondents with higher perceptions of risk will report lower willingness to consume products in relation to the best-before date.

2.4. Trust

The degree of trust that consumers have in information provision, including the providers of that information, is one factor that has been found to affect risk perceptions of food products (Frewer et al., 1996; Tonsor et al., 2009). As with risk perception, trust has been shown to be a multi-dimensional concept: a number of different types and sources of trust have been identified in relation to food (Hobbs and Goddard, 2015; Lobb et al., 2007). Concepts of trust in relation to date labels appear from this review to be under-researched, with most studies focussing on trust in food safety information relating to food scares (e.g. Lobb et al., 2007) or trust in other types of labels such as sustainability claims (e.g. Sirieix et al., 2013), or brand (e.g. Lassoued and Hobbs, 2015).

We explore two concepts of trust and their association with risk perceptions and willingness to consume. The first concept measures trust in expiry-date labels as conveyers of information. This comes under the category of system trust, where people base their trust on established rules (such as food safety guidelines) and the enforcement of those rules (Lindgreen, 2003). The second type of trust is described as calculative trust, defined as the "rational evaluation that others are likely to be behave in a way that does not harm their own interests" (Hobbs and Goddard, 2015, pp. 71). This concept evokes the constraints on future behaviour that Earle (2010) uses to define this concept: we interpret that consumers may perceive food manufacturers to be constrained by their need to avoid prosecution and/or to gain repeat business; by extension they trust date labels and may also perceive them to have a buffer built in. This can also be seen as the food industry needing to protect itself from economic losses, and by proxy it is trusted to protect the interests of consumers (Frewer et al., 1996). We therefore developed the following hypotheses:

H9. Consumers with greater trust in the label will have a higher WTC with respect to the best-before date.

H10. Consumers with stronger sense of calculative trust will have a higher WTC with respect to the best-before date although potentially lower trust in the label (as they may perceive it to be set conservatively).

H11. Consumers with higher risk perception will have lower trust in the label.

3. Method

We created a survey which was administered online between October 2016 and December 2016. Respondents were recruited through an online panel to create a sample of the Scottish popula-

tion stratified by age, income and gender. They confirmed that they were regular consumers of dairy products and that they were wholly or partly responsible for purchasing and disposal decisions in their household. We received 548 responses; the characteristics of the sample are outline in Table 1.

3.1. Survey measures

Willingness to consume (WTC) was measured by a series of questions that asked respondents when in relation to the expiry date they would be happy to consume a product. This was based on an approach used by WRAP (2011), though the response scale was adapted as respondents had already been screened as consumers of dairy products. Different products were used for the use-by and best-before conditions in each case, such that product/ expiry date combinations were realistic and could be found in a UK shop. The item was coded with 1, if they were only willing to consume the product prior to the best-before date, and 7 if they would be willing to consume the product any time after the best-before date. The exact wording of the questions and an example is displayed in Table 2.

Knowledge of the best-before date was measured by two statements adapted from the text of Regulation (EU) No. 1169/2011 as well as WRAP (2011) and TNS (2014). They read: "The date after which food may not retain specific properties" and "The date that is an indicator of food quality". We chose to include these two statements as best-before dates are described in different ways by different sources: best-before dates are both described as a general quality label (WRAP, 2011; TNS, 2014) and in terms of deterioration of certain properties such as taste (Regulation (EU) No. 1169/2011). Respondents selected a radio button next to each statement to indicate which date they understood it to refer to. Respondents were given the option to choose either best-before, use-by or sell-by/display-until. Knowledge was coded as a single item measure: 0 if they did not identify any best-before statement correctly, 1 if they answered one correctly and 2 if they answered both correctly.

Risk perception was measured as a multi-dimensional concept, drawing on Tsiros and Heilman's (2005) two risk constructs: product quality risk and personal risk. The wording of Tsiros and Heilman's (2005) measures were adapted to the home and best-before date context. For example, one of Tsiros and Heilman's measures of personal risk asked about "guests in your home thinking less of you for serving them a poor quality product" (pp. 120); we adapted this to date-label situation and asked whether it would be "appropriate to serve others dairy products after the best-before date". The wordings of our adapted measures are outlined in Table 3.

Label trust was one of two concepts of trust drawing on the food-labelling literature. It was measured by a series of statements that asked respondents the extent to which expiry dates were credible, meaningful and protected their interests. These measures

were developed by the authors but were based on the concepts described by (Tonkin et al., 2016a, 2016b) and partly adapted from the measures used by (Lassoued and Hobbs, 2015; Lobb et al., 2007). The wordings of the measures used are outlined in Table 3.

Calculative trust was the second of two concepts of trust, and captures the idea articulated by Frewer et al. (1996) and Hobbs and Goddard (2015) that we trust date labels because we believe that food system actors wish to protect their own interests. The measures themselves were adapted from some of the questions used in Frewer et al. (1996), including whether food system actors seek to protect their own interests. We developed additional measures to test the idea that by extension, respondents may perceive dates to be set earlier than necessary to encourage the purchase of more products, or believe that food companies are cautious in setting dates because they prioritise safety over waste. The wordings of the measures used are outlined in Table 3.

3.2. Study design and analyses

Hypotheses H1–H5 were tested using a simple Chi-square test. The WTC question was constructed as a mixed design that facilitated both within and between subject tests for H1–H4 (Charness et al., 2012). Only between subject tests were conducted for H5, which facilitated counterbalancing of order effects since respondents were randomly allocated to either the reduced or non-reduced condition for every product/date type combination. This resulted in 32 possible permutations of question order; on average, 17 respondents will have had the same question order. The number of respondents per test is described in Tables 4–6.

Hypotheses H6–H11 were tested by means of a structural equation model outlined in Fig. 1. The lavaan package (Rosseel, 2012) in R was used for analysis. The model was run twice: once for the subsample of respondents who were assigned to the non-reduced best-before yoghurt condition (n = 270); and once for the subsample of respondents who were assigned to the non-reduced best-before yoghurt condition (n = 286). Characteristics of these subsamples are reported in Appendix A Table A.

4. Results

4.1. Relationship between product type and WTC

We tested four conditions where respondents saw two different product types with the same date type. We tested these conditions both within and between subjects. The results of the within subject and between subject comparisons are outlined in Table 4. Where response categories 6 and 7 were low we also ran the Chi-squared test by merging these categories; this did not change which comparisons were significant. Both within and between subjects we found the same pattern emerged. We found evidence that WTC is different between milk and cheese, as well as between yoghurt and cheese, where both products have a use-by date. We did not find evidence of a difference when the products were yoghurt and milk, or when both products (yoghurt and cheese) had a best-before date. The largest amount of variance observed was in the between subject yoghurt and cheese use-by date comparison; the smallest was in the within subject yoghurt and milk use-by date comparison. These findings suggest that some product differences were pertinent to respondents' WTC, whether we compared the same people or different people. However, these product differences were only pertinent when the use-by date was present and not when the best-before date was present. These results partly support H1, as we find that WTC cheese is higher than WTC milk and yoghurt where use-by dates are present. However, WTC yoghurt does not appear to be different to WTC milk where both have a

Table 1
Sample demographics (548 observations).

Household income	%	Age	%
Less than £14,000	14	18–24	7
£14,000–£20,999	20	25–34	14
£21,000–£27,000	13	35–44	13
£28,000–£34,999	12	45–54	15
£35,000–£41,999	11	55–64	26
£42,000–£49,999	10	65+	25
£50,000–£65,999	9		
£66,000–or more	11	**Education**	
		Less than high school	1
		High/secondary school	41
Gender		University degree	30
Male	49	Postgraduate degree	13
Female	51	Professional qualifications	14
		Other	1

Table 2
Willingness to consume (WTC) example question.

Please look at the pictures of the products that follow. Indicated until when you would be happy to consume each product, relative to the date shown.						
	Before the date shown (1)	One the date shown (2)	1 day after the date shown (3)	2 days after the date shown (4)	3 days after the date shown (5)	Up to a week after the date shown (6)	Any time after the date shown (7)

Yoghurt with this expiry date:

Best Before 28.10.2016   Condition A

                              Condition B

REDUCED

Best Before 28.10.2016

Note. For each product/expiry date combination the respondent would either see the normal condition A or the reduced condition B. The survey used images of date labels found on real dairy products.

Table 3
Item measures for latent variables: risk perception, label trust and calculative trust including the item loadings, and average variance (AVE) extracted per factor.

Item measures per latent factor	Yoghurt best-before		Cheese best-before	
	Item loading (p-value)	AVE	Item loading (p-value)	AVE
Risk perception		0.50		0.55
If I consumed my usual dairy products, I believe they would pose a risk of food poisoning if I ate them:				
After the best-before date	0.64 (0.00)		0.65 (0.00)	
Scale: strongly disagree [1] strongly agree [7]				
How would you feel about eating cheese, yoghurt or butter past their best-before dates?				
It would be embarrassing if people knew I ate these dairy products past their best-before date	0.69 (0.00)		0.72 (0.00)	
I would feel I was not providing well for myself/my family	0.79 (0.00)		0.82 (0.00)	
I would worry they wouldn't taste very good	0.73 (0.00)		0.80 (0.00)	
Even if I'd eat it myself, it would not be appropriate to serve others dairy products after the best-before date	0.62 (0.00)		0.70 (0.00)	
Scale: Does not describe my feelings [1] clearly describes my feelings [5]				
Trust label		0.62		0.64
Please indicate the extent to which you agree with the following statements about expiry dates on dairy products				
Expiry date labels protect the interests of consumers	0.76 (0.00)		0.72 (0.00)	
Expiry dates on the dairy products I buy (use-by and best-before) are credible	0.79 (0.00)		0.82 (0.00)	
Expiry date labels on dairy products are meaningful	0.81 (0.00)		0.86 (0.00)	
Scale: strongly disagree [1] strongly agree [7]				
Calculative trust		0.54		0.57
Please indicate the extent to which you agree with the following statements about expiry dates on dairy products				
Expiry dates are set earlier than necessary to encourage us to buy more	0.82 (0.00)		0.81 (0.00)	
Food companies are too cautious in setting expiry dates, they focus on safety at the expense of creating waste	0.76 (0.00)		0.78 (0.00)	
It is in the interests of food companies to set expiry dates earlier than necessary	0.61 (0.00)		0.67 (0.00)	
Scale: strongly disagree [1] strongly agree [7]				

Note. All factor loadings are reported as fully standardised.

use-by date. We do not find evidence to support H2 as WTC cheese and yoghurt with a best-before date appear to be similar.

4.2. Relationship between date type and WTC

We tested conditions where respondents saw the same type of products with a different date type. We tested these conditions both within and between subjects. The results of the within subject and between subject comparisons are outlined in Table 5. As above, where response categories 6 and 7 were low we also ran the Chi-squared test by merging these categories; this did not change which responses were significant. We found evidence that date type was pertinent to respondents' WTC yoghurt with a use-by date and yoghurt with a best-before date; this was only found in the between subject comparison. We found no evidence to suggest that respondents' WTC cheese was associated with a difference in date type; the variance was slightly higher between responses in the comparison made between subjects but it was not significant.

Our observation of a different result for the within and between subject conditions could indicate that personal factors are important in determining a respondents' WTC, with the same person responding similarly regardless of the date type. To see if these differences could be linked to the socio-demographic profile of the samples, we checked using a Chi-squared test to see how similar randomly-allocated subject samples were for the between subject yoghurt use-by/best-before comparison. We found that while they were similar in terms of age and income, there were significantly more women in the yoghurt best-before condition. Across all other between subject comparisons the two randomly allocated subject samples were not significantly different in terms of age, income or gender.

These results partly support H3, as we find that WTC yoghurt with a use-by date is lower than WTC yoghurt with a best-before, but only in the between subject condition and cannot rule out that this could be linked to the female-dominant sub-sample. We find no evidence to support H4 and instead find that WTC cheese is similar regardless of the date type.

4.3. Relationship of reduced labelling and WTC

The reduced comparison was only made between subjects. The results of the comparisons are outlined in Table 6. For each product type/date type combination we found no difference in respondents' willingness to pay. These results provide no evidence to support H5 that respondents would have a lower WTC products with a reduced label.

Table 4
Comparison of WTC responses by product type, total subjects (n = 548).

	WTC							N	Chi square	DF	p value
	1	2	3	4	5	6	7				
Within subject											
Milk use-by	17	52	26	20	14	10	5	144	17.32	6	0.01
Cheese use-by	16	41	15	15	16	25	16	138	3.48	6	0.75
Milk use-by	20	53	26	21	9	6	3	138	3.48	6	0.75
Yoghurt use-by	19	58	20	17	8	11	5				
Cheese use-by	18	46	17	16	12	25	9	143	13.57	6	0.03
Yoghurt use-by	22	61	26	10	9	11	4				
Cheese best-before	20	37	13	18	12	28	20	148	7.67	6	0.26
Yoghurt best-before	22	43	21	19	14	19	10				
Between subject											
Milk use-by	21	47	18	16	7	9	1	119	12.34	6	0.05
Cheese use-by	23	36	17	16	6	19	10	127			
Milk use-by	18	46	18	15	12	13	3	125	5.96	6	0.43
Yoghurt use-by	26	50	31	13	10	8	2	140			
Cheese use-by	21	31	15	15	10	19	17	128	20.75	6	0.00
Yoghurt use-by	23	47	25	20	9	8	3	135			
Cheese best-before	14	31	17	20	18	24	14	138	9.60	6	0.14
Yoghurt best-before	19	39	16	19	9	14	6	122			

Table 5
Comparison of WTC by date type – total subjects (n = 548).

	WTC							N	Chi square	DF	p value
	1	2	3	4	5	6	7				
Within subject											
Cheese use-by	17	45	14	16	13	20	10	135	2.7	6	0.85
Cheese best-before	19	34	14	17	13	24	14				
Yoghurt use-by	18	53	26	20	7	9	3	136	3.74	6	0.70
Yoghurt best-before	19	45	23	19	9	17	4				
Between subject											
Cheese use-by	22	32	18	15	9	24	16	136	4.95	6	0.55
Cheese best-before	15	34	16	21	17	28	20	151			
Yoghurt use-by	27	55	25	10	11	10	4	142	15.45	6	0.02
Yoghurt best-before	22	37	14	19	14	16	12	134			

Table 6
Comparison of WTC responses by reduced condition, total subjects (n = 548).

Between subject	WTC							N	Chi square	DF	p value
	1	2	3	4	5	6	7				
Milk use-by	38	99	44	36	21	19	6	263	10.24	6	0.11
Milk use-by reduced	46	105	70	25	21	16	2	285			
Cheese use-by	39	77	32	31	22	44	26	271	5.14	6	0.92
Cheese use-by reduced	33	96	42	27	19	38	22	277			
Cheese best-before	34	68	30	38	30	52	34	286	1.89	6	0.93
Cheese best-before reduced	36	59	34	33	22	48	30	262			
Yoghurt use-by	45	108	51	30	18	19	7	278	2.88	6	0.82
Yoghurt use-by reduced	44	106	38	30	23	23	6	270			
Yoghurt best-before	41	82	37	38	23	33	16	270	7.05	6	0.32
Yoghurt best-before reduced	55	74	53	36	22	28	10	278			

4.4. Relationship between knowledge, risk perceptions, trust, and WTC

The latent constructs of risk perception, label trust and calculative trust were tested by means of confirmatory factor analysis. The standardised loadings of the latent variable item measures were above 0.50 and statistically significant when the model was run for both the yoghurt best-before and the cheese best-before sub-samples (see Table 3). We used (Fornell and Larcker, 1981) measures of convergent and discriminant validity to assess our measurement model, and found that the Average Variance Extracted (AVE) was at or above the recommended 0.50 for each latent variable, and the square of the correlations between different latent variables was lower than either of their respective AVE scores.

Goodness of fit for the whole model was judged against a range of statistics including the Comparative Fit Index (CFI) and the Root Mean Square Error Approximation (RMSEA). Both of these items indicated a good fit as the CFI was over the recommended threshold of 0.95 and the RMSEA was under the threshold of 0.08 (Kline, 2016). Table 7 outlines these and other commonly reported measures of model fit.

The results of the structural models are described in Figs. 2 and 3. Their results are broadly the same, though the magnitude of the coefficients and R^2 vary slightly. They indicate that perceived risk was negatively associated with WTC. This suggests that those who reported higher levels of perceived risk were less likely to be willing to consume yoghurt or cheese after the best-before date, supporting H8. There was a positive association between those
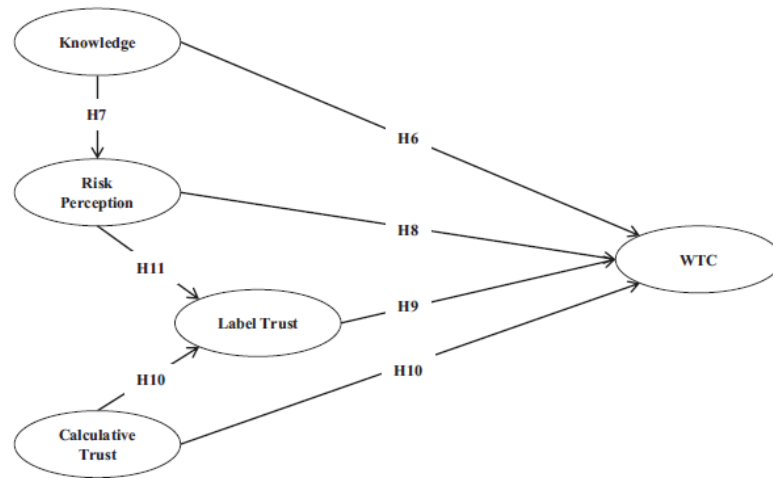
Fig. 1. Outline of structural model.

with better knowledge of best-before dates and WTC, though this relationship was not statistically significant in both models, and therefore H6 is not supported. Knowledge was found to have a negative association with risk perceptions, providing evidence to support H7. Label trust did not have a significant relationship with WTC, meaning H9 is not supported. On the other hand, we found that calculative trust has a direct, positive relationship with WTC and a negative relationship with label trust, supporting H10. Lastly, risk perception and label trust are positively related, providing evidence contrary to H11. Those that have stronger risk perceptions appear more likely to perceive date labels as meaningful, credible and protecting their interests.

The R-squared values indicate that 35% of the variance in WTC yoghurt with a best-before date, and 45% of the variance of WTC cheese, was accounted for by the models. The R-squared value for risk was extremely low, providing evidence that knowledge has a very weak association with risk perception. On the other hand, risk perceptions and calculative trust account for nearly half the variance observed in label trust.

Table 7
Goodness of fit indicators for best-before cheese (n =286) and best-before yoghurt (n =270) structural models.

	Model	
	Yoghurt best-before	Cheese best-before
Chi-squared	130.59	113.98
D.F.	60	60
Chi-squared p value	0.00	0.00
Root Mean Square Error of Approximation (RMSEA)	0.07	0.06
90% Conf	0.05–0.08	0.04–0.07
RMSEA p value	0.04	0.25
Comparative Fit Index (CFI)	0.98	0.99
Normed Fit Index (NFI)	0.96	0.98
Non-Normed Fit Index (NNFI)	0.97	0.99
Relative Fit Index (RFI)	0.95	0.97
Standardized Root Mean Square Residual (SRMR)	0.07	0.06
Adjusted Goodness of Fit Index (AGFI)	0.95	0.96
Incremental Fit Index (IFI)	0.98	0.99

5. Discussion

The first objective of this study was to assess the relations between product type, date type, and the presence of a reduced label on WTC dairy products. We found no difference in WTC for products with a reduced label compared to identical products without a reduced label. This is positive for expiry-date-based pricing as these results suggest that consumers' WTC is not affected by the awareness that a product was purchased when it was already approaching the end of its shelf life. We found that product type did make some difference to WTC: where date labels were held constant, respondents' WTC cheese was greater than respondents' WTC yoghurt or milk, but only where both products had use-by dates. Where cheese and yoghurt had best-before dates we did not observe WTC responses that were significantly different from one another; neither did we observe WTC responses that were significantly different between yoghurt and milk with use-by dates. These findings indicate that only some product differences are pertinent, and consumers take into account product/date combinations.

Physical differences between these products could be relevant to consumer responses, for example cheese being relatively hard and dry compared to yoghurt and milk. We may be able to hypothesise, therefore, that WTC bread would be higher than WTC juice. On the other hand, factors such as consumers' previous experience of how edible they have found these products after the expiry date might be driving these observations. In terms of understanding why product type seems to matter, future research should also include qualitative work to draw out the reasoning behind these responses.

Our comparison of date types where product type was held constant found that date type mattered for yoghurt but not for cheese. Furthermore, we found that date type was only significant in the between subject comparison for yoghurt, suggesting that a change from a use-by to a best-before date on its own is unlikely to change behaviour. Instead, personal differences matter when it comes to how we interpret date labels.

These findings imply that increasing the proportion of cheese or yoghurts with a best-before rather than a use-by date, as proposed (WRAP, 2017a), is on its own unlikely to have a large effect on consumption beyond the best-before label and consequently reduce food waste. Given this and evidence of the anchoring effects of date
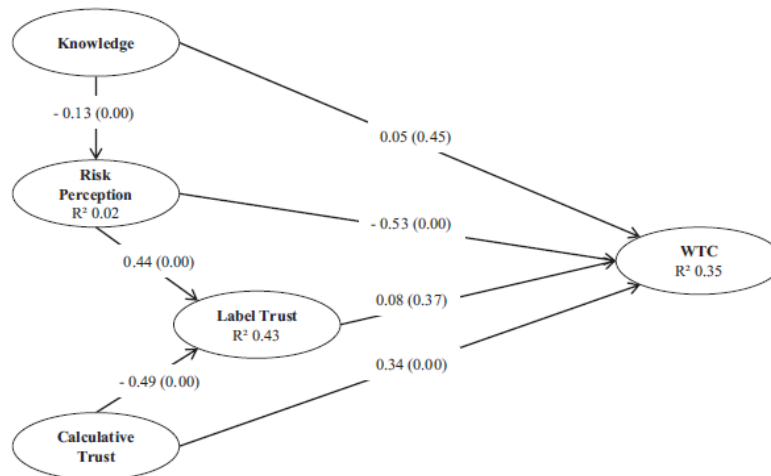
Fig. 2. Results of the structural model for best-before date yoghurt. * Standardised coefficients and p-values are reported e.g. 0.36 (0.00) and R^2 are reported within endogenous latent variables.
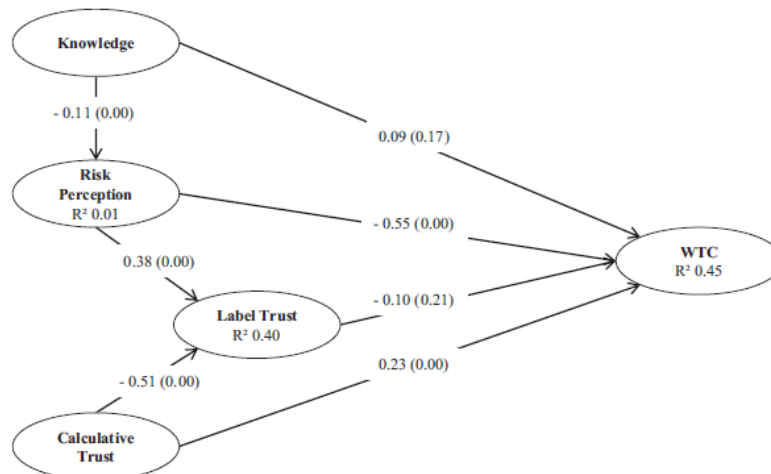

Fig. 3. Results of the structural model for best-before date cheese. * Standardised coefficients and p-values are reported e.g. 0.22 (0.01) and R^2 are reported within endogenous latent variables.

labels (Elsen et al., 2015), a more effective approach might be to encourage companies to give the maximum amount of shelf life to products and challenge any dates which may be unnecessarily cautious (WRAP, 2017a). Options such as intelligent food packaging might also be considered, though these may also present issues around initial consumer acceptance and longer-term behaviour as discussed by Raak et al. (2017); personal differences in terms of how we interpret these new types of indicators are still likely to matter.

The second objective of this study was to understand the relationship between best-before date knowledge, risk perceptions, and trust on WTC, and how these factors are associated with WTC. We found that respondents who reported higher risk percep-

tions were more likely to report lower WTC. This is consistent with Tsiros and Heliman's (2005) results where they found that higher perceived product quality risk was related to lower WTP. While the concepts of WTC and WTP are relevant to different contexts, the home and shopping contexts respectively, it appears that risk perception plays a role in both. We found that all risk perception item measures loaded onto a single latent factor. These item measures encompassed aspects of product quality risk and personal risk which were distinguished by Tsiros and Heilman (2005). This could indicate that in the home context these aspects of risk are not differentiated by consumers, not just across safety and quality aspects encompassed by product quality risk but also social aspects encompassed by personal risk. This has important implica-

tions for communicating with consumers alongside the proposed expiry-date streamlining (The Consumer Goods Forum, 2017). If these changes are to be effective, communications need to go beyond stating that products are safe to eat after the best-before date and address concerns about taste, quality, freshness, and social acceptability.

This recommendation is further supported by our finding with regard to best-before-date knowledge. We tested the extent to which best-before-date knowledge was associated with risk perceptions and WTC and found that it had limited-to-no association. Specifically, it had no direct association with WTC; there was an indirect relationship through risk perceptions, although its association with risk perceptions was small. It will be important to understand more about the formation of risk perceptions with regard to best-before dates in order to ensure that consumer education and communication is effective.

Higher risk perception was notably associated with higher levels of label trust. This finding ran counter to our hypothesis but could be understood as label use being driven by a particular need or interest: Grunert et al. (2010) for example, found that having an interest in healthy eating was associated with nutrition information use. Therefore we can interpret our findings as indicating that those with higher perceived risks tend to find date labels more trustworthy and salient.

We also explored the association of trust with WTC: trust in date labels' credibility, and calculative trust related to the food system actors which set date labels. We found that only calculative trust had a direct, positive association with WTC; trust in date labels had a weak, negative relationship with WTC, but this was not statistically significant. Respondents with higher levels of calculative trust were also less likely to have high levels of trust in the label itself.

The implications of these findings for expiry-date policy are challenging. On the one hand, it is desirable for consumers to trust the information they are presented with on a date label and perceive it as credible, reliable and meaningful; these labels are not otherwise fulfilling their traditional economic role in reducing quality uncertainties and information asymmetries (Lusk, 2013). It appears that in this model, the extent to which consumers trust labels does not have a direct impact on WTC, and is instead strongly associated with perceived risk: trying to improve consumer trust and confidence in labels alone may not result in lower food waste. On the other hand, it seems that the more consumers perceive food companies to be protecting their own interests with regard to setting the expiry date, the more willing they are to consume products after the best-before date. Companies are now being urged to ensure they give the absolute maximum shelf-life to products (WRAP, 2017b), which we also highlighted as being potentially effective in reducing food waste. The challenge may be that if companies provide the absolute maximum shelf-life, individuals with high calculative trust may still be willing to exceed the date and be disappointed with a product's quality, which companies may wish to avoid. If the same were found to apply to use-by dates then this could also result in food safety issues.

This study limited itself to two concepts of trust, calculative trust and trust in the labels themselves, as a measure of system trust, since the wider food safety and labelling literature indicated they were relevant to consumer interactions with labelling and perceptions of food safety. Future research could benefit from exploring other trust concepts identified in the literature (Hobbs and Goddard, 2015), that go beyond the rational concepts of trust and include social and emotional aspects which have been shown to be influential (Dunning et al., 2012). This could form an interesting counterpoint to social and psychological aspects of risk that were found to be relevant alongside safety and quality aspects

within our model. From the point of view of developing effective communications, further research into trusted sources of information with regard to date label interpretation would also be beneficial.

Our findings suggest that food manufacturers should weigh carefully the costs and benefits of investing in the tests required to move products from a use-by to a best-before date. For cheese, it appears that – at least for our respondents – that whether a product has a use-by date or a best-before date matters very little to their consumption and (by extension) waste decisions. For yoghurt, it appears that the date label may make some difference to some people. If date label changes are to be effective in contributing to food waste reduction, they will need to be combined with campaigns that address the range of perceived risks associated with products consumed beyond their best-before dates. From the perspective of retailers, having a greater volume of products on their shelves that have best-before rather than use-by dates is likely to increase opportunities for sales and/or redistribution, potentially reducing waste at the retail level; retail food waste aspects in relation to date labels are discussed more extensively by Aschemann-Witzel (2018). From the perspective of consumers, we agree that moving products to best-before dates does provide an opportunity to reduce food waste. Combined with effective communication over the long term, more people could be persuaded to eat products which have passed their best-before date, though encouraging people to eat (and consider socially acceptable) products which look or even taste slightly unpleasant, even though safe, will be challenging.

6. Conclusion

Our results suggest that on its own, the effect on food waste reduction of moving more dairy products to best-before dates is likely to be small. In order for such changes to be effective, consumer communication that goes beyond improving expiry-date knowledge to address the multifaceted nature of related risk perceptions and conceptions of date-label trust will be required. Communication will need to go beyond providing information to the effect that it is safe to eat products beyond the best-before date, and acknowledge that there is a difference between knowing a product is safe to eat and acting on that knowledge. Knowing the difference between date labels only goes so far in addressing these risk perceptions. Changes to date labelling and communication around those changes will need to take into account the interactions between consumer risk perceptions, trust in labels, and calculative trust in order to develop approaches that are effective for food waste reduction.

Conflicts of interest

None.

Appendix A

(See Table A).

Table A
Demographics of subsamples for best-before cheese (n = 286) and best-before yoghurt (n = 270) structural models.

Household income	Model		Age	Model	
	Cheese %	Yoghurt %		Cheese %	Yoghurt %
Less than £14,000	13	12	18–24	6	7
£14,000–£20,999	22	21	25–34	14	14
£21,000–£27,000	14	14	35–44	13	13
£28,000–£34,999	11	12	45–54	15	16
£35,000–£41,999	12	12	55–64	27	26
£42,000–£49,999	8	10	65+	25	24
£50,000–£65,999	8	9			
£66,000–or more	12	10	**Education**		
			Less than high school	1	1
			High/secondary school	41	37
Gender			University degree	28	30
Male	50	45	Postgraduate degree	12	16
Female	50	55	Professional qualifications	17	15
			Other	1	1

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Appendix II.   Surveys

Survey Stage 1

Q1   Thank you for participating in this survey about dairy products.   This survey is part of PhD research funded by the Scottish Government's Environmental and Social Research Programme. The research project has also been reviewed and approved by the Edinburgh University Research Ethics Board.   You will be asked questions about how you purchase, store, use, and dispose of dairy products in your household. All responses provided will be treated anonymously and all data collected will be stored securely, safely and in accordance with Data Collection Act (1998).   The results may be used in a range of publications such as academic papers, policy papers and news articles.   By starting this survey, you consent to the data collected from this survey being used in this way.

Q3 Which age bracket do you fall into?

- 18-24 (1)
- 25-34 (2)
- 35-44 (3)
- 45-54 (4)
- 55-64 (5)
- 65-74 (6)
- 75-84 (9)
- 85+ (10)

Q39 Please select your household income bracket (before tax).

○ Less than £14,000 (1)
○ £14,000 - £20,999 (2)
○ £21,000 - £27,999 (3)
○ £28,000 - £34,999 (4)
○ £35,000 - £41,999 (5)
○ £42,000 - £49,999 (6)
○ £50,000 - £65,999 (7)
○ £66,000 - £74,999 (8)
○ More than £75,000 (9)

Q2 Which of the following best describes how you identify your gender?

○ Male (1)
○ Female (2)
○ In another way (3) _____

Q5 Are you responsible for purchasing and disposing of food, including dairy products in your household?

- ○ Completely responsible (1)
- ○ Partly responsible (2)
- ○ Not at all responsible (3)

If Not at all responsible Is Selected, Then Skip To End of Block

Q6 How often do you purchase milk, yoghurt and cheese?

	Every day (1)	More than once a week (44)	Every week (45)	More than once a month (46)	Monthly (47)	Less than once a month (48)	Never (49)
Milk (1)	○	○	○	○	○	○	○
Cheese (2)	○	○	○	○	○	○	○
Yoghurt (3)	○	○	○	○	○	○	○

If Less than once a month Is Equal to 2, Then Skip To End of BlockIf Never Is Selected, Then Skip To End of Block

Q7 How important are the following factors in your choice of dairy products?

	Extremely important (1)	Very important (2)	Moderately important (3)	Slightly important (4)	Not at all important (5)
Health (1)	○	○	○	○	○

Enjoyment (2)	○	○	○	○	○
Convenience (3)	○	○	○	○	○
Price (4)	○	○	○	○	○
Taste (5)	○	○	○	○	○
No artificial ingredients (6)	○	○	○	○	○
Environmentally friendly (7)	○	○	○	○	○
Familiarity (8)	○	○	○	○	○
Freshness (9)	○	○	○	○	○
Shelf-life (10)	○	○	○	○	○
Farmer receives fair milk price (11)	○	○	○	○	○
Animal welfare (12)	○	○	○	○	○

Q8 Please look at the pictures of the products that follow. Indicate until when you would be happy to consume each product, relative to the date shown.

	Before the date shown (1)	On date shown (2)	1 day after date shown (3)	2 days after the date shown (4)	3 days after the date shown (5)	Up to a week after the date shown (6)	Anytime after the date shown (7)
If Product pair one Is Equal to A Milk with this expiry date (1)	○	○	○	○	○	○	○
If Product pair one Is Equal to B Milk with this expiry date (2)	○	○	○	○	○	○	○
If Product pair two Is Equal to A Cheese with this expiry date (3)	○	○	○	○	○	○	○
If Product	○	○	○	○	○	○	○

pair two Is Equal to B Cheese with this expiry date (4)							
If Product pair three Is Equal to A Cheese with this expiry date (5)	○	○	○	○	○	○	○
If Product pair three Is Equal to B Cheese with this expiry date (6)	○	○	○	○	○	○	○
If Product pair four Is Equal to A Yoghurt	○	○	○	○	○	○	○

with this expiry date (7)							
If Product pair four Is Equal to B Yoghurt with this expiry date (8)	○	○	○	○	○	○	○
If Product pair five Is Equal to A Yoghurt with this expiry date (9)	○	○	○	○	○	○	○
If Product pair five Is Equal to B Yoghurt with this expiry date (10)	○	○	○	○	○	○	○

Q9 The next block of questions will ask you how you use expiry labels on dairy products when shopping and at home. In the next two weeks how likely are you to:

	Extremely likely (1)	Moderately likely (2)	Slightly likely (3)	Neither likely nor unlikely (4)	Slightly unlikely (5)	Moderately unlikely (6)	Extremely unlikely (7)
Check the amount of time that a dairy product is open (2)	○	○	○	○	○	○	○
Check expiry dates on dairy products in your fridge (3)	○	○	○	○	○	○	○
Throw away dairy products because the use by date has passed (5)	○	○	○	○	○	○	○
Throw away dairy products based on the use by date and your senses (how it looks/smells/tastes) (6)	○	○	○	○	○	○	○
Throw away dairy products because they have been open longer than	○	○	○	○	○	○	○

recommended on the packaging (4)							
Throw away dairy products because the best before date has passed (7)	○	○	○	○	○	○	○
Throw away dairy products based on the best before date and your senses (8)	○	○	○	○	○	○	○
Throw away dairy products based on your senses, regardless of the expiry date (9)	○	○	○	○	○	○	○
Check expiry dates when shopping (13)	○	○	○	○	○	○	○
When shopping, check expiry dates on dairy products are sufficient to use as planned (10)	○	○	○	○	○	○	○
When shopping, choose dairy products whose expiry date is	○	○	○	○	○	○	○

furthest into the future (11)							
When shopping, forget to check the expiry dates on dairy products (12)	○	○	○	○	○	○	○
Throw away no dairy products at all (17)	○	○	○	○	○	○	○

Q10 Please select the dairy product for which you are most and least likely to take the action described in the next two weeks. If you do not think the type of product would make a difference to your actions then you can select no difference.

	Check expiry date information when shopping			Check and monitor expiry date information at home		
	Most (1)	Least (2)	No difference (3)	Most (1)	Least (2)	No difference (3)
Milk (1)	❑	❑	❑	❑	❑	❑
Cheese (2)	❑	❑	❑	❑	❑	❑
Yoghurt (3)	❑	❑	❑	❑	❑	❑
Butter (4)	❑	❑	❑	❑	❑	❑

Q11 Please indicate for the following dairy products how important expiry date information is to any decision to throw it away.

	Extremely important (11)	Very important (12)	Moderately important (13)	Slightly important (14)	Not at all important (15)
Milk (1)	○	○	○	○	○
Cheese (2)	○	○	○	○	○
Yoghurt (3)	○	○	○	○	○
Butter (4)	○	○	○	○	○

Q12 Please indicate the extent to which you are confident in your understanding of the following information on dairy products.

	Extremely confident (15)	Very confident (16)	Moderately confident (17)	Slightly confident (18)	Not confident at all (19)
Use by dates (1)	○	○	○	○	○

Best before dates (2)	❍	❍	❍	❍	❍
"Once open consume within..." information (3)	❍	❍	❍	❍	❍

Q13 Please read the following statements and select which type of expiry date they describe.

	Use by (1)	Best before (2)	Display until / sell by (3)	Don't know (4)
The date after which food may not retain specific properties (1)	○	○	○	○
The date after which food may present a risk to human health (2)	○	○	○	○
The date that is an indicator of food quality (3)	○	○	○	○
The date which retailers use to assist in stock rotation (4)	○	○	○	○
The date that is an indicator of food safety (5)	○	○	○	○
The date after which retailers may wish to remove the product from their shelves (6)	○	○	○	○

Q14 Who in the dairy supply chain do you believe is responsible for deciding the expiry dates on dairy products? Select any that apply.

- ❑ Dairy farmers (1)
- ❑ Manufacturers of dairy products (2)
- ❑ Retailers of dairy products (3)
- ❑ Government agencies e.g. Food Standards Agency (11)
- ❑ Independent food laboratories (13)
- ❑ Other (14) _____
- ❑ Don't know (15)

Q15 Please indicate the extent to which you find it easy or difficult to:

	Extremely easy (15)	Moderately easy (16)	Slightly easy (17)	Neither easy nor difficult (18)	Slightly difficult (19)	Moderately difficult (20)	Extremely difficult (21)
Find expiry date information on dairy products (1)	○	○	○	○	○	○	○
Check expiry date information on dairy	○	○	○	○	○	○	○

products when shopping (2)							
Make use of the use by date when deciding whether to throw away a dairy product (3)	○	○	○	○	○	○	○
Keep track of expiry dates at home (4)	○	○	○	○	○	○	○
Keep track of when you opened dairy products (5)	○	○	○	○	○	○	○
Determine the quality of dairy products using your	○	○	○	○	○	○	○

senses (6)							
Determine the safety of dairy products using your senses (7)	○	○	○	○	○	○	○
Make use of the best before date when deciding whether to throw away a dairy product (8)	○	○	○	○	○	○	○
Consume all the dairy products you purchase before their expiry dates (10)	○	○	○	○	○	○	○
Use your senses to tell if a dairy	○	○	○	○	○	○	○

product is edible (11)							
Remember to check expiry date information when shopping (12)	○	○	○	○	○	○	○
End up throwing away some of the dairy products you purchase (13)	○	○	○	○	○	○	○

Q16 Please indicate the extent to which you agree or disagree with the following statements.

	Strongly agree (1)	Agree (2)	Somewhat agree (3)	Neither agree nor disagree (4)	Somewhat disagree (5)	Disagree (6)	Strongly disagree (7)
Deciding when a	○	○	○	○	○	○	○

dairy product should be thrown away is not up to me, it is defined by the expiry date (3)							
It is up to me to decide whether or not a dairy product is edible (21)	○	○	○	○	○	○	○
The decision to dispose of a dairy product is within my control (1)	○	○	○	○	○	○	○
There are a large number of factors outside my control	○	○	○	○	○	○	○

which cause me to waste dairy products (17)							
I would be comfortable if there were no best before dates on cheese (4)	○	○	○	○	○	○	○
I would be comfortable if there were no best before dates on yoghurt (16)	○	○	○	○	○	○	○
I would be comfortable if there were no best before dates on butter (20)	○	○	○	○	○	○	○
I have a strategy to	○	○	○	○	○	○	○

ensure I consume products prior to their expiry date (5)							
I have an approach when shopping to make sure I check the expiry dates (6)	○	○	○	○	○	○	○
I have tactics to ensure I know how long products have been open in my fridge (7)	○	○	○	○	○	○	○
Using my senses is the best way to check if a dairy product is	○	○	○	○	○	○	○

still good to eat (2)							
I am confident in my ability to determine if a dairy product is edible using only my senses (19)	○	○	○	○	○	○	○

Q17 Checking the expiry dates of products in the supermarket is:

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)
Good:Bad (1)	○	○	○	○	○	○	○
Wise:Unwise (2)	○	○	○	○	○	○	○
Time consuming:Not time consuming (3)	○	○	○	○	○	○	○
Convenient:Inconvenient (4)	○	○	○	○	○	○	○
Necessary:Unnecessary (5)	○	○	○	○	○	○	○

Q18 Regularly checking the expiry dates of dairy products in my fridge is:

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)
Good:Bad (1)	❍	❍	❍	❍	❍	❍	❍
Wise:Unwise (2)	❍	❍	❍	❍	❍	❍	❍
Safe:Unsafe (3)	❍	❍	❍	❍	❍	❍	❍
Necessary:Unnecessary (4)	❍	❍	❍	❍	❍	❍	❍
Time consuming:Not time consuming (5)	❍	❍	❍	❍	❍	❍	❍
Convenient:Inconvenient (6)	❍	❍	❍	❍	❍	❍	❍
Wasteful:Not wasteful (7)	❍	❍	❍	❍	❍	❍	❍

Q19 Using the expiry information (use by date/best before date/"once opened consume within" information) to determine whether or not to consume a

dairy product is:

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)
Good:Bad (1)	❍	❍	❍	❍	❍	❍	❍
Wise:Unwise (2)	❍	❍	❍	❍	❍	❍	❍
Safe:Unsafe (3)	❍	❍	❍	❍	❍	❍	❍
Necessary:Unnecessary (4)	❍	❍	❍	❍	❍	❍	❍
Time consuming:Not time consuming (5)	❍	❍	❍	❍	❍	❍	❍
Convenient:Inconvenient (6)	❍	❍	❍	❍	❍	❍	❍
Wasteful:Not wasteful (7)	❍	❍	❍	❍	❍	❍	❍

Q20 If I consumed my usual dairy products, I believe they would pose a risk of food poisoning if I ate them:

	Strongly agree (1)	Agree (2)	Somewhat agree (3)	Neither agree nor disagree (4)	Somewhat disagree (5)	Disagree (6)	Strongly disagree (7)
Before the expiry date (1)	○	○	○	○	○	○	○
When open fewer than recommended number of days (2)	○	○	○	○	○	○	○
After the use by date (3)	○	○	○	○	○	○	○
After the best before date (4)	○	○	○	○	○	○	○
When open more than recommended number of days (5)	○	○	○	○	○	○	○
If you live in Scotland select Agree (6)	○	○	○	○	○	○	○

Q21 You have received this message because you appear to have misunderstood or misread the statement in the previous question "If you live in Scotland select Agree".To help us understand how people make decisions, we are interested in information about you. Specifically we are interested in whether you take the time to read directions; if not, some of your responses may not tell us much about decision making in the real world. Please be sure to read all directions carefully before you respond again. If you wish you can go back and amend your answer to the previous question and any others you think may be inaccurate. Please indicate whether you intend to go back and amend your answers now?

❍ Yes (1)
❍ No (2)

Q22 This next question will ask you about your attitude towards throwing away dairy products. When I throw away dairy products I...

	Strongly agree (1)	Agree (2)	Somewhat agree (3)	Neither agree nor disagree (4)	Somewhat disagree (5)	Disagree (6)	Strongly disagree (7)
Feel it is a waste of money (1)	○	○	○	○	○	○	○
Don't really think about the cost (2)	○	○	○	○	○	○	○
Know that trying to reduce the amount of dairy I throw away would be time consuming (3)	○	○	○	○	○	○	○
Don't really have the time to worry about what I'm wasting (4)	○	○	○	○	○	○	○
Think of the	○	○	○	○	○	○	○

effort that went into making the product (5)							
Feel it is a waste of the earth's resources (6)	○	○	○	○	○	○	○
Am bothered by my conscience (7)	○	○	○	○	○	○	○
Don't give it a second thought (8)	○	○	○	○	○	○	○
Consider the effects on the environment (9)	○	○	○	○	○	○	○
Think of those that don't have enough to eat (10)	○	○	○	○	○	○	○
Feel a moral	○	○	○	○	○	○	○

obligation to waste less (11)							
Am happy to be rid of older products whose quality has deteriorated (12)	○	○	○	○	○	○	○
Don't feel it is a waste if the expiry date has already passed (13)	○	○	○	○	○	○	○
Can't think of many benefits to reducing the amount of dairy I waste (14)	○	○	○	○	○	○	○

Q23 How would you feel about eating cheese, yoghurt or butter past their best before dates?

	Clearly describes my feelings (11)	Mostly describes my feelings (12)	Moderately describes my feelings (13)	Slightly describes my feelings (14)	Does not describe my feelings (15)
I can easily afford to buy fresh dairy products so I have no need to take this risk (1)	○	○	○	○	○
It would be embarrassing if people knew I ate these dairy products past their best before date (2)	○	○	○	○	○
I would feel I was not providing well for myself/my family (3)	○	○	○	○	○
I would worry they wouldn't taste very good (4)	○	○	○	○	○

I would enjoy eating them (5)	○	○	○	○	○
I would feel uncomfortable about eating them (6)	○	○	○	○	○
It is better for health to eat the freshest products possible (7)	○	○	○	○	○
Even if I'd eat it myself, it would not be appropriate to serve others dairy products after the best before (8)	○	○	○	○	○
I would feel a little shameful (9)	○	○	○	○	○
I would feel happy to eat them to make sure nothing was wasted (10)	○	○	○	○	○
I only eat	○	○	○	○	○

products in prime condition (11)					

Q24 Please rank the following situations: where 1 represents the worst outcome; and 4 represents the best given the options available.

_____ Becoming ill because of eating dairy products beyond their expiry date (1)

_____ Eating a dairy product but finding it was not of the quality expected (2)

_____ Creating avoidable food waste (3)

_____ Spending money on food that is not eaten (16)

Q25 Please indicate the extent to which you agree with the following statements about expiry dates on dairy products.

	Strongly agree (4)	Agree (5)	Somewhat agree (6)	Neither agree nor disagree (7)	Somewhat disagree (8)	Disagree (9)	Strongly disagree (10)
Expiry dates on the dairy products I buy (use by and best before) are credible (1)	○	○	○	○	○	○	○
Expiry dates	○	○	○	○	○	○	○

on the dairy products I buy (use by and best before) are not trustworthy (2)							
Use by dates reliably indicate until when it is safe for me to eat a dairy product (3)	○	○	○	○	○	○	○
Best before dates reliably indicate when a dairy product is past its best (4)	○	○	○	○	○	○	○
"Once opened consume within" information accurately reflects how long a dairy	○	○	○	○	○	○	○

product lasts once open (5)							
Expiry dates are more reliable on some dairy products than others (6)	○	○	○	○	○	○	○
Expiry date labels on dairy products are meaningful (7)	○	○	○	○	○	○	○
My trust in the date label depends on the brand of dairy product (8)	○	○	○	○	○	○	○
Date labels are more reliable on products from supermarkets than smaller or independent	○	○	○	○	○	○	○

shops (9)							
I don't believe there is a fixed point in the future when food becomes waste (10)	○	○	○	○	○	○	○

Q26 Please indicate the extent to which you agree with the following statements about expiry dates on dairy products.

	Strongly agree (1)	Agree (2)	Somewhat agree (3)	Neither agree nor disagree (4)	Somewhat disagree (5)	Disagree (6)	Strongly disagree (7)
Expiry date labels protect the interests of consumers (1)	○	○	○	○	○	○	○
Expiry date labels protect the interests of food companies (2)	○	○	○	○	○	○	○

I have a high level of trust in the food system to deliver high quality dairy products (3)	❍	❍	❍	❍	❍	❍	❍
Expiry dates are set earlier than necessary to encourage us to buy more (4)	❍	❍	❍	❍	❍	❍	❍
I can rely on the food system to provide dairy products that are safe to eat (7)	❍	❍	❍	❍	❍	❍	❍
Food companies are too cautious in setting expiry dates, they focus on safety at the expense	❍	❍	❍	❍	❍	❍	❍

of creating waste (8)						
It is in the interests of food companies to set expiry dates earlier than necessary (6)	○	○	○	○	○	○	○
The actions of food companies are partly responsible for my household food waste (5)	○	○	○	○	○	○	○
I can take actions that will impact the safety of dairy products that I consume (9)	○	○	○	○	○	○	○
I have a responsibility	○	○	○	○	○	○	○

for the dairy products my household wastes (10)							

Q27 Thinking about people who are important to you; how do you think they would feel about you performing the following actions?

	Strongly approve (1)	Approve (2)	Somewhat approve (3)	Neither approve nor disapprove (4)	Somewhat disapprove (5)	Disapprove (6)	Strongly disapprove (7)
Eating dairy products after the use by date (1)	○	○	○	○	○	○	○
Eating dairy products after the best before date (5)	○	○	○	○	○	○	○
Eating dairy products that have been	○	○	○	○	○	○	○

open longer than recommended on the packaging (9)							
Checking the expiry date information in shops (6)	○	○	○	○	○	○	○
Regularly checking expiry dates on dairy products in my fridge (3)	○	○	○	○	○	○	○
Using my senses to check whether a dairy product is still ok to consume (4)	○	○	○	○	○	○	○
Trying to reduce the number of dairy products I throw away (7)	○	○	○	○	○	○	○
Throwing	○	○	○	○	○	○	○

away dairy products if I was at all unsure whether they were okay to consume (8)							
Creating waste of dairy products that could have been avoided (10)	○	○	○	○	○	○	○

Q28 Thinking again about those people who are important to you; how often do you think they perform the following actions?

	Always (1)	Most times (2)	Sometimes (3)	Occasionally (4)	Infrequently (5)	Almost never (6)	Never (7)
Eat dairy products after the use by date (1)	○	○	○	○	○	○	○
Eat dairy products after the best before date (2)	○	○	○	○	○	○	○
Eat dairy products that	○	○	○	○	○	○	○

have been open longer than recommended on the packaging (3)							
Check expiry date information in shops (4)	○	○	○	○	○	○	○
Regularly check expiry dates on dairy products in their fridge (5)	○	○	○	○	○	○	○
Use their senses to check whether a dairy product is still ok to consume (6)	○	○	○	○	○	○	○
Try to reduce the number of dairy products they throw away (7)	○	○	○	○	○	○	○
Throw away dairy products	○	○	○	○	○	○	○

if they are at all unsure whether they were okay to consume (8)							
Create waste of dairy products that could have been avoided (10)	○	○	○	○	○	○	○

Q29 When it comes to expiry dates and whether or not to throw away dairy products, the following people's knowledge and opinions are important to me:

	Extremely important (1)	Important (2)	Somewhat important (3)	Neither important nor unimportant (4)	Somewhat unimportant (5)	Unimportant (6)	Extremely unimportant (7)
Neighbours (2)	○	○	○	○	○	○	○
Parents (3)	○	○	○	○	○	○	○
Siblings (4)	○	○	○	○	○	○	○
Friends (5)	○	○	○	○	○	○	○
Partner/Spouse	○	○	○	○	○	○	○

(6)							
Children (7)	❍	❍	❍	❍	❍	❍	❍
Other (8)	❍	❍	❍	❍	❍	❍	❍

Q30 Please read the statements in the columns below and indicate which dairy product you would consider to be the most likely and least likely to apply in each case. If you do not perceive there to be a difference between the products then you can just select no difference.

	Risk to health if consumed after expiry date			Feel wasteful when I throw away			Confident in using my senses to determine if edible		
	Most (1)	Least (2)	No Difference (3)	Most (1)	Least (2)	No Difference (3)	Most (1)	Least (2)	No Difference (3)
Milk (1)	❑	❑	❑	❑	❑	❑	❑	❑	❑
Cheese (2)	❑	❑	❑	❑	❑	❑	❑	❑	❑
Yoghurt (3)	❑	❑	❑	❑	❑	❑	❑	❑	❑
Butter (4)	❑	❑	❑	❑	❑	❑	❑	❑	❑

Q31 Please indicate how effective you believe the following actions are for minimising dairy product food waste in your household:

	Highly effective (1)	Effective (2)	Somewhat effective (3)	Neither effective nor ineffective (4)	Somewhat ineffective (5)	Ineffective (6)	Highly ineffective (7)
Paying greater attention to expiry dates in the shops (1)	○	○	○	○	○	○	○
Checking the expiry dates of dairy products in my fridge regularly (2)	○	○	○	○	○	○	○
Making a note of when I opened products (3)	○	○	○	○	○	○	○
Interpreting	○	○	○	○	○	○	○

best before dates correctly (4)							
Eating products after their best before date if they looked and smelled okay (5)	○	○	○	○	○	○	○
Using my own senses rather than the expiry date to decide when to throw away a product (6)	○	○	○	○	○	○	○

Q32 Please indicate to what extent you agree or disagree with the following statements:

	Strongly agree (1)	Agree (2)	Somewhat agree (3)	Neither agree nor disagree (4)	Somewhat disagree (5)	Disagree (6)	Strongly disagree (7)
Reducing the number of dairy products I throw away is an effective way to reduce my household's environmental impact (1)	○	○	○	○	○	○	○
The amount of food I throw away does not have a negative environmental impact as long as I recycle it (2)	○	○	○	○	○	○	○
Reducing my dairy product waste is less effective than	○	○	○	○	○	○	○

recycling it at minimising my household's environmental impact (3)							
I do not feel that I am wasting food if I dispose of dairy products into the food waste recycling (4)	○	○	○	○	○	○	○
It would be too much effort to reduce my food waste, I prefer to focus on recycling (5)	○	○	○	○	○	○	○
I prefer to find other ways to reduce my environmental impact than reducing the amount of dairy products	○	○	○	○	○	○	○

I waste (6)							
I have a moral responsibility to reduce the amount of dairy products I waste (8)	○	○	○	○	○	○	○
There are more convenient ways to reduce my environmental impact than reducing dairy product waste (9)	○	○	○	○	○	○	○

Q33 Which of the following sources of information have most influenced your understanding and use of expiry dates, and which do you believe to be most trustworthy?

	Importance & Influence					Trustworthiness				
	Very influential (1)	Somewhat influential (2)	Neither influential nor uninfluential (3)	Somewhat uninfluential (4)	Not influential at all (5)	Very trustworthy (1)	Somewhat trustworthy (2)	Neither trustworthy nor untrustworthy (3)	Somewhat untrustworthy (4)	Not trustworthy at all (5)
Expiry date label itself (1)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Internet/Social Media (2)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
TV/Radio/Print (3)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Supermarkets (4)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Other food shops (5)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Public information leaflet (6)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Education (school/university/college) (7)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Professional training (e.g. food service) (8)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Government Agencies e.g. Food Standard's	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Agency (FSA) (9)										
Love Food Hate Waste/Waste Resources Action Programme (WRAP) (10)	○	○	○	○	○	○	○	○	○	○
Zero Waste Scotland (ZWS) (11)	○	○	○	○	○	○	○	○	○	○
Family (12)	○	○	○	○	○	○	○	○	○	○
Friends (13)	○	○	○	○	○	○	○	○	○	○
Other (14)	○	○	○	○	○	○	○	○	○	○

Q34 In the last 12 months, have you read, seen or heard anything about the following:

	Definitely yes (1)	Probably yes (2)	Not sure (3)	Probably not (4)	Definitely not (5)
The amount of food that is wasted by households (1)	○	○	○	○	○
Ways to reduce the	○	○	○	○	○

amount of food that is wasted (2)					
Food safety issues around dairy products (3)	○	○	○	○	○
Campaigns by supermarkets to reduce food waste (4)	○	○	○	○	○
Campaigns by food manufacturers to reduce food waste (5)	○	○	○	○	○
Environmental impact of household food waste (6)	○	○	○	○	○
Food banks (7)	○	○	○	○	○

Q35 To what extent do you agree with the following statements?

	Strongly agree (1)	Agree (2)	Somewhat agree (3)	Neither agree nor disagree (4)	Somewhat disagree (5)	Disagree (6)	Strongly disagree (7)
We are approaching the limit of the number of people the Earth can support (1)	○	○	○	○	○	○	○
Humans have the right to modify the natural environment to suit their needs (2)	○	○	○	○	○	○	○
When humans interfere with nature it often produces disastrous consequences (3)	○	○	○	○	○	○	○
Human ingenuity will	○	○	○	○	○	○	○

insure that we do not make the Earth unlivable (4)							
Humans are seriously abusing the environment (5)	○	○	○	○	○	○	○
The Earth has plenty of natural resources if we just learn how to develop them (6)	○	○	○	○	○	○	○
Plants and animals have as much right as humans to exist (7)	○	○	○	○	○	○	○
The balance of nature is strong enough to cope with the impacts of modern industrial nations (8)	○	○	○	○	○	○	○

Despite our special abilities, humans are still subject to the laws of nature (9)	○	○	○	○	○	○	○
The so-called "ecological crisis" facing humankind has been greatly exaggerated (10)	○	○	○	○	○	○	○
The Earth is like a spaceship with very limited room and resources (11)	○	○	○	○	○	○	○
Humans were meant to rule over the rest of nature (12)	○	○	○	○	○	○	○
The balance of nature is very delicate and easily	○	○	○	○	○	○	○

upset (13)							
Humans will eventually learn enough about how nature works to be able to control it (14)	○	○	○	○	○	○	○
If things continue on their present course, we will soon experience a major ecological catastrophe (15)	○	○	○	○	○	○	○

Q38 Education

Please select the option that most closely describes your education

❍ Less than high school (1)
❍ High/secondary school (2)
❍ University degree (3 or 4 years) (4)
❍ Postgraduate degree (6)
❍ Professional qualifications (7)
❍ Prefer not to say (8)

Q40 Are there other people in your household?

❍ Yes (1)
❍ No (2)
If No Is Selected, Then Skip To In which local authority do you live?

Q41 What are the ages of any other members of your household?

Person 1 (1)	❍ 0-5	❍ 6-10	❍ 11-17	❍ 18 -	❍ 25 -	❍ 35 -	❍ 45 -	❍ 55 -	❍ 65 -	❍ 75 or older

	(1)	(2)	(3)	24 (4)	34 (5)	44 (6)	54 (7)	64 (8)	74 (9)	(10)
Person 2 (2)	○ 0-5 (1)	○ 6-10 (2)	○ 11-17 (3)	○ 18 - 24 (4)	○ 25 - 34 (5)	○ 35 - 44 (6)	○ 45 - 54 (7)	○ 55 - 64 (8)	○ 65 - 74 (9)	○ 75 or older (10)
Person 3 (3)	○ 0-5 (1)	○ 6-10 (2)	○ 11-17 (3)	○ 18 - 24 (4)	○ 25 - 34 (5)	○ 35 - 44 (6)	○ 45 - 54 (7)	○ 55 - 64 (8)	○ 65 - 74 (9)	○ 75 or older (10)
Person 4 (4)	○ 0-5 (1)	○ 6-10 (2)	○ 11-17 (3)	○ 18 - 24 (4)	○ 25 - 34 (5)	○ 35 - 44 (6)	○ 45 - 54 (7)	○ 55 - 64 (8)	○ 65 - 74 (9)	○ 75 or older (10)
Person 5 (5)	○ 0-5 (1)	○ 6-10 (2)	○ 11-17 (3)	○ 18 - 24 (4)	○ 25 - 34 (5)	○ 35 - 44 (6)	○ 45 - 54 (7)	○ 55 - 64 (8)	○ 65 - 74 (9)	○ 75 or older (10)
Other (6)	○ 0-5 (1)	○ 6-10 (2)	○ 11-17 (3)	○ 18 - 24 (4)	○ 25 - 34 (5)	○ 35 - 44 (6)	○ 45 - 54 (7)	○ 55 - 64 (8)	○ 65 - 74 (9)	○ 75 or older (10)

Q42 In which local authority do you live?

○ Aberdeen City (4)
○ Aberdeenshire (5)
○ Angus (6)
○ Argyll & Bute (7)
○ Clackmannanshire (8)
○ Dumfries & Galloway (9)
○ Dundee City (10)
○ East Ayrshire (11)
○ East Dunbartonshire (12)
○ East Lothian (13)
○ East Renfrewshire (14)
○ Edinburgh, City of (15)
○ Eilean Siar (16)
○ Falkirk (17)
○ Fife (18)
○ Glasgow City (19)
○ Highland (20)
○ Inverclyde (21)
○ Midlothian (22)
○ Moray (23)
○ North Ayrshire (24)
○ North Lanarkshire (25)
○ Orkney Islands (26)
○ Perth & Kinross (27)
○ Renfrewshire (28)

- ○ Scottish Borders (29)
- ○ Shetland Islands (30)
- ○ South Ayrshire (31)
- ○ South Lanarkshire (32)
- ○ Stirling (33)
- ○ West Dunbartonshire (34)
- ○ West Lothian (35)
- ○ Prefer not to say (1)

Q43 Where do you regularly (at least once a month) purchase your dairy products. Select all that apply.

- ❑ Tesco (1)
- ❑ Sainsbury's (2)
- ❑ Asda (3)
- ❑ Morrisons (4)
- ❑ Cooperative (5)
- ❑ Lidl (6)
- ❑ Aldi (7)
- ❑ Waitrose (8)
- ❑ Independent shops (9)
- ❑ Marks and Spencer's (10)
- ❑ Other (11) _____
- ❑ McColl's (12)
- ❑ Premier (13)

Q44 How much of your food shopping do you do online?

- ○ None (1)
- ○ 25% (2)
- ○ 50% (3)
- ○ 75% (4)
- ○ All (5)

Q45 How much, on average, do you spend per week on food? Please only include all food that you consume at home and do not include takeaways,

alcohol or tobacco.

- ○ Less than £25 (1)
- ○ £25-£50 (2)
- ○ £50-75 (3)
- ○ £75-100 (4)
- ○ £100-£125 (5)
- ○ £125-150 (6)
- ○ More than £150 (7)

Survey Stage 2

Q1.1 Thank you for participating in this follow up survey about dairy products.   You will be asked questions about how you have purchased, stored, used, and disposed of dairy products in your household since you responded to the previous survey around three weeks ago.   This survey is part of PhD research funded by the Scottish Government's Environmental and Social Research Programme. The research project has been reviewed and approved by the Edinburgh University Research Ethics Board.   All responses provided will be treated anonymously and all data collected will be stored securely, safely and in accordance with Data Collection Act (1998).   The results may be used in a range of publications such as academic papers, policy papers and news articles.   By starting this survey, you consent to the data collected from this survey being used in this way.

Q2.1 Please estimate the percentage of your household's total dairy products that got thrown away in the last three weeks

	0% (1)	10% (2)	20% (3)	30% (4)	40% (5)	50% (6)	60% (7)	70% (8)	80% (9)	90% (10)	100% (11)
Milk (1)	○	○	○	○	○	○	○	○	○	○	○
Cheese (2)	○	○	○	○	○	○	○	○	○	○	○
Yoghurt (3)	○	○	○	○	○	○	○	○	○	○	○
Butter (4)	○	○	○	○	○	○	○	○	○	○	○
Other e.g.	○	○	○	○	○	○	○	○	○	○	○

cream (5)										

Q2.2 In the last three weeks how much milk has your household thrown away?   For reference 1 pint is roughly 550ml. Please estimate if you are not sure.

	Nothing (1)	1-100ml (2)	100 - 200ml (3)	200 - 300ml (4)	300 - 400ml (5)	400 - 500ml (6)	500 - 600ml (7)	600 - 700ml (8)	700 - 800ml (9)	800 - 900ml (10)	900 - 1000ml (11)	1000ml + (12)
Milk (1)	○	○	○	○	○	○	○	○	○	○	○	○

Q2.3 In the last three weeks how much cheese has your household thrown away? Please estimate if you are not sure.

	Nothing (1)	1-25g (2)	25 - 50g (3)	50 - 100g (4)	100 - 150g (5)	150 - 200g (6)	200 - 250g (7)	250 - 300g (8)	300 - 350g (9)	350g+ (10)
Cheese (1)	○	○	○	○	○	○	○	○	○	○

Q2.4 In the last three weeks how much yoghurt has your household thrown away?   For reference a single serving pot that you might find in an adult multi-pack typically weighs 150g. Please estimate if you are not sure.

	Nothing (1)	1-25g (2)	25 - 50g (3)	50 - 100g (4)	100 - 150g (5)	150 - 200g (6)	200 - 250g (7)	250 - 300g (8)	300 - 350g (9)	350g+ (10)
Yoghurt (1)	○	○	○	○	○	○	○	○	○	○

Q2.5 In the last three weeks how much butter has your household thrown away? For reference a typical block of butter weighs 250g. Please try to estimate if you are not sure.

	Nothing (1)	1-25g (2)	25-50g (3)	100-150g (4)	150-200g (5)	200-250g (6)	250g+ (7)
Butter (1)	○	○	○	○	○	○	○

Q2.6 In the last three weeks how much of other types of dairy products has your household thrown away?

	None at all (1)	A little (2)	A moderate amount (3)	A lot (4)	A great deal (5)
Other e.g.	○	○	○	○	○

cream, soured cream (1)					

Q2.7 Thinking about the amount of dairy product you threw away in the last three weeks, do you think you threw away more or less than other households like yours?

- ❍ Far below average (1)
- ❍ Moderately below average (2)
- ❍ Slightly below average (3)
- ❍ Average (4)
- ❍ Slightly above average (5)
- ❍ Moderately above average (6)
- ❍ Far above average (7)

Q3.1 When shopping in the last three weeks, how often did you check the expiry dates of the following dairy products before buying them?

	Every time (1)	Most of the time (2)	About half the time (3)	Sometimes (4)	Not at all (5)	Not purchased (7)
Milk (1)	❍	❍	❍	❍	❍	❍
Yoghurt (2)	❍	❍	❍	❍	❍	❍
Cheese (3)	❍	❍	❍	❍	❍	❍

Butter (4)	○	○	○	○	○	○
Other e.g. cream (5)	○	○	○	○	○	○

Q3.2 Checking expiry dates more frequently when shopping would have helped me prevent some dairy products being thrown away...

○ Strongly agree (1)
○ Agree (2)
○ Somewhat agree (3)
○ Neither agree nor disagree (4)
○ Somewhat disagree (5)
○ Disagree (6)
○ Strongly disagree (7)

Q3.3 How well do the following statements explain why you didn't check expiry dates more often when shopping?

	Extremely well (1)	Very well (2)	Moderately well (3)	Slightly well (4)	Not well at all (5)
I had other things on my mind (1)	○	○	○	○	○
I didn't have time to check (2)	○	○	○	○	○
Date labels were not easy to understand (3)	○	○	○	○	○
There is little point as most dates are the same (4)	○	○	○	○	○
I buy similar things each week so don't need to (5)	○	○	○	○	○
Date labels were not easy to find (6)	○	○	○	○	○

Q3.4 What do you think would encourage you to check expiry dates more often when shopping?

Q3.5 Regularly checking expiry dates when shopping has helped me prevent dairy products that I purchased from being thrown away

○ Strongly agree (1)
○ Agree (2)
○ Somewhat agree (3)
○ Neither agree nor disagree (4)
○ Somewhat disagree (5)
○ Disagree (6)
○ Strongly disagree (7)

    Q3.6 What motivated you to check the expiry dates frequently when shopping?

Q4.1 At home in the last three weeks, how frequently did you check the expiry dates of dairy products in your fridge?

	Every day (1)	Several times a week (2)	Once a week (4)	Less than once a week (8)	Never (5)	N/A (7)
Milk (1)	○	○	○	○	○	○
Yoghurt (2)	○	○	○	○	○	○
Cheese (3)	○	○	○	○	○	○
Butter (4)	○	○	○	○	○	○
Other e.g. cream (5)	○	○	○	○	○	○

If N/A Is Equal to 5, Then Skip To End of BlockIf Every day Is Equal to 5, Then Skip To Regulary checking expiry dates of dai...

Q4.2 Checking expiry dates of dairy products in my fridge more frequently would have helped me prevent some dairy products from being thrown

away...

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Q4.3 How well do the following statements explain why you didn't check the expiry dates of dairy products in your fridge more often?

	Extremely well (1)	Very well (2)	Moderately well (3)	Slightly well (4)	Not well at all (5)
I didn't have time to check more often (1)	❍	❍	❍	❍	❍
Checking dates of dairy products in my fridge was not a priority (2)	❍	❍	❍	❍	❍
Date labels	❍	❍	❍	❍	❍

were not easy to understand (3)					
I know how long they last, so I don't really look (4)	○	○	○	○	○

Q4.4 What do you think would encourage you to check the expiry dates of dairy products in your fridge more often?

Q4.5 Regularly checking expiry dates of dairy products in my fridge has helped me prevent some dairy products from being thrown away

- ○ Strongly agree (1)
- ○ Agree (2)
- ○ Somewhat agree (3)
- ○ Neither agree nor disagree (4)
- ○ Somewhat disagree (5)
- ○ Disagree (6)
- ○ Strongly disagree (7)

Q4.6 What motivates you to check the expiry dates of dairy products in your fridge frequently?

Q5.1 At home in the last three weeks, how often did you throw away a dairy product because the use by date had passed?

	Every day (1)	Several times a week (2)	Once a week (3)	Less often (4)	Never (5)	N/A (6)
Milk (1)	○	○	○	○	○	○
Cheese (2)	○	○	○	○	○	○
Yoghurt (3)	○	○	○	○	○	○

If Never Is Equal to 3, Then Skip To At home in the last three weeks, how ...If Every day Is Selected, Then Skip To At home in the last three weeks, how ...

Q5.2 Thinking about your answer in the previous question, how important was the look, smell or taste also in your decision to throw away dairy products once the use by date had passed?

	Extremely important (1)	Very important (2)	Moderately important (3)	Slightly important (4)	Not at all important (5)	N/A (6)
Milk (1)	○	○	○	○	○	○
Yoghurt (2)	○	○	○	○	○	○
Cheese (3)	○	○	○	○	○	○

Q5.3 At home in the last three weeks, how often did you throw away some dairy product because the best before date had passed?

	Every day (1)	Several times a week (2)	Once a week (3)	Less often (4)	Never (5)	N/A (6)
Milk (1)	❍	❍	❍	❍	❍	❍
Cheese (2)	❍	❍	❍	❍	❍	❍
Yoghurt (3)	❍	❍	❍	❍	❍	❍
Butter (4)	❍	❍	❍	❍	❍	❍

If Never Is Equal to 4, Then Skip To At home in the last three weeks, how ...If Every day Is Selected, Then Skip To At home in the last three weeks, how ...

Q5.4 How important was the look, smell or taste also in your decision to throw away dairy products once the best before date had passed?

	Extremely important (1)	Very important (2)	Moderately important (3)	Slightly important (4)	Not at all important (5)	N/A (6)
Milk (1)	❍	❍	❍	❍	❍	❍
Cheese (2)	❍	❍	❍	❍	❍	❍
Yoghurt (3)	❍	❍	❍	❍	❍	❍
Butter (4)	❍	❍	❍	❍	❍	❍

Q5.5 At home in the last three weeks, how often did you throw away some dairy product because it had been open for more than the recommended number of days?

	Every day (1)	Several times a week (2)	Once a week (3)	Less often (4)	Never (5)	N/A (6)
Milk (1)	○	○	○	○	○	○
Cheese (2)	○	○	○	○	○	○
Yoghurt (3)	○	○	○	○	○	○
Butter (4)	○	○	○	○	○	○

If Never Is Equal to 4, Then Skip To How often did you throw away some dai...If Every day Is Selected, Then Skip To How often did you throw away some dai...

Q5.6 How important was the look, smell or taste also in your decision to throw away dairy products once the they had been open more than the recommended number of days?

	Extremely important (1)	Very important (2)	Moderately important (3)	Slightly important (4)	Not at all important (5)	N/A (6)
Milk (1)	○	○	○	○	○	○
Cheese (2)	○	○	○	○	○	○

Yoghurt (3)	○	○	○	○	○	○
Butter (4)	○	○	○	○	○	○

Q5.7 How often did you throw away some dairy product because it looked, smelled or tasted bad, even if it was before the expiry date?

	Every day (1)	Several times a week (2)	Once a week (3)	Less often (4)	Never (5)	N/A (6)
Milk (1)	○	○	○	○	○	○
Cheese (2)	○	○	○	○	○	○
Yoghurt (3)	○	○	○	○	○	○
Butter (4)	○	○	○	○	○	○
Other e.g. cream (5)	○	○	○	○	○	○

Q5.8 How often did you throw away some dairy product because too much was served?

	Every day (1)	Several times a week (2)	Once a week (3)	Less often (4)	Never (5)	N/A (6)	Don't know (7)
Milk (1)	○	○	○	○	○	○	○
Cheese	○	○	○	○	○	○	○

(2)							
Yoghurt (3)	❍	❍	❍	❍	❍	❍	❍
Butter (4)	❍	❍	❍	❍	❍	❍	❍
Other e.g. cream (5)	❍	❍	❍	❍	❍	❍	❍

Q6.1 Throwing away dairy products, such as cheese, yoghurt or butter, when they reach their expiry dates is something...

	Strongly agree (1)	Agree (2)	Somewhat agree (3)	Neither agree nor disagree (4)	Somewhat disagree (5)	Disagree (6)	Strongly disagree (7)
I do frequently (1)	❍	❍	❍	❍	❍	❍	❍
I do automatically (2)	❍	❍	❍	❍	❍	❍	❍
I do without having to consciously remember (3)	❍	❍	❍	❍	❍	❍	❍
That makes	❍	❍	❍	❍	❍	❍	❍

me feel weird if I do not do it (4)							
I do without thinking (5)	○	○	○	○	○	○	○
That would require effort not to do it (6)	○	○	○	○	○	○	○
That belongs to my routine (7)	○	○	○	○	○	○	○
I start doing before I realise I'm doing it (8)	○	○	○	○	○	○	○
I would find hard not to do (9)	○	○	○	○	○	○	○
I have no need to think about doing (10)	○	○	○	○	○	○	○
That's typically me (11)	○	○	○	○	○	○	○
I have been doing for a	○	○	○	○	○	○	○

long time (12)						

Q7.1 If food companies were able to extend the shelf-life of dairy products further, do you believe this would be an effective way to help you waste

less?

- ○ Extremely effective (1)
- ○ Very effective (2)
- ○ Moderately effective (3)
- ○ Slightly effective (4)
- ○ Not effective at all (5)

Q7.2 Other than monitoring expiry dates, which of the following describe the actions you take to minimise the amount of dairy product you throw away?

	Describes me extremely well (1)	Describes me very well (2)	Describes me moderately well (3)	Describes me slightly well (4)	Does not describe me (5)
Check fridge temperature (1)	○	○	○	○	○
Ensure products are stored in	○	○	○	○	○

suitable containers or materials (2)	○	○	○	○	○
Plan meals (3)	○	○	○	○	○
Make a shopping list (4)	○	○	○	○	○
Get creative with meals to use up odds and ends (5)	○	○	○	○	○
Checking quantity of products in fridge before shopping (6)	○	○	○	○	○
Using the freezer (7)	○	○	○	○	○

Q7.3 Are there any other actions that you think contribute to minimising the amount of dairy product you throw away?

Q7.4 Thinking again about the dairy products that you threw away, where the main reason was that the expiry date had passed. Which of the following statements describe the underlying reasons that the dairy products passed their expiry date?

	Strongly agree (1)	Agree (2)	Somewhat agree (3)	Neither agree nor disagree (4)	Somewhat disagree (5)	Disagree (6)	Strongly disagree (7)
I only want to have the freshest food so I threw out what I thought was old (1)	○	○	○	○	○	○	○
I probably bought more than we needed (2)	○	○	○	○	○	○	○
The package size I bought was too large (3)	○	○	○	○	○	○	○
My social plans changed (4)	○	○	○	○	○	○	○
I don't feel it is my responsibility to think about my food waste when so	○	○	○	○	○	○	○

much is wasted by food companies (5)							
Other people influenced the amount I threw away (6)	○	○	○	○	○	○	○
My work plans changed (7)	○	○	○	○	○	○	○
I don't think it matters if some goes to waste (8)	○	○	○	○	○	○	○
I lost track of what we had (9)	○	○	○	○	○	○	○

Q7.5 Are there any other barriers or challenges that you think contribute to the amount of dairy product you throw away?

Q8.1 Please indicate the extent to which the following statements describe you...

	Describes me extremely well (1)	Describes me very well (2)	Describes me moderately well (3)	Describes me slightly well (4)	Does not describe me (5)
Dairy products are an important part of my diet (1)	○	○	○	○	○
I get a lot of pleasure from eating dairy products (2)	○	○	○	○	○
The type of dairy products I buy says a lot about me (3)	○	○	○	○	○
It is important to me to make a good choice of dairy product (4)	○	○	○	○	○
I am likely to make a poor choice of dairy	○	○	○	○	○

product (5)					
I am likely to buy a dairy product with a shorter expiry date than I expected (6)	❍	❍	❍	❍	❍
I tend to buy the same types of dairy products every time I go shopping (7)	❍	❍	❍	❍	❍
I have previously experienced food poisoning due to eating an out of date dairy product (8)	❍	❍	❍	❍	❍
I have previously experienced a dairy product tasting bad after it passed its expiry date (9)	❍	❍	❍	❍	❍

Q9.1 How would you describe your employment status?

- ○ Employed full time (1)
- ○ Employed part time (2)
- ○ Unemployed looking for work (3)
- ○ Unemployed not looking for work (4)
- ○ Retired (5)
- ○ Student (6)
- ○ Disabled (7)

Q9.2 Is there another adult in your household?

- ○ Yes (1)
- ○ No (2)

If No Is Selected, Then Skip To End of Block

Q9.3 How would you describe the employment status of the second adult?

❍ Employed full time (1)
❍ Employed part time (2)
❍ Unemployed looking for work (3)
❍ Unemployed not looking for work (4)
❍ Retired (5)
❍ Student (6)
❍ Disabled (7)

Appendix III. Extension to Chapter 4

Measurement invariance analysis was conducted for TPB model up to intentions. As discussed in the chapter this was not possible in the full model due to sample size limitations. The sample up to intentions uses measures only from survey 1 and therefore includes 548 observations. This appendix describes the results of this analysis conducted form models A1, B1 and C1 on the basis of gender, income and age.

Measurement invariance analysis Model A1

In order conduct the measurement invariance analysis for Model A1 the items for attitudes (Q19_2 and Q19_3) and PBC (Q15_6 and Q15_11) were recoded to five point scales from 7 due to the number of 0 frequencies present in sample groups that was formed.

Between the male and female samples there appears to be some deterioration in the fit between the configural model and the model in which the item loadings are constrained. This is indicated by both a significant difference between the chi-square statistic and an increase in the CFI and RMSEA values. This suggests that item loadings are not invariant across the male and female groups. Given that this model only runs to intentions, analysis to identify which loadings could be freed to proceed with constrained threshold and structural models. Suffice to say that gender should be a factor explored in future research.

There is not sufficient evidence to dismiss the hypothesis of invariance across the age and income groups (Table III-I). While the chi-square indicates a difference between the thresholds and structural model for age and between the configural and loadings model for income, this is not supported by deterioration in either the CFI or RMSEA (Kline 2016).

Table III-I Measurement Invariance TPB Model A1

Model and constraints	CFI	RMSEA	Df	Chisq	Chisq diff	Df diff	Pr(>Chisq)
Gender							
Full	0.99	0.07	112	400.21	-	-	-
Configural	1.00	0.06	224	476.13	75.92	112	1.00
Loadings	0.99	0.07	237	515.72	39.59	13	0.00
Thresholds	1.00	0.05	310	545.92	30.20	73	1.00
Regressions	0.99	0.05	313	580.10	34.18	3	0.00
Income							
Full	0.99	0.07	112	400.21	-	-	-
Configural	0.99	0.07	224	531.58	131.37	112	0.10
Loadings	0.99	0.07	237	552.98	21.40	13	0.07
Thresholds	0.99	0.06	310	587.02	34.03	73	1.00
Regressions	0.99	0.06	313	619.86	32.85	3	0.00
Age							
Full	0.99	0.07	112	400.21	-	-	-
Configural	0.99	0.07	224	501.06	100.85	112	0.77
Loadings	0.99	0.07	237	546.96	45.90	13	0.00
Thresholds	0.99	0.06	310	568.24	21.28	73	1.00
Regressions	0.99	0.06	313	619.88	51.64	3	0.00

Measurement invariance analysis Model B1

In order conduct the measurement invariance analysis for Model B1 the items for attitudes (Q17_1, Q17_2, Q17_5) and PBC (Q16_6) were recoded to five point scales from 7 due to a high number of 0 frequencies present in one of the groups that was formed. While the need to condense response categories indicates some potential differences in the way responses were given across groups, it is not clear whether this is systematic or due to chance. When the models were compared across groups there was no evidence that they differed significant across the gender, income groups. However, there was some evidence that when item loadings are constrained the age models were non invariant (Table III-II).

Table III-II Measurement Invariance TPB Model B1

Model and constraints	CFI	RMSEA	Df	Chisq	Chisq diff	Df diff	Pr(>Chisq)
Gender							
Full	0.99	0.06	51	157.39	-	-	-
Configural	1.00	0.06	102	186.31	28.92	51	0.99
Loadings	1.00	0.06	111	203.56	17.25	9	0.04
Thresholds	1.00	0.03	155	206.32	2.76	44	1.00
Regressions	1.00	0.03	157	208.70	2.39	2	0.30
Income							
Full	0.99	0.06	51	157.39	-	-	-
Configural	1.00	0.06	102	191.84	34.46	51	0.96
Loadings	1.00	0.06	111	223.32	31.48	9	0.00
Thresholds	1.00	0.04	155	225.17	1.85	44	1.00
Regressions	1.00	0.04	157	228.86	3.69	2	0.16
Age							
Full	0.99	0.06	51	157.39	-	-	-
Configural	0.99	0.06	102	211.93	54.54	51	0.34
Loadings	0.99	0.07	111	242.41	30.48	9	0.00
Thresholds	1.00	0.05	155	250.88	8.47	44	1.00
Regressions	1.00	0.05	157	251.68	0.80	2	0.67

Measurement invariance analysis Model C1

In order conduct the measurement invariance analysis for Model C1 the items for attitudes (Q18_2) and PBC (Q15_4) were recoded to five point scales from 7 due to a high number of 0 frequencies present in one of the groups that was formed. While the need to condense response categories indicates some potential differences in the way responses were given across groups, it is not clear whether this is systematic or due to chance. When the models were compared across groups there was no evidence that they differed significant across the gender, income or age groups (Table III-III).

Table III-III Measurement Invariance TPB Model C1

Model and constraints	CFI	RMSEA	Df	Chisq	Chisq diff	Df diff	Pr(>Chisq)
Gender							
Full	1.00	0.06	24	67.53	-	-	-
Configural	1.00	0.05	48	85.75	18.22	24	0.79
Loadings	1.00	0.05	54	96.45	10.70	6	0.10
Thresholds	1.00	0.04	85	114.40	17.96	31	0.97
Regressions	1.00	0.03	87	115.34	0.94	2	0.62
Income							
Full	1.00	0.06	24	67.53	-	-	-
Configural	1.00	0.05	48	76.10	8.57	24	1.00
Loadings	1.00	0.04	54	79.24	3.14	6	0.79
Thresholds	1.00	0.03	85	103.94	24.70	31	0.78
Regressions	1.00	0.03	87	105.36	1.42	2	0.49
Age							
Full	1.00	0.06	24	67.53	-	-	-
Configural	1.00	0.05	48	77.69	10.16	24	0.99
Loadings	1.00	0.05	54	90.52	12.83	6	0.05
Thresholds	1.00	0.04	85	113.70	23.17	31	0.84
Regressions	1.00	0.03	87	115.15	1.46	2	0.48

Appendix IV.   Extension to Chapter 5

Table IV-I Measures of food waste attitudes

Author	Variable Name	Variable measures
Stefan et al. (2013)	Moral attitudes	Throwing away food does not bother me When I throw away food I feel guilty
Stefan et al. (2013)	Lack of concern	I do not really worry about the environmental impact of the food that I throw away I do not really worry about the impact of my food waste on the distribution of resources in the world I do not really worry about the amount of food that I throw away I do not really worry about the cost of the food that I throw away
Stancu et al. (2015)	Attitudes towards food waste	Food waste is: Not at all negative-extremely negative / Foolish-not foolish Loading the environment with household food waste is: Not at all negative-extremely negative / Harmful-not harmful
Stancu et al. (2015)	Moral Norms	Wasting food would: Make me feel guilty about people who do not have enough food /

		Make me feel guilty about the environment / Give me a bad conscience
Graham-Rowe et al. (2015)	Attitudes to reducing food waste	For me to reduce the amount of fruit and vegetables that gets thrown away from my household over the next seven days would be: extremely pointless - extremely worthwhile / extremely unenjoyable - extremely enjoyable / extremely foolish - extremely wise / extremely bad / extremely good / extremely unpleasant - extremely pleasant / extremely harmful - extremely beneficial
Russell et al. (2017)	Attitudes to food waste	I think engaging in food waste behaviours is: bad – good / harmful - beneficial / unpleasant – pleasant / unsatisfying – satisfying
Visschers et al. (2015)	Personal attitudes	It is unnecessary to waste food: it can always be used in some way. It is immoral to discard foods while other people in the world are starving It upsets me when unused products end up in the waste bin
Visschers et al. (2015)	Financial attitudes	I think that wasting food is a waste of money I cannot afford to pay for foods that are then discarded Saving money does not motivate me to discard less food I rarely think about money when I throw away food

Appendix V.   Extension to Chapter 7

A multi-sample invariance analysis split the sample into two groups according to their level of best-before date knowledge as outlined in section 3.1.5. The sample was then split into those who got two questions correct (n = 281) and those who got either zero or one questions correct (n = 267).

The regression coefficients for the configural model are outlined in Table V-I. The regression coefficients indicate that there was little difference in the relationships between risk, trust and WTC between the higher knowledge and lower knowledge groups.

Table V-I Regression coefficients configural model

	Unstandardised			Standardised		
Direct effects	Estimate	SE	p value	Estimate	SE	p value
Knowledge Low (n = 267)						
WTC ~ Risk	- 0.76	0.08	0.00	- 0.52	0.05	0.00
WTC ~ Label Trust	0.03	0.12	0.78	0.02	0.09	0.78
WTC ~ Calculative Trust	0.27	0.08	0.00	0.23	0.07	0.00
Label Trust ~ Risk	0.44	0.04	0.00	0.42	0.03	0.00
Label Trust ~ Calculative Trust	- 0.35	0.04	0.00	- 0.40	0.04	0.00
Knowledge High (n =281)						
WTC ~ Risk	- 0.74	0.10	0.00	- 0.47	0.06	0.00
WTC ~ Label Trust	0.05	0.15	0.76	0.04	0.12	0.76
WTC ~ Calculative Trust	0.27	0.13	0.05	0.21	0.11	0.04
Label Trust ~ Risk	0.52	0.04	0.00	0.40	0.03	0.00
Label Trust ~ Calculative Trust	- 0.61	0.05	0.00	- 0.59	0.04	0.00

The results presented in Table V-II also indicate that once the loadings and thresholds have been constrained, there are significant differences between the structural models. This is indicated by an increase in the RMSEA and a significant difference between the Chi-square values in the strong invariance and structural models.

Table V-II Measurement Invariance

Measurement invariance models	CFI	RMSEA	DF	Chisq	Chisq diff	DF diff	Pr(>Chisq)
Configural	0.99	0.04	196	282.84	NA	NA	NA
Weak invariance (loadings)	0.99	0.04	208	306.89	24.05	12	0.02
Strong invariance (thresholds)	0.99	0.03	261	342.45	35.55	53	0.97
Structural invariance (regressions)	0.99	0.04	266	362.67	20.22	5	0.00