The Development and Evaluation of an Intervention to Encourage Improved Engagement with UK Nutrition Labels

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Abstract

Nutrition labels are a policy tool that aim to encourage healthier dietary habits through changes in nutrient intake. However, consumer nutrition label engagement is inconsistent, which can lead to erroneous dietary choices. This thesis presents a series of chapters which inform the development, implementation and evaluation of a nutrition label engagement intervention for healthy UK adults.

The first empirical study investigated nutrition label engagement during a novel food choice task in 80 UK adults. It employed eye-tracking, think-aloud and individual differences measures in a single laboratory experiment. The findings supported the effectiveness of the food choice task in directing visual attention towards nutrition labels. Study 1 showed significantly reduced nutrition label engagement for purchase-based decisions and for when the nutrition labels required greater levels of interpretation. Furthermore, performance measures were lower for health-related compared to nutrient-specific choices, suggesting that interventions were needed to improve consumer capability and motivations. The differences in accuracy were not predicted by known individual differences to nutrition label engagement.

The second empirical study used a mixed methods approach to explore nutrition label engagement using a refined food choice task and open-ended question survey in 111 UK adults. The quantitative findings from Study 1 were mostly replicated in a diverse, online consumer population. This demonstrated the robustness of the food choice task as an instrument to measure the effectiveness of a nutrition label engagement intervention.

Furthermore, Study 2 analysed consumer nutrition label experiences using inductive and deductive reflexive thematic analysis. The findings highlighted that accessible labels informed food choices but the complexities in nutrition information can lead to mistrust, lack of credibility and disengagement. The participants were also asked to rate BCTs and intervention approaches extracted from a systematic review to provide insights from the target audience regarding their acceptability to further inform the intervention design.

The third empirical study implemented and evaluated a novel nutrition label intervention with 140 participants, to assess its effectiveness and acceptability. There were mixed findings in relation to the intervention but some promising insights for future development were highlighted. Participants held favourable views on the intervention received which were explored using a mixed-methods approach.

The research conducted was based on strong theoretical foundations, robust measures and consumer insights into nutrition label engagement. The findings demonstrated the complexities and challenges of developing interventions at a population-level for nutrition label engagement but provided comprehensive insights to help inform future interventions.

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Authors Declaration

This thesis is the result of my own work and has not previously been submitted for any other degree at University of Staffordshire or another institution.

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List of Acronyms

AN(c)OVA(s)	Analysis of (co)Variance(s)
BCT(s)	Behaviour Change Technique(s)
BCTT	Behaviour Change Techniques Taxonomy
BCW	Behaviour Change Wheel
BMI	Body Mass Index
COM-B	Capability, Opportunity, Motivation, Behaviour
EU	European Union
NHS	National Health Service
rmANOVAs(s)	Repeated-measures Analysis of Variance(s)
SES	Socioeconomic Status
UK	United Kingdom
USA	United States of America

Chapter 1: Literature Review and Thesis Overview

This chapter reviews relevant literature to provide context for the work presented in this thesis. The chapter starts by exploring factors which led to the introduction of nutrition labels and their role in improving population health. Next, an overview of UK nutrition labels is outlined and how nutrition label engagement is positioned in this thesis is justified. This is followed by a review of consumer nutrition label engagement, including the influence of known individual differences, and a summary of public health campaigns aimed at improving nutrition label engagement. The chapter concludes with an overview of the thesis, including the scope of the thesis, thesis aim and thesis objectives.

1.1 Factors Leading to the Introduction of Nutrition Labels

1.1.1 Changes in Consumer Food Purchasing Environment

In the UK, until the mid-nineteenth century, the most common food purchasing environments were market stalls and local shops (Turner, 1995). In these purchasing environments, foods typically comprised basic ingredients (Kessler, 1989) and the seller's knowledge of the nutritional composition of the products satisfied the consumer need for nutrition information (Turner, 1995). Whilst there were rudimentary food labelling regulations from the 1800s, which made it illegal to sell foods not suitable for human consumption, it was not until the late nineteenth century that comprehensive food label regulations were issued (Turner, 1995). These regulations were issued based on changes in the food purchasing environments, where there was a consumer pivot to purchasing food products from supermarkets (Inman et al., 2009).

Supermarkets sell food products in stores, and more recently online, to consumers on a larger and more expansive scale than local shops and market stalls (O'Mahony et al., 2025). Supermarkets are now the primary environment for consumers to make food choices (Inman et al., 2009; Turner, 1995). Consumer demand for supermarkets to stock a variety of food products from various manufacturers has driven advancements in trade and agricultural sciences, particularly in relation to extending product shelf-life (Patterson, 2019). To extend product shelf-life, 'prepacked' food products were introduced; prepacked foods have been placed partially, or fully, in packaging to protect them from the external environment before it is sold (Food Standards Agency, 2024) and typically contain added preservatives to slow food decay (Sapio et al., 2025). These changes in consumer demand have resulted in increased availability of prepacked, ultra-processed food products (which typically contain five or more ingredients) in the supermarket environment (Moodie et al., 2013; O'Mahony et al., 2025; Sapio et al., 2025).

The popularity of supermarket shopping, the vast quantity of products they stock, and the increases in the nutritional complexities of prepacked food products contributed to the untenable ability for supermarkets to relay nutritional information to consumers (Inman et al., 2009; Patterson, 2019). In the 1980s, consumer desire for nutritional information led to the implementation of voluntary, often ambiguous and mostly uncorroborated nutritional statements by food manufacturers on their prepacked food products (Taylor & Wilkening, 2008; Turner, 1995). These nutritional statements and health claims, such as "extremely low in saturated fat", were presented to inform consumers of nutritional content and to market the prepacked product (Chandon & Wansink, 2012; Cohen & Lesser, 2016). Therefore, to ensure the appropriateness and accuracy of the nutritional information displayed on prepacked food products, standardised nutrition label legislation was introduced in the 1990s (Section 1.2).

1.1.2 Changes in Consumer Food Preparation and Meal Taking

In addition to the changes in the food purchasing environment, in the last century, there was also a shift in the domestic pattern of food preparation and meal taking (Reardon & Timmer, 2008). Up to the late 1960s, meals were typically prepared from basic ingredients in the home (Kessler, 1989). This domestic pattern, along with food purchases from market stalls and local shops, facilitated the sharing of information relating to food consumption, meal preparation and ingredients from one generation to the next (Turner, 1995). In recent decades consumers shifted away from cooking homemade meals towards selecting convenient, prepacked food products, partly due to increased availability in supermarkets (Ahlgren et al., 2004). Many factors influenced this shift, including the post-war shift for women to continue in the workforce outside of the home (Reardon & Timmer, 2008). This further encouraged convenient weekly or monthly shopping of extended life food products, and the purchasing of prepacked food products to save home preparation time (Patterson, 2019; Sapio et al., 2025).

The importance of inherited food-based knowledge was superseded by knowledge for how to interpret cooking instructions, ingredient lists, and packaging information displayed on prepacked food (Turner, 1995). Advances in kitchen refrigeration and cooking equipment such as domestic microwaves in the 1970s, facilitated the rise in the consumption of prepacked products, especially for consumers facing time pressures to prepare meals (Ahlgren et al., 2004). These changes in shopping and domestic environments increased the popularity of prepacked, typically ultra-processed food products called ‘ready meals’ (Ahlgren et al., 2004). Ready meals are food products, typically containing many ingredients, that are prepacked into a portioned meal for an individual to consume, usually after reheating (Ni Mhurchu et al., 2011; Vanderlee et al., 2012). Ready meals are also highly processed in response to consumer desires for convenient, tasty and low-priced products and are typically higher in calories and fats than non-packed products (Chandon & Wansink, 2012; Shim, 2025). Consequently, the consumption of prepacked food products has resulted in reduced quality and nutritional composition in population diets (Nguyen & El-Serag, 2010). These domestic changes, in addition to the changes in the food purchasing environment, intensified the need for consumers to be able to access nutritional information for prepacked food products.

1.1.3 The Impact of Food Choice on Population Health

The changes in the food purchasing environment and increased consumption of prepacked foods, are key contributors to worsening population health outcomes (Glanz et al., 2005; O’Mahony et al., 2025). In the UK, USA and Canada, ultra-processed foods account for over half of the estimated population calories consumed (Sapio et al., 2025). These changes in population diet are reflected in the worldwide prevalence rate for adult excessive body weight (Juul et al., 2025; World Health Organization, [WHO], 2025). Excessive body weight is when a person is at risk due to excessive or abnormal accumulation of body fat (WHO, 2025). The rate of worldwide excessive body weight has nearly tripled since 1975 (WHO, 2025), which is when the changes in the food environment began, and the worldwide prevalence rate for adult obesity has more than doubled since 1990 (WHO, 2025).

The latest statistics published by WHO (2025) in 2022 categorised 2.5 billion (43%) of adults (individuals aged over 18 years) as having excessive body weight. In the UK, the focus for this research, obesity levels have increased from 15% in 1993 to 29% in 2022 (Stiebahl, 2025), with an average of 63% of adults (range of 59% to 65% across the four UK nations) categorised as having excessive body weight (NHS Digital, 2021; Public Health England, 2017). In UK adults, self-reported excessive body weight is higher than the average rates across 38 countries (The Organisation for Economic Cooperation and Development, 2025) and is one of the highest rates across 20 European countries (Marques et al., 2018). This demonstrates how excessive body weight has become increasingly normalised within the UK adult population (Robinson, 2017).

It is estimated that excessive body weight, not including associated non-communicable diseases, is responsible for over 30,000 annual deaths in England and an NHS cost of £6.1 billion in 2014-25, projected to rise to £9.7 billion in 2050 (Public Health England, 2017). Furthermore, in England, three of the top five risk factors for premature death (poor diet, obesity and high blood pressure) are closely associated with excessive body weight and dietary patterns (Institute for Health Metrics and Evaluation [IHME], 2019; Steel et al., 2018). Therefore, the excessive body weight prevalence rate in the UK is concerning; as excessive body weight poses a considerable risk to health, is a major cause of preventable deaths and has significant economic public health costs (Lobstein, 2015; Ng et al., 2014). The economic burden of excessive body weight on public health costs is significant and can be accrued from primary, indirect and secondary sources (Kent et al., 2019; Lobstein, 2015; Luo et al., 2007). Primary costs include related surgeries, pharmaceutical treatments and primary care weight management programmes (Kent et al., 2019; McCombie et al., 2014). Indirect costs accrue from related ill health, such as lost productivity and disability support (Lightwood et al., 2019). In the UK, indirect costs due to excessive body weight are estimated to rise to £49.9 billion by 2050 (Public Health England, 2017).

Secondary costs are chiefly attributable to treating associated chronic non-communicable diseases, which form the highest economic burden of excessive body weight (Lobstein, 2015; Egnell et al., 2019; Luo et al., 2007). Excessive body weight has been suggested to increase the risk of developing gastrointestinal and colorectal cancers (Paragomi et al., 2024; Ulrich et al., 2018), adenocarcinoma cancer (Arnold et al., 2016) and cardiovascular diseases (Borrell & Samuel, 2014). Positive associations have been reported between BMI and bone, joint and muscle problems (Adouni et al., 2024; King et al., 2013) and BMI and back pain (Koyanagi et al., 2015). Furthermore, having excessive body weight can result in a five times higher risk factor for type II diabetes (Sattar & Gill, 2014). Research by Afshin et al. (2019) suggested dietary improvement could prevent a quarter of European deaths from non-communicable diseases. Thus, public health initiatives such as nutrition labels are vital to encourage dietary improvement and reduce excessive body weight prevalence.

Further to the public health costs of excessive body weight, individuals may experience physical costs, such as replacing clothes, increased food costs and being overlooked for workplace promotions (Lobstein, 2015; Nield et al., 2025). There are also risks of experiencing psychological costs such as anxiety due to anticipating, fearing, or experiencing weight-based stigmatisation (Major et al., 2014; Manivel et al., 2025; Nield et al., 2025). Weight-based stigmatisation has been derived from media-based portrayals and public discourse of individuals with excessive body weight being 'lazy' and 'a drain on national resources' (Puhl & Heuer, 2009; Wanniarachichi et al., 2020). The unfavourable attitudes extend to public perceptions of weight loss medications (Al-Mahzoum et al., 2025; Auerbach et al., 2025). These stigmatisations can reduce quality of life and can result in diminished self-esteem, due to reduced self-perception, and negative judgements received by others, including healthcare professionals (Bonsaksen et al., 2015; Lin et al., 2024; Puhl, 2023). Nutrition labels have been reported not to perpetuate weight stigma (Musicus & Moran, 2025).

Although excessive body weight and diet-related non-communicable diseases are closely related to food choice, there is evidence to suggest that genetic factors impact an individuals' susceptibility (Maes et al., 1997). Excessive body weight is a result of an energy imbalance, whereby energy expenditure is consistently lower than energy intake from foods consumed (Gortmaker et al., 2011). Nutrition label engagement can inform consumers on the nutrient consumption of prepacked foods to aid energy (from key nutrients) intake. There are three sources of energy expenditure: (a) basal metabolic rate, the amount of energy required during a state of rest to maintain normal cellular metabolism; (b) digestion and breaking down of food; and (c) any physical activity (Omer, 2020). Due to persistent worldwide rises in excessive body weight and factors which contribute to chronic energy imbalances, there is strong evidence for the prevalence to be explained by a complex interaction between genetic, behavioural and environmental factors (Herrera & Lindgren, 2010; Rukh et al., 2013). These factors are guided by an individual’s genetic predisposition, the processes controlled by the central nervous system and voluntary lifestyle control (Omer, 2020).

As genetics are relatively stable, it is likely that persistent rises in the prevalence rates of excessive body weight are driven by changes in lifestyle factors (Herrera & Lindgren, 2010; Omer, 2020). This thesis is focused on the result of lifestyle changes related to the increased consumption of prepacked food products, which are often high in key nutrients, and contribute to an increased risk of excessive body weight, chronic diseases and mental health conditions (Dai et al., 2024; Donini et al., 2023). Consequently, nutrition labels are an important initiative to help consumers to make healthier, informed dietary choices. Beyond the scope of this thesis are lifestyle factors related to decreased energy expenditure, such as longer sedentary working hours (Kim et al., 2016; Ostry et al., 2006) and activities which encourage extended time spent sitting (Patterson et al., 2018).

1.1.4 The Role of Nutrition Labels in Improving Population Dietary Health

Dietary intake, especially the lack of consumer nutritional awareness and the increased consumption of prepacked food products, is a major modifiable lifestyle contributor to excessive body weight and diet-related non-communicable diseases (Azman & Sahak, 2014; Donini et al., 2023; Scarborough et al., 2011; Swinburn et al., 2011). A review conducted by Afshin et al. (2019) suggested that dietary intake improvement could prevent a quarter of European deaths from non-communicable diseases. Therefore, improving the diet of the population is one of the largest health-related actions needed to improve national health and it can increase quality-adjusted life years (Afshin et al., 2019; Department of Health and Social Care, 2019).

The World Health Organization Global Non-Communicable Disease Action Plan for 2013-2030 (WHO, 2013) outlined voluntary global targets aimed at reducing the impact of non-communicable diseases related to excessive body weight. The action plan targeted a 25% relative reduction in the prevalence of high blood pressure and a halt in the rise of obesity and type II diabetes (WHO, 2013). There are population-level initiatives informed by the WHO policy, including sugar tax (Hoffer et al., 2015; Nocella & Srinivasan, 2019; The National Food Strategy, 2021), the NHS “5-a-day” fruit and vegetable consumption campaign (NHS, 2018) and nutrition labels.

Nutrition labels are a policy tool that aim to encourage healthier dietary habits through changes in nutrient intake, particularly from fats and sugars (Donini et al., 2023; Nocella & Srinivasan, 2019). Energy consumed by food or drink is calculated from the nutrient composition of the product and the overall value is measured in calories. It is recommended that women should consume approximately 2,000 calories and men 2,500 calories per day and all adults should consume a balanced, healthy diet to support good health (Bojang & Manchana, 2023; NHS, 2022b). However, most adults continuously consume a greater dietary intake than required, which can lead to excessive body weight and diet-related non-communicable diseases (Barrera & Shively, 2022; NHS, 2023a). Nutrition labels play a vital role in influencing food choice and diet quality, by informing consumers about the nutritional composition of prepacked food products.

Consumer engagement with nutrition labels has been reported to increase the likelihood of purchasing healthier products (Mhurchu et al., 2018). This suggests that nutrition labels can lead to behaviour changes in consumers, as they can guide individuals to choose healthier prepacked food products (Garcia, 2024). This engagement with nutrition labels can improve overall diet quality and reduce the risk of diet-related health issues, as nutrition labels promote awareness of the nutritional composition of prepacked food products and encourage the reduced consumption of less healthy food choices (Budreviciute et al., 2020; Garcia, 2024). Improving dietary quality can support consumers to maintain a healthier weight and can lead to weight loss (Egnell et al., 2019; Hauser et al., 2024; IHME, 2019). Consequently, increasing consumer engagement with nutrition labels is important to optimise the effectiveness of nutrition labels as a public health initiative to improve population dietary health.

1.2 The Historical Context of Nutrition Labelling in the UK

The requirement for appropriate nutrition labelling on prepacked food products 'On Nutrition Labelling for Foodstuffs' Directive 90/496 was issued by the Council of the European Communities and European Parliament in 1990. The directive acted as a public nutrition education intervention, following growing scientific knowledge of the relationship between diet and health (Turner, 1995). It was a significant step in nutrition labelling history as it attempted to standardise nutrition labelling guidelines for manufacturers who displayed nutrition information on the packaging of their food products. The directive stated nutritional information provided should be easily understood and simple to appeal to the average consumer. Furthermore, it outlined that nutritional information should use legible characters in one conspicuous place in tabular form on the packaging (Somerick & Weir, 1998). These principles formed the basis for present-day nutrition labels.

The directive reduced variability of voluntary nutrition information manufacturers presented until the early 1990s (Taylor & Wilkening, 2008; Turner, 1995). Food manufacturers in Europe were permitted to trade food products that complied with Directive 90/496 by 1 April 1992 and were prohibited to trade food products which did not comply from 1 October 1993. Despite consistency in the way the nutrition information was presented, it was not mandatory across all eligible prepacked food products. Article 2 of Directive 90/496 stated that nutrition labelling was optional for food products and only compulsory where the manufacturer had made a nutrition claim on their product labelling, presentation, or advertising, beyond that of generic advertising. Although minor updates to Directive 90/496 were made in

Directive 2003/120 and Directive 2008/100, they did not address the mandatory requirement for nutrition labels on eligible prepacked foods products

In October 2011, Regulation 1169/2011 ‘On the Provision of Food Information to Consumers’ was published by the European Parliament and Council of the European Union. Regulation 1169/2011 repealed Directive 90/496, updating provisions outlined within the earlier directive and then had a single regulation to provide certainty to stakeholders and consumers. Regulation 1169/2011 was introduced from 13 December 2014, and the implementation of the mandatory nutrition declaration was required by all food manufacturers by 13 December 2016. Regulation 1169/2011 continues to be the legislation implemented in the UK.

1.3 Current UK Nutrition Labels

Regulation 1169/2011 stipulates mandatory provision of nutrition declarations on prepacked food products, to assist public health nutrition education and support informed consumer food choices. It requires mandatory nutrition declarations to reflect key nutrients to public health, such as fat, saturated fat, sugar and salt (Gibson-Moore & Spiro, 2021). Nutrition values presented on prepacked food products are informed by average values for the food based on: (a) the analysis of the food product by the manufacturer; (b) calculations on the average values of the actual or known ingredients; (c) calculations from accepted and established data.

In the UK, two types of nutrition labels are typically presented on prepacked food products, which comply with Regulation 1169/2011: (1)

mandatory nutrition declarations, which present nutritional information in tabular form on the back or side of product packaging (hereby described as ‘back-of-pack’ nutrition labels). (2) voluntary ‘front-of-pack’ nutrition labels, which repeat key nutrients informed by their importance to public health (Gibson-Moore & Spiro, 2021). If presented, front-of-pack nutrition labels must be displayed in addition to back-of-pack nutrition labels (Department of Health, 2016). Regulation 1169/2011 remains active since the UK left the EU (Department of Health and Social Care, 2021).

UK manufacturers of prepacked food products are required to state, in tabular numerical form: (a) energy value, reported in kilojoules (kJ) and kilocalories (kcal); or (b) energy value and the amount of carbohydrates, fat, protein, salt, saturates and sugars reported in grams (for definitions see Table 1.1). If present in significant amounts this mandatory back-of-pack nutrition label can be supplemented with values for fibre, monounsaturates, polyunsaturates, starch, vitamins and minerals. The directive requires nutritional information to be stated per 100g (or 100 millilitres (ml)) and per serving where appropriate, to preserve the ability for consumers to compare nutritional content of products in different package sizes (Gracia et al., 2009; NHS, 2022a; 2023a). Regulation 1169/2011 states the daily reference intake for an average adult female to consumer to maintain a healthy diet, with no special dietary requirements, be displayed near to this back-of-pack nutrition label. The reference intake for key nutrients of fat, saturates, salt and sugar refer to maximum values. The back-of-pack nutrition label is non-directive as it states nutrient values for a food product without interpretation (Donini et al., 2023).

Currently there is no international agreement for front-of-pack nutrition labels but there are limited general recommendations (Institute of Medicine, 2012). The recommendations are for front-of-pack nutrition labels to: (a) duplicate only five key nutrients, informed by public health initiatives; and (b) ensure that the format is simple and easy for consumers to interpret. The easily viewable and simple front-of-pack nutrition label should allow consumers to engage in quick decision making about the relative healthfulness or nutritional content of the food product (Feunekes et al., 2008; Promeranz, 2011). This has led to the implementation of a variety of front-of-pack nutrition labels across the world including nutriscore, health logos, star-based systems and traffic light symbols (Devaux et al., 2024).

Table 1.1

Definitions and Reference Daily Intake from the Nutrient Declaration

Nutrient	Definition	Reference intake
Energy / calories	Energy / calories are calculated from nutrient composition of the food product e.g., fats are converted based on 37kJ/g or 9kcal/g	8400kJ or 2000kcal
Carbohydrates	Any carbohydrate which humans can metabolise, includes polyols	260g
Sugars	All disaccharides and monosaccharides, excludes polyols	90g
Fat	Total amount of lipids, includes phospholipids	70g
Saturates	Fatty acids without a double bond	20g
Protein	Calculated by multiplying the total Kjeldahl nitrogen by 6.25	50g
Salt	Calculated by multiplying the sodium nutrient average value by 2.5	6g

Since 2013, UK manufacturers have been encouraged to present voluntary front-of-pack nutrition labels (Department of Health and Social Care, 2017). This was in response to continued rises in excessive body weight and non-communicable diseases (Donini et al., 2023). Key policy objectives for the introduction of front-of-pack nutrition labels in the UK were two-fold: (a) have a simpler format to encourage healthier choices for the key nutrients of public health concern; and (b) encourage product reformulation to improve the healthfulness of products (Kanter et al., 2018). The voluntary front-of-pack nutrition label must either present the energy value (kJ and kcal) alone or present the energy value (kJ and kcal) plus the presentation of the following four key nutrients, displayed in grams, fat, salt, saturates and sugar, which are deemed of key importance to public health. The nutrition values presented in front-of-pack nutrition labels should be presented per 100g (or per 100ml) and/or per portion, and this should be quantified near the nutrition label (Department of Health, 2017). The front-of-pack nutrition label is displayed in the principal field of vision to help consumers to make easy and quick decisions on what to purchase based on the nutritional content (Bix et al., 2015; Department of Health and Social Care, 2017).

In addition to calories, the semi-directive front-of-pack nutrition labels have background evaluative traffic light colours to aid consumer interpretation of the remaining four key nutrients per 100g or per serving (Department of Health, 2016). Figure 1.1 outlines the guidelines for the colour coding per 100g, when a food product is greater than 100g per serving is used. A green background indicates low nutrient content, amber indicates moderate content and red indicates high content (Grunert et al., 2010). Figure 1.2 shows an example multiple traffic light front-of-pack nutrition label taken from the Department of Health (2016) front-of-pack labelling guidance.

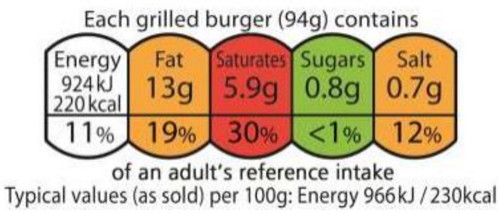
Figure 1.1

Criteria for Green, Amber and Red Colour Coding for the Four Key Nutrients per 100g of Food

Text	LOW[8]	MEDIUM	HIGH	
Colour code	Green	Amber	Red	
			>25% of RIs	>30% of RIs
Fat	≤ 3.0g/100g	> 3.0g to ≤ 17.5g/100g	> 17.5g/100g	> 21g/portion
Saturates	≤ 1.5g/100g	> 1.5g to ≤ 5.0g/100g	> 5.0g/100g	> 6.0g/portion
(Total) Sugars	≤ 5.0g/100g	> 5.0g to ≤ 22.5g /100g	> 22.5g/100g	> 27g/portion
Salt	≤ 0.3g/100g	> 0.3g to ≤ 1.5g/100g	>1.5g/100g	>1.8g/portion

Figure 1.2

A Multiple Traffic Light Front-of-Pack Nutrition Label



Nutrition labels are a prominent policy tool for promoting healthier dietary choices by informing consumers of the nutritional composition of prepacked food products (Baltas, 2001; Kanter et al., 2018). They present at point-of-purchase and during food preparation (Cowburn & Stockley, 2005).

This enables consumers to obtain nutrition information easily at population-level (Campos et al., 2011). Nutrition labels are considered a population-based, cost-effective, diet-related intervention with the capacity to influence dietary choice, irrespective of an individual's weight (and thus mitigating weight stigma), whilst retaining an individual's freedom of choice in food product selection (Crino et al., 2015; Gebreslassie et al., 2020; Graham et al., 2012; Miller et al., 2015). Therefore, in the UK the nutrition label remains an important aspect on prepacked food packaging to communicate the nutritional content of the food product to the consumer on a population level to guide healthier food choices at the point of purchase (Azman & Sahak, 2014; Grunert & Wills, 2007; Mawad et al., 2015). To determine the effectiveness of nutrition labels as a policy tool it is important to understand how consumers engage with nutrition labels.

1.4 Consumer Engagement with Nutrition Labels

A variety of common terms are used to refer to consumer interactions with nutrition labels including 'comprehend', 'knowledge', 'look', 'read' 'understand' and 'use' (Anastasiou et al., 2019; Cowburn & Stockley, 2005; Crino et al., 2015; Grunert et al., 2010). These terms are not always defined within the literature, which can lead to ambiguity in scope and challenges when comparing studies (Campos et al., 2011). Furthermore, the terms used to encompass nutrition label engagement can vary considerably across disciplines (Azman & Sahak, 2014). Within this thesis the term 'engagement' encompasses consumer interactions with nutrition labels. This approach to terminology is similar to that taken by other researchers, so that the findings of the research are relevant across disciplines which may use different terminology (Campos et al., 2011; Graham et al., 2012).

It is important to understand population level engagement with nutrition labels to determine their effectiveness at guiding food choices. This thesis is only concerned with adult nutrition label engagement. In the UK, individuals are legally defined as adults after their 18th birthday (Arnett, 2007). Thus, the nutrition label engagement discussed throughout this thesis is focused on individuals aged 18 years and older. This thesis is focused on consumer engagement with the current UK nutrition labels and is not seeking to amend the design, format or implementation of the current labels (Roberto & Khandpur, 2014). Therefore, this literature is not reviewed within the thesis but there are reviews available which make enhancement recommendations (Devaux et al., 2024; Graham et al., 2012; Peonides et al., 2022). The following literature review will evaluate consumer engagement with nutrition labels and the characteristics which may be associated with differing engagement levels, including personal and contextual variables. It will conclude with an exploration of current public health nutrition label engagement campaigns and justify the need for future population-level interventions to improve the effectiveness of nutrition labels as a public health initiative.

1.4.1 Measures of Nutrition Label Engagement

It has been reported that consumers have an increased likelihood of purchasing healthier products following nutrition label engagement (Mhurchu et al., 2018). However, there is still confusion and misperceptions on how to engage with nutrition labels, which can lead to erroneous dietary choices or a lack of engagement with the labels (An et al., 2021; Cha et al., 2014). Existing reviews have highlighted the positive association between consumer's nutrition label engagement and improved healthier dietary choices, but that these associations are complex and sometimes inconsistent (An et al., 2021; Anastasiou et al., 2019; Cowburn & Stockley, 2005; Graham et al., 2012; Song et al., 2021).

Systematic reviews conducted by Campos et al. (2011) and Anastasiou et al. (2019) synthesised 120 articles and 26 articles respectively. These reviews reported a consistent, positive association between a consumer's self-reported nutrition label engagement and their ability to make accurate healthier dietary choices. Campos et al. reported a greater than 50% self-reported prevalence rate of nutrition label engagement in the general population when making food choices across the reviewed articles. This finding is consistent with an earlier review of 103 studies conducted by Cowburn and Stockley (2005), who also reported high self-reported engagement with nutrition labels and findings by Bhawra et al. (2022) who reported that UK consumers self-reported the highest nutrition label engagement across five countries. However, researchers have highlighted discrepancies between self-reported nutrition label engagement and actual nutrition label engagement when measured objectively, such as through food purchases or attention-based measures (Graham et al., 2012). The objectively measured findings show much lower nutrition label engagement during food purchases (Campos et al., 2011).

In the review by Cowburn and Stockley (2005) some of the studies employed a think-aloud protocol to supplement the self-reported measures of nutrition label engagement. This protocol is where participants think-aloud as they complete the tasks. It was reported that consumers referenced the nutrition labels but did not process the information further as they found it confusing, especially the technical and numerical information. These findings, of lower nutrition label engagement compared with self-reported measures, was supported by Grunert et al. (2010) who reported only 27% of consumers in an in store observational study used the nutrition labels to make food choices. This over-reporting of self-reported nutrition label engagement could be attributed to the retrospective premise of self-report measures, which can be privy to demand characteristics, such as attempts to appear more health conscious (Podsakoff et al., 2003). Most of these findings were prior to the national guidelines for front-of-pack nutrition labels, thus, these behaviours may differ in the present day.

In addition to the think-aloud protocol, other studies have implemented eye-tracking technology as an objective measure of consumers' attention when making food choices to complement the self-reported measures (Graham et al., 2012). Studies that have measured visual attention have reported nutrition label engagement to be lower than self-reported nutrition label engagement (Ares, et al., 2014; Graham & Jeffery, 2011). These findings suggest that eye-tracking measures may provide estimates of the instinctive nutritional search behaviours employed when making dietary choices. Nutrition labels play a vital role to inform consumers about the nutritional composition of prepacked food products to support healthier diets (Egnell et al., 2019). Therefore, implementing study measures which are representative of consumer nutrition label engagement are critical to understanding how to improve the effectiveness of nutrition labels and nutrition label interventions.

1.4.2. Age and Sex

It is commonly reported across literature reviews that middle-to-older aged adults and females have higher levels of engagement with nutrition labels (Campos et al., 2011; Christoph et al., 2015; Cowburn & Stockley, 2005; Stran & Knol, 2013). The reasons for these higher levels of engagement vary from trust in the information provided, shopping habits and income levels (Campos et al., 2011). Therefore, it is important for these demographic characteristics to be considered as potential predictors of nutrition label engagement.

1.4.3 BMI and Self-Perceived Weight

As outlined in Section 1.1.3, excessive body weight refers to when there is a risk posed to a person's health through an excessive or abnormal accumulation of body fat (WHO, 2025). Body Mass Index (BMI) is measured using the equation of an individual's weight in kilograms divided by their height in metres squared (NHS, 2023b). It has been reported that consumers with a normal or healthy weight BMI status (within the range of 18 kg/m^2 to 24.9 kg/m^2) have an improved ability to engage in healthier dietary choices (Borgmeier & Westenhoefer, 2009; Vyth et al., 2010), which may suggest that individuals with a healthy BMI status focus holistically across the nutrition label information presented (Grunert et al., 2010). In contrast, consumers with BMI greater than 25kg/m^2 are reported to engage with nutrition labels but focus on the information relating to serving size and calorie content, which can reduce their ability to identify healthier food products (Graham & Jeffery, 2011).

It has also been established within the research that a consumer's own weight perception can influence their engagement with nutrition labels (Rasberry et al., 2007). When an individual is seeking to control their weight there have been higher reports of greater nutrition label engagement, which may be due to seeking out nutritional information to support dietary goals (Campos et al., 2011; Christoph et al., 2015). Therefore, a consumer's perception of being overweight can influence how they engage with nutrition labels in terms of frequency and purpose. Hence, the inclusion of BMI and self-perceived measures within research studies can provide stronger insights into engagement with nutrition labels and how these measures may form a barrier or facilitator to this engagement.

1.4.4 Educational Attainment and Health Literacy

It has been reported that individuals who have high educational achievements have greater levels of engagement with nutrition labels in terms of frequency of viewing and understanding (Campos et al., 2011; Graham & Jeffery, 2011). However, Drichoutis et al. (2005) reported the association between education and nutrition label engagement was mediated by nutrition knowledge. This suggests that consumers were more likely to engage with nutrition labels because they had higher levels of nutrition knowledge, not because they had higher educational attainment. Furthermore, Mackert et al. (2013) argue that educational attainment is not a strong reflection of a consumer's health literacy skills, which are pivotal for the consumer to fully engage with nutrition labels (Moore et al., 2018a).

Nutrition label health literacy refers to a consumers' capacity to obtain, process and understand the nutrition label information and draw appropriate decisions based on their literacy and numeracy skills e.g., determine how the nutrients contribute to their daily food intake (Weiss et al., 2005). Health literacy has been reported to be associated with education status and other social determinants of health, including socio-economic status and ethnicity, but health literacy associations with health persist when they are controlled for (Baker et al., 1997; McNichol & Rootman, 2016). Thus, researchers suggest that a nutrition label-based health literacy measure may be the most appropriate instrument to assess the cognitive and social determinants of health in relation to nutrition labels (Heinrich, 2012; Rowlands et al., 2013; Stagliano & Wallace, 2013; Weiss et al., 2005).

There is a complex interplay between health literacy and nutrition label engagement. A scoping review of 16 studies conducted by Malloy-Weir and Cooper (2016) reported that judgements about food can be influenced by the level of health literacy. The review highlighted that consumers with lower health literacy levels may benefit from interventions designed to improve nutrition label engagement. It has been argued that consumers with lower health literacy have a higher likelihood of looking at non-relevant nutrition information when making food choices (Mackert et al., 2013). Therefore, there is a strong argument for health literacy to be measured when examining engagement with nutrition labels to be more encompassing of relevant skills than the measure of educational attainment and other social determinants of health (Diamond, 2007; McNichol & Rootman, 2016; Moore et al., 2018a).

1.4.5 Motivations for Food Choice and Attitudes Toward Nutrition Labels

Consumer dietary choice motivations are individual differences which can influence nutrition label engagement (Ares et al., 2014; Grunert & Wills, 2007). These motivations are centred on the features of a product which are of greatest importance to the individual consumer, for example, the convenience, price or expected taste and liking of a product (Perez-Cueto, 2019; Steptoe et al., 1995; Turner et al., 2014). Marlow (2017) suggested that when a consumer places the greatest importance on taste, this can lead to a lack of engagement with the nutrition labels. In turn, this can lead to less healthy dietary choices, especially if the consumer perceives unhealthy prepacked food products to be tastier than the healthier alternatives. Turner et al. (2014) and Vyth et al. (2010), reported that consumers with a health motivation have increased familiarity and more favourable attitudes towards nutrition labels. This may be due to the individual being motivated to enhance and protect their health and therefore are more likely to actively seek nutritional information to inform healthier dietary choices (Azman & Sahak, 2014; Barreiro-Hurlé et al., 2010; Bialkova et al. 2014). Furthermore, this may be influenced by consumers attitudes and perceptions towards nutrition labels, with more favourable opinions associated with greater nutrition label engagement (Campos et al., 2011).

There may also be processing style differences between consumers based on the purpose of a shopping visit. If a consumer is shopping as part of a routine, for example a weekly shopping trip, it has been suggested that heuristic processing is employed. Heuristic processing is where an individual forms an immediate food choice based on the information available to them rather than any analytical processing of the information present (Hodgkins et al., 2012). Heuristic processing can lead to reduced involvement with the nutrition labels, particularly the back-of-pack nutrition label, as they require time to analytically process (Sanjari et al., 2017). This reduced involvement can be due to a lack of time and competing demands on cognitive resources (Hodgkins et al., 2012). Cognitive overload can lead consumers to rely on heuristic processing to simplify the task. This mindset may lead consumers to prefer the front-of-pack nutrition labels, due to being presented in the principal field of vision (Becker et al., 2015). It may also lead consumers to focus on a single value for comparison, such as calories or fat content, which may lead to erroneous dietary choices (Antúnez et al., 2013; Ares, et al., 2012; Grunert & Wills, 2007).

Whilst heuristic processing is typically used during routine shopping trips, consumers are more likely to engage in systematic processing when they have specific motivations to seek nutritional information, such as methodologically searching for nutrition information when following a weight loss programme or when mindfully choosing healthier alternatives (Hodgkins et al., 2012). Based on these circumstances, Hodgkins et al. (2012) reported that the combination of non-directive (the mandatory back-of-pack nutrition label) and semi-directive (the front-of-pack nutrition label) nutrition label on the packaging of prepacked food products provides elements of ease of use and increased processing speed. This research highlights the importance of catering for a range of consumers without the need to reduce the underlying nutritional information. Therefore, measuring and exploring these potential variations in food choice motivations is important as they may impact nutrition label engagement levels.

1.4.6 Public Health Campaigns to Improve Nutrition Label Engagement

Nutrition labels are a public health communication tool that consumers depend on to determine the dietary quality of prepacked food products (Sadhukhan & Pramanik, 2023; Somerick & Weir, 1998). However, there has been a lack of public health messaging and campaigns aimed at improving nutrition label engagement, beyond the mere presence of the labels. As discussed, nutrition label engagement can be influenced by a variety of factors, hence nutrition label presence alone may not effectively influence population diet without guidance on how to engage with the labels (Kiszko et al., 2014; Sinclair et al., 2014).

Consumers can actively seek information on how to engage with nutrition labels in policy documents (Department of Health, 2016). However, consumers are not the intended audience for policy documents. As a result, the language used can be a barrier to consumers seeking information, as it poses ways to communicate information to consumers from a manufacturers' perspective (e.g., Department of Health, 2016). Alternatively, consumers can seek information on the NHS website (NHS, 2022a; Figure 1.3). However, these approaches require the consumer to be interested and motivated to seek out this information, which based on the literature review presented may not be an effective public health strategy.

Figure 1.3

Nutrition Label Engagement Guidance on the NHS website

Food shopping tips

You're standing in the supermarket aisle looking at 2 similar products, trying to decide which to choose. You want to make the healthier choice, but you're in a hurry.

If you're buying pre-packaged or ready meals, check to see if there's a nutrition label on the front of the pack, and then see how your choices stack up when it comes to the amount of energy, fat, saturated fat, sugars and salt.

If the nutrition labels use colour coding, you'll often find a mixture of red, amber and green.

So when you're choosing between similar products, try to go for more greens and ambers, and fewer reds, if you want to make a healthier choice.

In addition, mobile health initiatives have been introduced to help to educate consumers on the nutritional content of food products. These initiatives have focused on food scanner apps, where consumers scan prepacked food products to gain nutritional information. The UK Government recommended a food scanner app as part of the Change4Life campaign, which supported parents in choosing lower in sugar foods for their children (Bradley et al., 2020; Mahdi et al., 2023). Food scanner apps vary in the nutritional feedback shared with consumers, ranging from providing enlarged nutrition labels, logging the food as part of daily intake, or contextualising nutrition values, e.g., the Change4Life app depicts the amount of total sugars in a food product as sugar cubes (Bradley et al., 2020). However, Werle et al. (2024) reported that on-package nutrition labels systematically outperformed food scanner apps in supporting consumers' intention and behaviour to make healthier choices. Consequently, ensuring nutrition label engagement is improved, without the reliance on mobile applications, is essential to improving the efficacy and effectiveness of nutrition labels as a public health communication tool.

Therefore, it is of utmost importance that consumer nutrition label needs are understood and how these needs can be addressed in future population-level nutrition label engagement interventions. This would help to improve the effectiveness of nutrition labels as a public health tool. It has been reported that consumers hold a preference for the nutrition labels that are already implemented in their country (Gibson-Moore & Spiro, 2021), which may be due to familiarity with the labels (Acton et al., 2023). Therefore, interventions designed to improve existing nutrition label engagement should be prioritised.

1.5 Overview of the Thesis

1.5.1 The Aim and the Objectives of this Thesis

The aim of this thesis was to design, implement and evaluate an intervention to encourage improved UK adult consumer nutrition label engagement. The objectives of this thesis were to:

1. Systematically review and evaluate the effectiveness of existing single-component nutrition label engagement interventions targeting healthy adults.
2. Explore the factors and experiences which influence nutrition label engagement in UK adult consumers and test a novel instrument to assess engagement.

3. Design, implement and evaluate a novel intervention aimed at improving UK consumer nutrition label engagement.

1.5.2 Thesis Structure

This chapter provided a literature review, which highlighted the need to improve nutrition label engagement as a public health communication tool. Following this chapter the thesis has a further nine chapters which address the Thesis Aim and objectives. Each chapter included in the thesis is briefly described below.

Chapter 2 presents the findings from a systematic review conducted on existing single-component nutrition label engagement interventions (Thesis Objective 1). *Chapter 3* outlines the theoretical framework used throughout the thesis, both for the novel instrument (food choice task) and the intervention design process. *Chapter 4* discusses the research paradigm and justifies the methodological approaches taken in the empirical studies reported in this thesis.

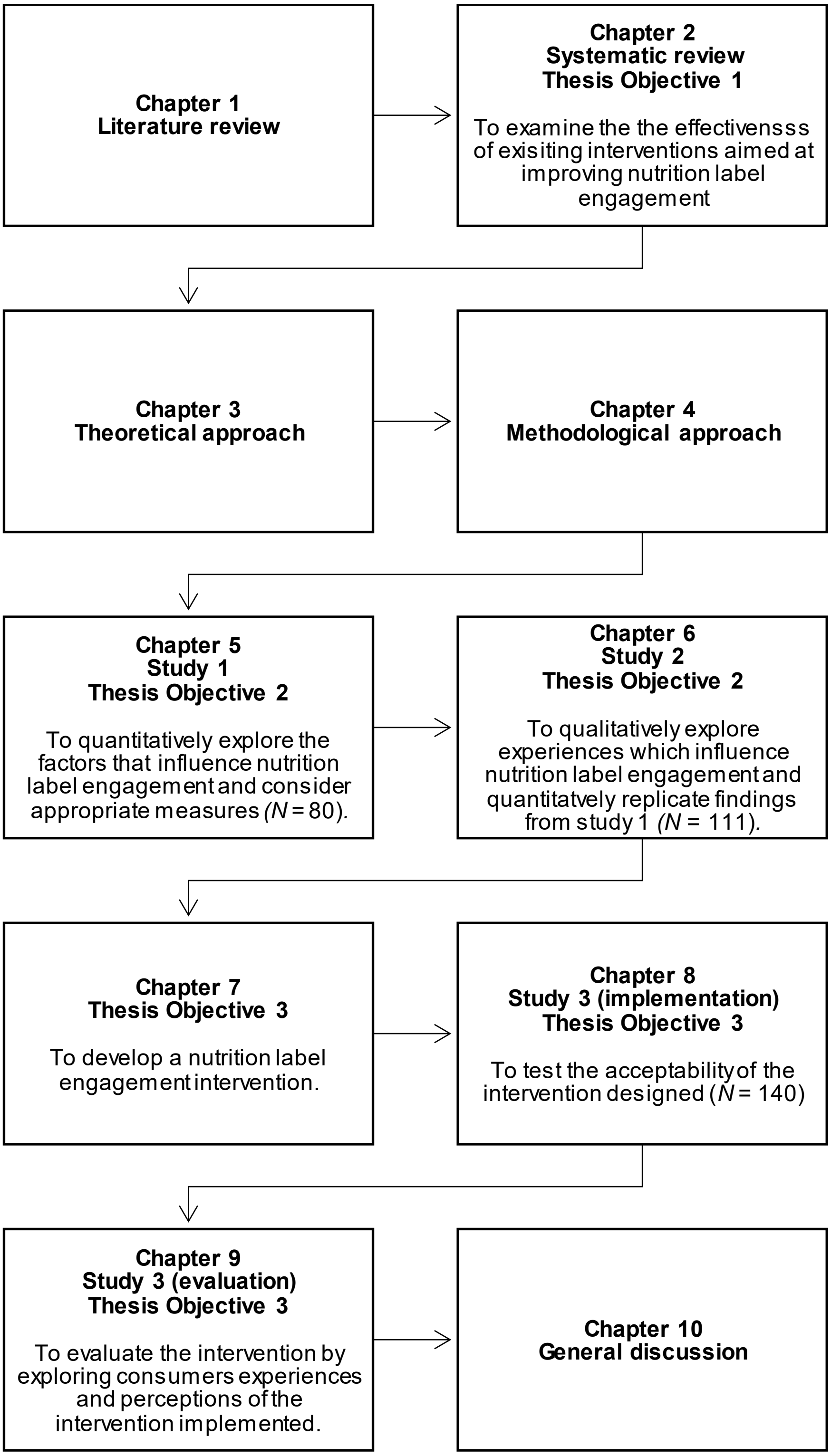
Chapter 5 presents the first empirical study conducted as part of this thesis. Study 1 implemented the novel food choice task to quantitatively explore factors which influenced nutrition label engagement for 80 participants in an eye-tracking, think-aloud, laboratory experiment (Thesis Objective 2). *Chapter 6* reports the findings from a mixed-methods empirical study, which aimed to replicate the quantitative findings from Study 1. Study 2 also explored the experiences of nutrition label engagement in 111 participants (Thesis Objective 2).

Chapter 7 presents the intervention developed in this thesis. It demonstrates how the key findings from earlier chapters, additional empirical findings and pilot testing informed the design of the intervention (Thesis outcome 3). *Chapter 8* reports the quantitative findings from Study 3, which implemented the novel intervention with 140 participants (Thesis Objective 3). *Chapter 9* evaluates the intervention from a consumer perspective using a mixed-methods approach (Thesis Objective 3).

The thesis is concluded in *Chapter 10*, which discusses the findings in relation to the Thesis Aim and objectives and highlights the original contributions to knowledge. It evaluates the work conducted in the thesis and outlines the implications and future directions. Figure 1.4 shows an overview of the chapters presented within this thesis and how each of the empirical chapters and findings contributed to the thesis objectives.

Figure 1.4

The Thesis Structure and How the Chapters Align to the Thesis Objectives



Chapter 2: Systematic Review

Chapter 1 outlined the value of nutrition labels for population health and new initiatives to improve consumer nutrition label engagement were needed. This chapter presents a systematic review of single-component nutrition label engagement interventions delivered to healthy adults. Existing interventions were evaluated on ‘intervention promise’ and ‘active ingredients’ extracted using the Behaviour Change Technique Taxonomy (BCTT; Michie et al., 2013). This review was needed to synthesise existing single-component nutrition label engagement interventions in healthy adults to draw conclusions on effectiveness to inform future intervention design. Chapter 2 concludes by summarising key findings of the systematic review to support the development of the intervention in the thesis, and outlines how the key findings addressed Thesis Objective 1.

2.1 Rationale and Aims

2.1.1 Existing Systematic Review Findings

Two existing systematic reviews have synthesised nutrition label engagement intervention studies (Moore et al., 2018a; Schruff-Lim et al., 2023). Moore et al. (2018a) concluded, from reviewing 17 studies, that educational interventions can improve public health nutrition label policy. Moore et al. (2018a) suggested future research must determine the effectiveness of education-based interventions focused on comprehension and nutrition label use, and the needs of the specific target population need to be considered. This evaluation was suggested as the conclusions drawn from the review were from a broad population, children to older adults, and included samples with medical conditions e.g., diabetes. These individual differences can influence nutrition label engagement and may affect the content, format and delivery of a nutrition label engagement intervention. Therefore, this approach may limit the applicability of the findings to inform a nutrition label engagement intervention for healthy adults, which is the population group of focus for the present thesis.

Moreover, the intervention studies synthesised in Moore et al.'s (2018a) review were limited to educational interventions, which the researchers outlined were the most common type of nutrition label interventions implemented. This limited the type of intervention study that was eligible for inclusion in the review, potentially excluding relevant studies which employed other intervention types. Therefore, a review with broader intervention type criteria, but specific to healthy adults, would provide insights from the literature into consumer nutrition label engagement.

Schruff-Lim et al. (2023) conducted a systematic review on nutrition label engagement interventions that excluded studies that had a child-only sample population and/or individuals living with a diet-related chronic disease. Their findings were generalisable to the healthy adult population. The systematic review conducted by Schruff-Lim et al. had a broader scope for intervention type compared to Moore et al.'s (2018a) review and synthesised 54 papers, comprised 62 studies and 85 nutrition label engagement interventions. The review by Schruff-Lim et al. synthesised single and multi-component intervention studies, that included a nutrition label engagement intervention with a complementary behaviour change intervention component (termed nutrition label+ interventions). The nutrition label+ intervention studies focused on improving nutrition label engagement with a behaviour change intervention component, such as real-time basket feedback (where nutrition information is updated when food products are added to virtual shopping baskets). To reduce heterogeneity of the studies included, the authors limited the complementary intervention component to exclude interventions with multiple complementary behaviour change components.

The findings from Schruff-Lim et al.’s (2023) systematic review concluded that educational materials and reference information can improve consumers’ ability to interpret nutrition labels. It highlighted that personal relevance of engaging with nutrition labels can influence the motivation and goals to nutrition label engagement when making food choices. The review did not include studies which included the back-of-pack nutrition label, which are the mandatory labels across different countries. Furthermore, the review included studies which investigated a variety of front-of-pack nutrition labels, of varying interpretative natures, which may have impacted the findings. Therefore, limiting focus to one type of front-of-pack nutrition label along with the back-of-pack nutrition label, or synthesising across the label types would have added context and generalisability to the findings. Consequently, a review conducting only intervention studies focused on the mandatory back-of-pack nutrition label and/or the multiple traffic light nutrition label would overcome some of the limitations identified in Schruff-Lim et al.’s review.

In addition, the effectiveness of core components of nutrition label engagement interventions were omitted from Schruff-Lim et al.’s (2023) systematic review. The review included a range of plus components, for example, the availability of healthy foods or swaps, which may also have impacted nutrition label engagement outcome measures due to the environment/external resource factors. Thus, it is challenging to unpick which components of the intervention were most effective at eliciting improved nutrition label engagement. Moore et al.'s (2018a) review drew conclusions across both single-component and multi-component nutrition label interventions. Therefore, a review focused on single-component nutrition label engagement interventions targeting adults, not integrated into wider health-promotion interventions may provide a foundation for the type of tasks, theories and effectiveness of the core intervention. This synthesis will establish which components are most effective and may be used in future interventions.

2.1.2 Determining the Effectiveness of Interventions

To aid understanding the effectiveness of nutrition label engagement interventions a theoretical approach can draw comparisons across studies. Identifying 'active ingredients' within interventions supports researchers to compare and build upon interventions implemented in different studies. The Behaviour Change Technique Taxonomy (BCTT; Michie et al., 2013) is a method of specifying intervention content by 'active ingredients' in an agreed and reliable language spanning disciplines and behaviours (Michie et al., 2013). Schruff-Lim et al. (2023) synthesised intervention studies with behaviour change components but did not determine effectiveness of the interventions based on these 'active ingredients', which would have strengthened the conclusions.

The BCTT (Michie et al., 2013) is a cross-discipline, hierarchically structured taxonomy developed by experts who rated labels and definitions.

These tasks resulted in 93 Behaviour Change Techniques (BCTs) clustered into 16 groups. These groups include ‘goals and planning’ and ‘covert learning’ (Appendix A) and the techniques can be used in isolation or in combination when targeting behaviour change. Due to the number of techniques, they are not all defined within this thesis, instead BCTs coded within the systematic review are defined later in this chapter. Online training has been effective at training individuals to become competent at BCTT coding (Wood et al., 2014).

The BCTT has been successfully applied to various health behaviour interventions, with an increased use of the taxonomy to enable synthesis of ‘active ingredients’ in intervention-based systematic reviews e.g., targeting sugar-sweetened beverage and water consumption (Vargas-Garcia et al., 2017) and their use in dietetics practice in primary health care (Rigby et al., 2020). However, the BCTT has yet to be applied to nutrition label engagement interventions. Applying the BCTT to interventions could yield insights into their effectiveness and help to draw conclusions across heterogeneous studies (Moore et al., 2018a; Schruff-Lim et al., 2023).

2.1.3 Systematic Review Question

The current review addressed Thesis Objective 1, it systematically reviewed and evaluated the effectiveness of existing single-component nutrition label engagement interventions targeting healthy adults. To achieve this objective the review questions were:

1. Are single-component nutrition label engagement interventions (targeting multiple traffic light front-of-pack and/or back-of-pack

nutrition labels) effective at improving nutrition label engagement in healthy adults?

2. Which components (i.e., BCTs) of nutrition label engagement interventions are most effective?

2.2 Methods

A review protocol was preregistered on PROSPERO (ID: CRD42022349556) and an ethics disclaimer was accepted by University of Staffordshire (Appendix B). The review was conducted according to the preferred reporting items for systematic reviews and meta-analyses (Page et al., 2021).

2.2.1 Eligibility Criteria

The PICO (Population, Intervention, Comparator, Outcome) framework was used to specify the inclusion criteria for papers eligible to be included within the review. This approach specifies the population, intervention, comparison and outcomes paper eligibility (Figure 2.1). Studies were excluded if the nutrition label intervention was delivered as part of a multi-component intervention, due to possible carry-over effects. Qualitative studies and case studies were excluded as they did not include quantitative comparators outlined in the inclusion criteria, which were needed to calculate intervention promise. Only peer-reviewed published, English language (or translated to English), studies were included. Studies were eligible if there was a broad population range but only if separate analysis was conducted for the population (healthy adults) eligible for the review. No limits were placed on country or year of publication.

Figure 2.1

The Inclusion Criteria Based on PICO Framework

P (Population)	I (Intervention)	C (Comparator)	O (Outcome)
Adults aged over 18 years, living without a self-reported acute or chronic diet-related condition	Single-component nutrition label (back-of-pack and/or multiple traffic light front-of-pack) engagement interventions, beyond the presence/ introduction of labels and not specific to improving engagement with a specific nutrient	Quantitative empirical study design with any baseline-, post-follow-up intervention timepoints and any comparator or control group	Change in nutrition label engagement (i.e. knowledge, attitude, attention, behaviour)

2.2.2 Information Sources

The search was conducted without date restrictions in December 2018 in seven databases: CINAHL, MedLine, PubMed, PsycInfo, PsycArticles, Science Direct and Scopus. To identify papers and to avoid bias in key word searches, reference lists of articles and grey literature were inspected in March 2019. In addition, hand searches were conducted in the following journals: Appetite, The British Journal of Nutrition and The Journal of the Academy of Nutrition and Dietetics, due to these journals providing the most hits in the original searches. Alerts were established to identify new publications following initial searches in December 2018 with top-up searches in June 2020, July 2022, October 2023 and June 2024, articles were screened using the same criteria. A systematic top-up search has not been completed in advance of thesis submission, as the findings from the systematic review informed the intervention that was implemented within this body of work.

2.2.3 Search Strategy

The Boolean search query was developed using the PICO framework. The search terms were associated into three categories: (a) intervention: “nutrition label”; (b) comparison: “intervention”; and (c) outcome: “healthier dietary choices”. The full search query can be found in Figure 2.2. Since the type of intervention components were not known a priori, search terms maximised the yield of the search by referring to broad label terms. The population element was unspecified to reflect the common practice of not stipulating ‘adults’ in article titles and studies may include analyses for separate sub-populations based on age. Hence, a specified population search term was not deemed appropriate for this review.

Figure 2.2

Search Query Based on PICO Framework Search Terms

P (Population)	**I** (Intervention)	**C** (Comparator)	**O** (Outcome)
None	(“nutri* label” OR “food label” OR “back-of-pack label” OR “front-of-pack label” OR “nutri* information” OR “traffic light”)	AND (intervention OR behav*)	AND (diet OR choice OR food OR health OR select*)

2.2.4 Selection Process

The hits returned from the searches conducted in 2018 and 2020 were exported to excel and duplicates removed. SH used an excel spreadsheet to screen titles and abstracts of all identified studies, with 10% screened by HS. Following this, SH screened all full texts of eligible studies, with HS screening 10% of these articles. These original searches were added to Rayyan, a systematic review management platform (Ouzzani et al., 2016), to help manage the large number of articles and to add subsequent top-up searches conducted in 2022, 2023 and 2024. This approach was taken to ensure searches and decisions were logged efficiently and transparently. Duplicate automatic identification within Rayyan for later searches was the only automation tool used during the selection process.

2.2.5 Data Collection Process

Data extraction was performed by SH using a standardised data extraction form derived from the Cochrane template. The data extracted from each study included information relating to: (a) study design; (b) participant characteristics; (c) intervention details (and control where applicable); (d) nutrition label engagement measures; (e) nutrition label engagement outcomes and timepoints; (f) BCTs. The BCTs (Michie et al., 2013) were extracted and coded from all included studies by SH and discussed with HS. Prior to BCT extraction and coding, SH and HS completed online BCT coding training. All 93 BCTs were considered during the coding. A BCT was coded as present using the method taught in the training; by highlighting relevant text and rating the presence of the BCT based on confidence.

2.2.6 Quality Assessment

The Quality Assessment Tool for Quantitative Studies developed for the Effective Public Health Practice Project (Armijo-Olivo et al., 2012; Thomas et al., 2004) was used to assess study quality. This has been used by similar systematic reviews (e.g., Moore et al., 2018a; Schruff-Lim et al., 2023) and was devised to assess quality of public health interventions. The tool assesses bias risk across six domains: (a) selection bias; (b) study design; (c) confounders; (d) blinding; (e) data collection method; (f) withdrawals and dropouts. Ratings are classified into a global rating for each paper of weak, moderate or strong. SH assessed the quality of included studies and HS assessed 10% of these as an independent reviewer.

2.2.7 Effect Measures and Synthesis of Results

The overall nutrition label engagement scores e.g., outcome of a food-choice task using nutrition labels, nutrition label attention measures or self-reported nutrition label engagement, were used as the primary outcome measure. Studies which reported multiple timepoints and/or measures had multiple outcomes synthesised as part of the review. This approach was taken so measures and timepoints could also be evaluated to inform development and implementation of the intervention designed within this thesis.

Due to study design and outcome variable heterogeneity a meta-analysis or meta-regression were not appropriate. Therefore, a narrative synthesis of the papers was conducted with an “intervention promise” calculated for each study. Due to inconsistent effect size reporting, they were not used to inform intervention promise (Clark-Carter, 2019; Lewis et al., 2021). Potential promise of each intervention was calculated based on the outcome of significance tests each paper reported (Nyman et al., 2018). Interventions were categorised "*very promising*", where statistically significant increases in nutrition label engagement were reported in the intervention group relative to **both** baseline (a within-group difference) and at least one comparator group e.g., a control group (a between-group difference). Interventions were categorised "*quite promising*", if a statistically significant increase in nutrition label engagement relative to **either** the baseline (within-group difference) or comparator (between-group difference). Interventions were categorised "*non-promising*", if no statistically significant differences for the intervention group relative to the baseline or comparator were reported.

The effectiveness of BCTs within the intervention were evaluated relative to "intervention promise" (Lewis et al., 2021; Nyman et al., 2018). The approach to calculate effectiveness of BCTs followed the same steps as existing systematic reviews (e.g., Lewis et al., 2021; Nyman et al., 2018). The promise intervention categories enabled a ratio to be calculated based on the number of times a BCT was present in "*very/quite promising*" interventions, divided by the number of times the BCT was present in the "*non-promising*" interventions. The BCTs had to be present in both categories of intervention to be reported as a ratio. Where a ratio could not be calculated, the number of times a BCT was present in "*very/quite*" promising interventions was reported and no value was reported for "*non-promising*" interventions.

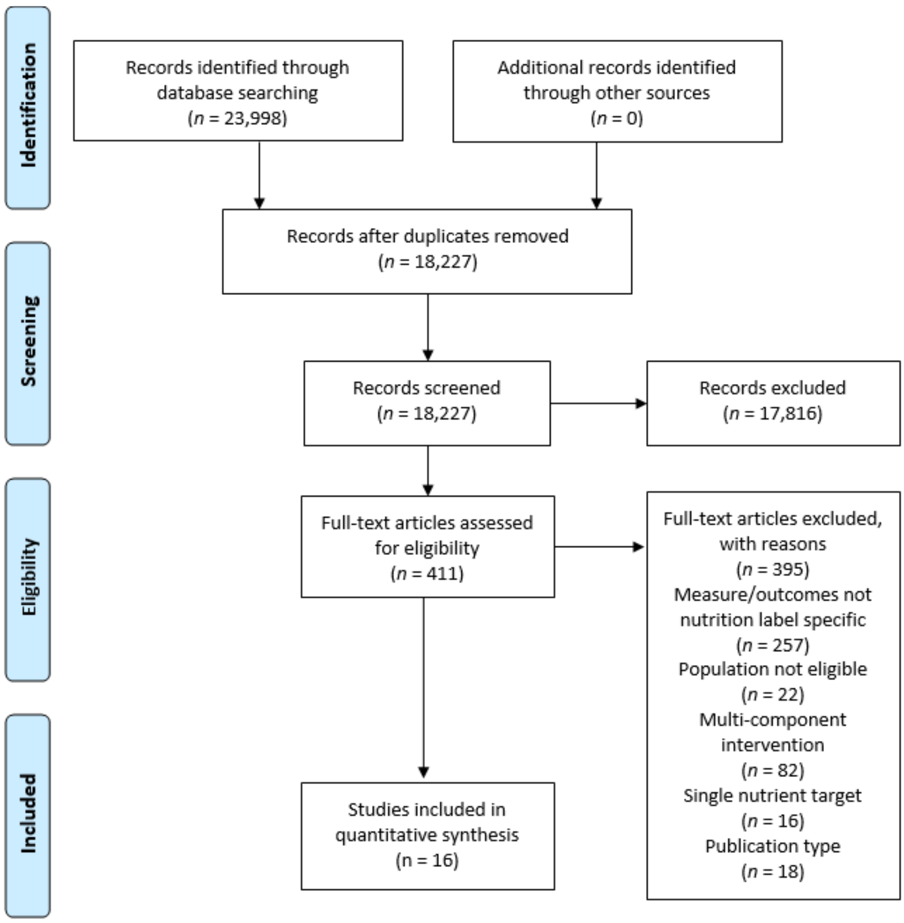
2.3 Results

2.3.1 Study Selection

Figure 2.3 shows the PRISMA flow diagram (Moher et al., 2009) of the study selection process. The stages of the initial and top-up database searches were amalgamated for reporting conciseness in this thesis. 23,998 articles were identified. After duplicate removal, title and abstract screening was performed on 18,227 articles. After the initial screening 411 full-text articles were screened for inclusion. 16 articles with 15 unique interventions were included in this review.

Figure 2.3

PRISMA Flow Diagram of Study Selection



2.3.2 Study Characteristics

2.3.2.1 Sample Characteristics. Table 2.1 summaries nutrition label engagement intervention characteristics and results from articles included in this review. Two studies were combined as Graham et al. (2015) as they reported the same intervention delivered to the same population sample (Graham et al., 2015, 2016). 15 unique interventions were synthesised from 16 articles that met the review eligibility criteria, all totals in the results section are 15 to reflect the unique intervention studies reviewed. A total of 3,686 participants took part across all studies, with 2,854 known participants assigned to intervention groups (Kees et al., 2014, did not report the number of participants assigned to each condition). All participants were adults who were aged 18 years or older with no medical or dietary-related conditions reported. Most of the studies had a majority female sample (*n* = 10), some of the studies had a majority male sample (*n* = 2) and some of the studies did not report the sex of participants (*n* = 3). Most studies were conducted in the USA (*n* = 10), with studies also included from Canada (*n* = 2), Iran (*n* = 1), Romania (*n* = 1) and Brazil (*n* = 1).

The demographic characteristics reported varied across the articles included in the systematic review. One study reported health literacy and BMI (Graham et al., 2015). Nine studies reported education attainment (Dukeshire et al., 2014; Esfandiari et al., 2020; Graham et al., 2015; Kreuter et al., 2002; Lindhurst et al., 2007; Miller et al., 2017, 2018; Souza et al., 2016; Taylor-Davis et al., 2000); four studies reported socio-economic status (Dukeshire et al., 2014; Graham et al., 2015; Lindhurst et al., 2007; Souza et al., 2016); two studies reported relationship status (Graham et al., 2015;

Kreuter et al., 2002); and four studies reported ethnicity of the sample, which were predominantly white (Graham et al., 2015; Kreuter et al., 2002; Miller et al., 2018; Taylor-Davis et al., 2000).

One study did not report demographic characteristics (Brunt & Schafer, 1997) and four studies did not report demographic characteristics beyond sex and/or age (Dooley et al., 1998; Miller et al., 2019; Mnerie et al., 2015; Souza et al., 2016). Six of the studies included in the review explicitly outlined their eligibility criteria which focused on the participants' ability to read and write in fluent English (Graham et al., 2015; Miller et al., 2017, 2018, 2019), be a regular household food purchaser (Esfandiari et al., 2020) and lack of nutrition label engagement (Mnerie et al., 2015).

Table 2.1

Summary of Existing Single-Component Nutrition Label Engagement Interventions Included in the Systematic Review

Author(s), year, country, quality rating	Sample size, characteristics & eligibility	Intervention detail (theory, setting, incentive, duration, mode of delivery, format, comparator)	Measures and timepoints	Intervention findings and intervention promise
Brunt & Schafer. (1997) USA Quality rating: Weak	*N* = 8 No demographic characteristics reported Eligibility: None reported	Theory: None Setting: Public library Incentive: None reported Duration: Brief single session Mode of delivery: Face-to-face Format: Pamphlet Comparator: Baseline	Measures: Five questions assessed back-of-pack nutrition label engagement (correct responses) Timepoints: Baseline and immediate post-intervention Evaluation: None	Findings: Improvements in nutrition label engagement from baseline to post-intervention but significance tests not reported Intervention promise: Non-promising
Dooley et al. (1998) USA	*N* = 212 60% female No further demographic characteristics reported	Theory: None Setting: Supermarket and follow-up telephone questionnaires Incentives: None	Measures: Five questions to assess nutrition label engagement (yes/correct responses)	Findings: Significant increases in nutrition label engagement from baseline to post-intervention (p <.001[a]).

Author(s), year, country, quality rating	Sample size, characteristics & eligibility	Intervention detail (theory, setting, incentive, duration, mode of delivery, format, comparator)	Measures and timepoints	Intervention findings and intervention promise
Quality rating: Moderate	Baseline intervention group n = 102; Baseline control group n = 110; post-intervention group n = 86; post-control group n = 89 Eligibility: None reported	Duration: 5-minute single session Mode of delivery: Face-to-face Format: Nutrition label brochure Comparator: Baseline and control	Timepoints: Baseline, 10-day post-intervention Evaluation: None	Non-significant differences for comparator Intervention promise: Quite promising
Dukeshire et al. (2014) Canada Quality rating: Weak	N = 19 Mostly female (figure not reported) Aged: 18-75 years Education: 58% min. college SES: 26% \$0-\$39,999; 16% not disclosed	Theory: None Setting: Grocery store Incentive: None Duration: 2-hour single session Mode of Delivery: Face-to-face Format: Workshop and store tour Comparator: Baseline	Measures: Nutrition label engagement confidence (7-item 5-point Likert scale) and knowledge (2-items; MCQ) Timepoints: Baseline, immediate post-intervention and 1 month follow-up	Findings: Significant improvements in nutrition label engagement from baseline to post-intervention (p <.01[a]). Sample too small for follow-up (n = 3) Intervention promise: Quite promising

Author(s), year, country, quality rating	Sample size, characteristics & eligibility	Intervention detail (theory, setting, incentive, duration, mode of delivery, format, comparator)	Measures and timepoints	Intervention findings and intervention promise
	Eligibility: None reported		Evaluation: Yes (7-item satisfaction 5-point Likert scale)	
Esfandiari et al. (2020) Iran Quality rating: Moderate	*N* = 673 53.5% female Aged: 20-70 years Education: 64% higher education Eligibility: Regular food purchasers for household	Theory: None Setting: Shopping centre and door-to-door (post only) Incentive: Coffee cup with nutrition label image Duration: 10-minute single session Mode of Delivery: Face-to-face Format: Pamphlet Comparator: Baseline	Measures: Nutrition label engagement knowledge (11-items), attitudes (5-items) and practices (6-items). Measured on 5-point Likert scales Timepoints: baseline and 3/6-month post-intervention Evaluation: None	Findings: Significant improvements in nutrition label engagement measures from baseline to post-intervention (p <.05[a]) Intervention promise: Quite promising

Author(s), year, country, quality rating	Sample size, characteristics & eligibility	Intervention detail (theory, setting, incentive, duration, mode of delivery, format, comparator)	Measures and timepoints	Intervention findings and intervention promise
Graham et al. (2015; 2016)[b] USA Quality rating: Strong	Adults *N* = 153 *M* age: 38.1 years 87% female Education: 56.2% min. college SES: 12.4% < $25,000 Newest Vital Sign: 50.4% 6 correct *M* BMI: 27.9kg/m^2 Ethnicity: 82.4% white Relationship status: 73.4% married Self-reported label use often/always = 45.8% Most or all food shopping for household = 89%	Theory: None Setting: University laboratory turned grocery aisle Incentive: Kept chosen foods Duration: 90-minute single session Mode of Delivery: Face-to-face Format: In-aisle explanatory signage Comparator: Control	Measures: Nutrition label engagement attention (eye-tracking) and healthfulness of food choices Timepoints: Immediate post-intervention Evaluation: None	Findings: Significant improvements in attention to nutrition labels and healthfulness of foods selected compared to comparator (p <.05[a]). Some non-significant findings reported Intervention promise: Quite promising.

Author(s), year, country, quality rating	Sample size, characteristics & eligibility	Intervention detail (theory, setting, incentive, duration, mode of delivery, format, comparator)	Measures and timepoints	Intervention findings and intervention promise
	Intervention group *n* = 35; control group *n* = 26 Eligibility: able to read and write in English			
Kees et al. (2014) USA Quality rating: Weak	*N* = 238 48% female Mean age: 35 years Age range 18-72 years 54% primary shoppers *n* per group not reported. Eligibility: None reported	Theory: None Setting: Online Incentive: Recruitment via Amazon Mechanical Turk, likely payment but not reported Duration: Single time point Mode of Delivery: Online Format: Educational prime Comparator: Control	Measures: Nutrition label engagement attention (2-items 7-point Likert scale), ease of use (2-item 7-point Likert scale) engagement (2-item 7-point Likert scale) and thought listing (open retrospective textboxes). Timepoints: Immediate post-intervention	Findings: Significant improvement for ease of use after educational prime (p <.05). No significant difference across other measures Intervention promise: Quite promising

Author(s), year, country, quality rating	Sample size, characteristics & eligibility	Intervention detail (theory, setting, incentive, duration, mode of delivery, format, comparator)	Measures and timepoints	Intervention findings and intervention promise
			Evaluation: None	
Kreuter et al. (2002) USA Quality rating: Strong	*N* = 632 77% female Ethnicity: 97% white *M* age: 50.1 years *M* education: 12.1 years Relationship status: 76% married Intervention conditions *n* = 484; control condition *n* = 148 Eligibility: None reported	Theory: None Setting: Community-based clinics Incentive: $1 to medical office staff for each completed questionnaire Duration: Single time point, materials posted Mode of Delivery: Remote Format: Educational materials personalised vs. national brochure Comparator: Baseline and control	Measures: Nutrition label engagement dichotomous yes/no to reading the labels in the last 12 months. If 'yes' asked difficulty rating, nutrients sought, frequency and impact on food purchase choices Timepoints: baseline and 3-month post-intervention Evaluation: Yes (recall/ rating of the intervention (yes/no or Likert scale))	Findings: Significant self-reported improved understanding between baseline and post-intervention for intervention conditions (p <.05[a]). Significant self-reported use higher in intervention conditions compared to control at follow-up (p <.05[a]). One intervention condition significantly higher frequency of label engagement than control at follow-up (p <.05) but

Author(s), year, country, quality rating	Sample size, characteristics & eligibility	Intervention detail (theory, setting, incentive, duration, mode of delivery, format, comparator)	Measures and timepoints	Intervention findings and intervention promise
				other comparisons non-significant Intervention promise: Very promising
Lindhurst et al. (2007) Canada Quality rating: Moderate	*N* = 259 81% female Aged 18->65 Education: 51% min high school SES: 33.59% <25,000 Follow-up *n* = 35 Eligibility: None reported	Theory: None Setting: Community setting Incentive: None Duration: Single session Mode of Delivery: Face-to-face Format: Workshop Comparator: Baseline	Measures: Nutrition label engagement attitudes (1-item) and behaviours (2-items) Measured on 5-point Likert scales Timepoints: Baseline, immediate post-intervention and 3-month follow-up	Findings: Percentage means indicated increased nutrition label engagement, but significance tests not reported Intervention promise: Non-promising

Author(s), year, country, quality rating	Sample size, characteristics & eligibility	Intervention detail (theory, setting, incentive, duration, mode of delivery, format, comparator)	Measures and timepoints	Intervention findings and intervention promise
			Evaluation: Yes (workshop rated on Likert scale from 1-5)	
Miller et al. (2017) USA Quality rating: Strong	*N* = 140 College students *M* age: 20.7 years *M* education: 14.6 years Intervention *n* = 70; control *n* = 70 Eligibility: Able to read from a computer screen and use a mouse; fluent English	Theory: None Setting: Web-based remote Incentive: None Duration: 7-minute single session with tasks 60-90 minutes total Mode of Delivery: Remote (web-based) Format: PowerPoint slides and nutrition label training task with feedback on choices Comparator: Baseline and control	Measures: Nutrition label engagement knowledge quiz (18-items MCQs), self-reported label use (1-item 5-point Likert scale), nutrition label health literacy (7-items MCQs) and accuracy on a nutrition label task (24 trials three blocks; healthier option chosen was accurate response) Timepoints: Baselines, immediate post-	Findings: Significant improvements in label reading accuracy and decreased time to read labels compared to baseline and control (p <.05[a]). Health literacy significantly predicted accuracy (p <.001), but gender and self-reported label use were non-significant (p > .05) Intervention promise: Very promising

Author(s), year, country, quality rating	Sample size, characteristics & eligibility	Intervention detail (theory, setting, incentive, duration, mode of delivery, format, comparator)	Measures and timepoints	Intervention findings and intervention promise
			intervention and performance across three food choice blocks Evaluation: Yes (2-items for skills and 2-items for overall session, 5-point Likert scales)	
Miller et al. (2018) USA Quality rating: Strong	*N* = 44 59% female Age: 18-26 years; *M* = 19 years *M* education: 14 years Ethnicity: 23% Hispanic Self-reported nutrition label engagement: over	Theory: Information processing framework Setting: Web-based remote Incentive: Course credit Duration: 2-hour single session Mode of Delivery: Remote (web-based)	Measures: Nutrition label engagement from selecting healthier product from paired stimuli across three blocks of 24 food comparisons and empowerment (7-items on continuous scale)	Findings: Significant nutrition label engagement improvement from block 1 to block 2 (p <.01[a]) of the food comparison task and from block 1 to block 3 (<.05[a]). 5/7 empowerment items significantly improved

Author(s), year, country, quality rating	Sample size, characteristics & eligibility	Intervention detail (theory, setting, incentive, duration, mode of delivery, format, comparator)	Measures and timepoints	Intervention findings and intervention promise
	half the time (mean = 56.1) Eligibility: Fluent English; aged between 18-30 years	Format: Online 20-minute narrated slide tutorial and a nutrition label training task with feedback on choices Comparator: Baseline	Timepoints: Baseline, immediate post-intervention and performance across three food choice blocks Evaluation: Yes (4 items, measured on a visual analogue scale 0-100)	from baseline to post-intervention (*p* <.05[a]) Intervention promise: Quite promising
Miller et al. (2019) USA Quality rating: Strong	*N* = 90 74% female Eligibility: Fluent English; no vision impairment/eye disease	Theory: Information Processing Framework & COM-B Setting: Laboratory Incentive: College credit Duration: Single session Mode of Delivery: In-person laboratory	Measures: Nutrition label engagement effort (eye-tracking), empowerment (6-items continuous 0-100 scale) and food choice task accuracy (selecting healthier outcomes from 24 trials across three bocks)	Findings: Significant improvements in accuracy (*p* <.001; no instruction difference *p*>.05) and decreased effort (*p* <.001); with feedback+ highlighting significant effort deceases (*p* <.001)

Author(s), year, country, quality rating	Sample size, characteristics & eligibility	Intervention detail (theory, setting, incentive, duration, mode of delivery, format, comparator)	Measures and timepoints	Intervention findings and intervention promise
		Format: 20-minute narrated slide presentation, orientation tasks and nutrition label training task where some received accuracy feedback only and others received accuracy and highlighted differences Comparator: Baseline and 3 food choice task blocks	Timepoints: Baseline, immediate post-intervention and performance across three food choice blocks Evaluation: Yes (4 general items and 6 specific items measured on a continuous scale 0-100)	across the three food choice tasks. Significant improvement in empowerment (*p* <.001), no significant difference for task instruction (*p* >.05) Intervention promise: Very promising
Mnerie et al. (2015) Romania	*N* = 98 Eligible ages: 20 years and older	Theory: None Setting: Not Reported Incentive: None	Measures: Nutrition label engagement knowledge, attitude and motivation (scale undefined)	Findings: Percentage means indicated increased nutrition label engagement, significance tests not reported

Author(s), year, country, quality rating	Sample size, characteristics & eligibility	Intervention detail (theory, setting, incentive, duration, mode of delivery, format, comparator)	Measures and timepoints	Intervention findings and intervention promise
Quality rating: Weak	No further demographic characteristics reported. Eligibility: Did not read or understand nutrition labels	Duration: Weekly discussions over 3-week period Mode of Delivery: Face-to-face Format: Fact sheets and discussions based on ten labels from foods consumed that week Comparator: Baseline	Timepoints: Procedure repeated once a week for 3 weeks Evaluation: None	Intervention promise: Non-promising
Pennings et al. (2014) USA Quality rating Moderate	*N* = 32 63% female All undergraduate students Aged 18-24 years	Theory: None Setting: Laboratory Incentive: None Duration: 10-minute single session Mode of Delivery: Face-to-face Format: Booklet	Measures: Nutrition label engagement attention for five cereal boxes (eye-tracking) Timepoints: Baseline and immediate post-intervention	Findings: Significant improvements in nutrition label engagement from baseline to post-intervention and compared to the control (p <.01[a])

Author(s), year, country, quality rating	Sample size, characteristics & eligibility	Intervention detail (theory, setting, incentive, duration, mode of delivery, format, comparator)	Measures and timepoints	Intervention findings and intervention promise
	Intervention *n* = 16; control *n* = 16 Eligibility: None reported	Comparator: Baseline and control	Evaluation: None	Intervention promise: Very promising
Souza et al. (2016) Brazil Quality rating: Moderate	*N* = 702 82.6% female *M* age: 26.6 years 53.2% min. high school education Mean SES: R$1969.54 Eligibility: Over 18 years	Theory: None Setting: Not reported Incentives: None Duration: Single session Mode of Delivery: Face-to-face Format: Educational materials and 50-minute dialogue Comparator: Baseline	Measures: Nutrition label engagement questionnaire (22-items, dichotomous responses), and 1 stimulus task to determine product health Timepoints: Baseline and 30-day post-intervention Evaluation: Yes (1-item 4-point Likert scale)	Findings: Significant improvement in reading the nutrition label reported from baseline to post-intervention (p <.001) and traffic light colour indicator understanding (p <.01[a]). Significant difference between baseline and post-intervention for importance of nutrition information (p <.05[a]). Four non-significant

Author(s), year, country, quality rating	Sample size, characteristics & eligibility	Intervention detail (theory, setting, incentive, duration, mode of delivery, format, comparator)	Measures and timepoints	Intervention findings and intervention promise
				findings relating to knowledge Intervention promise: Quite promising
Taylor-Davis et al. (2000) USA Quality rating: Strong	*N* = 386 43% women Age: 60-74 years *M* = 69.4 years Education: 50% min. high school Ethnicity: All white Majority rated nutrition knowledge as average	Theory: Nutrition Communication Model & Adult learning theory Setting: Remote (posted to home) Incentive: None Duration: Bi-weekly newsletters over 10 weeks Mode of Delivery: Remote	Measures: Nutrition label engagement knowledge (47-item content MCQs with an “I don’t know option); perceived nutrition knowledge (20-item 5-point Likert scale); interest in nutrition (8-item 5-point Likert scale); food behaviour (81-item 5-point Likert scale);	Findings: At post-intervention significant improvements in nutrition knowledge, perceived nutrition knowledge, interest in nutrition and 2 behavioural measures ($p < .05^{a}$) compared to baseline and control. Condition with follow-up calls had significantly higher cognitive and

Author(s), year, country, quality rating	Sample size, characteristics & eligibility	Intervention detail (theory, setting, incentive, duration, mode of delivery, format, comparator)	Measures and timepoints	Intervention findings and intervention promise
	n = 127 newsletter with telephone interview *n* = 127 newsletter only *n* = 132 control No significant differences between groups at baseline. Eligibility: None reported	Format: Newsletters and newsletters with telephone calls Comparator: Baseline and control	stages of change (6-items) Timepoints: Baseline and 2-week post-intervention Evaluation: Yes (process evaluation interviews 10-14 days after each newsletter)	affective improvements than those receiving the newsletter only (p <.05[a]). Some non-significant differences reported across the behavioural measures Intervention promise: Very promising

[a]Significance values varied across results but are reported collectively in the table as p <.05, p <.01 and p <.001 as appropriate.

[b]The findings from Graham et al. were reported across two papers based on the measures but have been combined for the present review as conclusions are drawn from the same participants and intervention, within the text these studies are referred to by the earliest date Graham et al. (2015) for clarity in the write-up.

2.3.2.2 The Format of the Existing Interventions. Most interventions were written educational materials e.g., a newsletter / booklet / pamphlet (*n* = 8) (Brunt & Schafer, 1997; Dooley et al., 1998; Esfandiari et al., 2020; Kreuter et al., 2002; Mnerie et al., 2015; Pennings et al., 2014; Souza et al., 2016; Taylor-Davis et al., 2000); PowerPoint slides (*n* = 3) (Miller et al., 2017, 2018, 2019); or in aisle educational signage (*n* = 1) (Graham et al., 2015). Of these interventions some were combined with a discussion (*n* = 3) (Mnerie et al., 2015; Souza et al., 2016; Taylor-Davis et al., 2000) or nutrition label training task (*n* = 3) (Miller et al., 2017, 2018, 2019). Remaining interventions comprised an educational prime (*n* = 1) (Kees et al., 2014); a workshop (*n* = 1) (Lindhurst et al., 2007) and a workshop and tour (*n* = 1) (Dukeshire et al., 2014).

In the studies synthesised, researchers commonly outlined content within the intervention was based on credible sources but sometimes with lack of detail. Only three studies drew upon existing theoretical underpinnings when reporting and/or evaluating the effectiveness of the intervention or measures implemented. Taylor-Davis et al. (2000) reported their findings in relation to the Nutrition Communication Model (Gillespie & Yarbrough, 1984) and the Adult Learning Theory (Knowles, 1978). Miller et al. (2018, 2019) reported the training food choice task was informed by the Information Processing Framework (Kanfer & Ackerman, 1989). Furthermore, Miller et al. (2019) related their findings back to the COM-B model (Capability, Opportunity, Motivation – Behaviour Model; Michie et al., 2011).

2.3.2.3 The Delivery Mode of the Interventions. Ten of the interventions were delivered face-to-face. These face-to-face interventions were delivered in a range of settings, these were in a supermarket setting (*n* = 4) (Dooley et al., 1998; Dukeshire et al., 2014; Esfandiari et al., 2020; Mnerie et al., 2015), a laboratory setting (*n* = 3) (Graham et al., 2015; Miller et al., 2019; Pennings et al., 2014) or a community setting (*n* = 2) (Brunt & Schafer, 1997; Lindhurst et al., 2007). Souza et al. (2016) reported their intervention was delivered face-to-face but did not report the setting. The remaining five interventions had asynchronous delivery modes online (*n* = 3) (Kees et al., 2014; Miller et al., 2017, 2018) or remote with physical resources posted to participants (*n* = 2) (Kreuter et al., 2002; Taylor-Davis et al., 2000). Thirteen of the interventions were delivered in a single session and two were delivered over a period of weeks. Mnerie et al. (2015) delivered their intervention in weekly sessions over a 3-week period and Taylor-Davis et al. (2000) delivered their intervention materials bi-weekly over a 10-week period. Most of the studies did not offer an incentive for participants.

2.3.2.4 Study Measures and Timepoints. The measures varied across the studies included in the review. Nutrition label engagement was measured objectively i.e., eye-tracking attention measures (*n* = 4), subjectively i.e., self-report questionnaires (*n* = 5), and a combination of objective and subjective measures (*n* = 6). The range of measures (i.e., a subscale, total scale or objective measure) included in a single study varied from a minimum of one to a maximum of five.

Self-reported nutrition label engagement, including ‘attitudes’, ‘knowledge’, ‘confidence’, ‘empowerment’, ‘use’ and ‘read’ were measured using questionnaires with a range of responses. Likert scales were the most reported type of questionnaire response (*n* = 5) (Dukeshire et al., 2014; Esfandiari et al., 2020; Kees et al., 2014; Lindhurst et al., 2007; Miller et al., 2017; Taylor-Davis et al., 2000), followed by multiple-choice questions (*n* = 3) (Dukeshire et al., 2014; Miller et al., 2017; Taylor-Davis et al., 2000), visual analogue scales (*n* = 2) (Miller et al., 2018, 2019) and dichotomous yes/no responses (*n* = 2) (Kreuter et al., 2002; Souza et al., 2016). Mnerie et al. (2015) did not describe the unit of measure for the scales used.

Objective measures of nutrition label engagement were employed in most of the studies. Eight studies used nutrition label/food product stimuli to measure engagement during food selection (Graham et al., 2015; Kees et al., 2014; Pennings et al., 2014; Miller et al., 2017, 2018, 2019; Mnerie et al., 2015; Souza et al., 2016) and two studies included nutrition label stimuli as a basis for comprehension questions (Brunt & Schafer, 1997; Dooley et al., 1998). Three of these studies used eye-tracking to assess nutrition label engagement (Graham et al., 2015; Miller et al., 2019; Pennings et al., 2014). Kees et al. (2014) included a ‘thought listing’ measure immediately after food task engagement to capture total, positive and negative nutrition-related thoughts.

The most common timepoints that the intervention measures were collected were at baseline and immediate post-intervention (*n* = 7) (Brunt & Schafer, 1997; Dukeshire et al., 2014; Lindhurst et al., 2007; Miller et al., 2017, 2018, 2019; Pennings et al., 2014), with two of these studies including

1-month (Dukeshire et al., 2014) or 3-month follow-up (Lindhurst et al., 2007). Two studies only collected measures at immediate post-intervention (Graham et al., 2015; Kees et al., 2014). Four studies collected performance-related task intervention measures across timepoints, which were in addition to other intervention measures collected (Miller et al., 2017, 2018, 2019; Mnerie et al., 2015). Five studies collected intervention measures at baseline and delayed post-intervention, at 10-days (Dooley et al. 1998), 2-weeks (Taylor-Davis et al., 2000), 30-days (Souza et al., 2016), 3 months (Kreuter et al., 2002) and 3-6 months (Esfandiari et al., 2020).

2.3.2.5 Intervention Promise. Five studies were categorised as 'very promising' (Kreuter et al., 2002; Miller et al., 2017, 2019; Pennings et al., 2014; Taylor-Davis et al., 2000). Seven studies were classified as 'quite promising'. These classifications were based on: (a) significant differences baseline to post-intervention for repeated-measures studies (*n* = 4) (Dukeshire et al., 2014; Esfandiari et al., 2020; Miller et al., 2018; Souza et al., 2016); (b) significant differences baseline to post-intervention for between-group studies without baseline measures (*n* = 2) (Graham et al., 2015; Kees et al., 2014); and (c) one study reported significant differences Baseline to post-intervention but not compared to the control condition (Dooley et al., 1998). Three studies were categorised as 'non-promising' due to no tests of significance outcomes reported (Brunt & Schafer, 1997; Lindhurst et al., 2007; Mnerie et al., 2015).

2.3.2.6 Behaviour Change Techniques in the Interventions. Ten different BCTs (Michie et al., 2013) were used across all interventions and were drawn from nine out of 16 different BCTT categories. Interventions contained an average of 6.10 BCTs. Table 2.2 shows coder confidence of the presence of each BCT per intervention using the method taught in the BCTT training. A coder confidence of '++' represents the BCT as being present with clear evidence, and a coder confidence of '+' represents the BCT as probably present but the evidence is unclear. If no coder confidence is provided in Table 2.2 the BCT was not coded in the intervention. Due to the heterogeneity and small number of studies within sub-groups (e.g., intervention setting, format and quality), it was not possible to calculate and draw meaningful conclusions from the promise ratio of BCTs used in sub-groups. Very/quite promising interventions contained less BCTs on average compared to non-promising interventions (5.92 vs. 6.67 respectively). The minimum number of BCTs used was 3 and the maximum was 9.

Table 2.3 shows the BCTs and the promise ratios reported from highest to lowest ratio. In total 10 BCTs were considered promising. All 10 BCTs had a promise ratio of at least 2, indicating they were reported in at least double the number of quite/very promising interventions as non-promising interventions. The eight BCTs with the highest promise ratios (ratios of 3-5, or present in three or more quite/very promising interventions, a threshold employed by Leslie et al., 2021) were: 'prompts/cues', 'instruction on how to perform the behaviour', 'demonstration of the behaviour', 'credible source', 'material reward (behaviour)', 'information about health consequences', 'behavioural practice' and 'habit formation'.

Table 2.2

BCT Presence and Coder Confidence Per Intervention

Study	BCT Code									
	1.1	2.7	4.1	5.1	6.1	7.1	8.1	8.3	9.1	10.2
Brunt & Schafer (1997)	+		+		+				+	
Dooley et al. (1998)			+		+	+			+	
Dukeshire et al. (2014)	+		++		++				++	
Esfandiari et al. (2020)			++		++	++			+	+
Graham et al. (2015, 2016)	+		++		++	++			+	++
Kees et al. (2014)	+		+		+	+			+	+
Kreuter et al. (2002)		+	++	++	++				++	
Lindhurst et al. (2007)	+	+	+	+	+	+			++	
Miller et al. (2017)		++	++	+	++	+	++	+	+	
Miller et al. (2018)		++	++	++	++	+	++	++	+	
Miller et al. (2019)		++	++	++	++	+	++	++	+	++
Mnerie et al. (2015)	+	++	++	++	++	+	++	+	++	
Pennings et al. (2014)	+		++	+	++	+			+	
Souza et al. (2016)	+		++	++	++	+			+	
Taylor-Davis et al. (2000)	++		+	+	+	+			++	

Table 2.3

Coded BCTs from the Reviewed Studies and their Promise Ratios

BCT Code and Name	Definition[a]	BCT category	Number of BCTs in promising interventions	Number of BCTs in non-promising interventions	Promise ratio*
7.1 Prompts/cues	"Introduce or define environmental or social stimulus with the purpose of prompting or cueing the behaviour. The prompt or cue would normally occur at the time or place of performance"	7. Associations	10	2	5
4.1 Instruction on how to perform the behaviour.	"Advise or agree on how to perform the behaviour (includes 'skills training')"	4. Shaping knowledge	12	3	4
6.1 Demonstration of the behaviour	"Provide an observable sample of the performance of the behaviour, directly in person or indirectly (e.g., via film, pictures, for the person to aspire to or imitate), includes 'modelling'"	6. Comparison of behaviour	12	3	4
9.1 Credible source	"Present verbal or visual communication from a credible source in favour of or against the behaviour"	9. Comparison of outcomes	12	3	4

BCT Code and Name	Definition[a]	BCT category	Number of BCTs in promising interventions	Number of BCTs in non-promising interventions	Promise ratio*
10.2 Material reward (behaviour)	"Arrange for the delivery of money, vouchers or other valued objects if and only if there has been effort and/or progress in performing the behaviour (includes 'positive reinforcement')"	10. Reward and threat	4	-	4*
5.1 Information about health consequences	"Provide information (e.g., written, verbal, visual) about health consequences of performing the behaviour"	5. Natural consequences	7	2	3.5
8.1 Behavioural practice/rehearsal	"Prompt practice or rehearsal of the performance of the behaviour one or more times in a context or at a time when the performance may not be necessary, in order to increase habit and skill"	8. Repetition and substitution	3	1	3
8.3 Habit formation	"Prompt rehearsal and repetition of the behaviour in the same context repeatedly so that the context elicits the behaviour"	8. Repetition and substitution	3	1	3
2.7 Feedback on outcome(s) of behaviour	"Monitor and provide feedback on the outcome of performance of the behaviour"	2. Feedback and monitoring	4	2	2

BCT Code and Name	Definition[a]	BCT category	Number of BCTs in promising interventions	Number of BCTs in non-promising interventions	Promise ratio*
1.1 Goal setting (behaviour)	"Set or agree a goal defined in terms of the behaviour to be achieved"	1. Goals and planning	6	3	2

[a]Definitions taken from Michie et al. (2013)

*BCT in promising interventions only, *n* = number of times BCT present.

2.3.2.7 Study Evaluation Reported. Seven of the included studies did not report consumer evaluation of the intervention (Brunt & Schafer, 1997; Dooley et al., 1998; Esfandiari et al., 2020; Graham et al., 2015; Kees et al., 2014; Mnerie et al., 2015; Pennings et al., 2014). Where evaluation was reported, most of the studies reported Likert-scale scores on intervention satisfaction items (*n* = 5) (Dukeshire et al., 2014; Kreuter et al., 2002; Lindhurst et al., 2007; Miller et al., 2017; Souza et al., 2016) or a visual analogue scale from 0-100 (*n* = 2) (Miller et al., 2018, 2019). One study reported process evaluation at each delivery point (Taylor-Davis et al., 2000).

2.3.2.5 Study Quality Assessment. Six of the included studies were rated as strong (Graham et al., 2015; Kreuter et al., 2002; Miller et al., 2017, 2018, 2019; Taylor-Davis et al., 2000); five were rated as moderate (Dooley et al., 1998; Esfandiari et al., 2020; Lindhurst et al., 2007; Pennings et al., 2014; Souza et al., 2016) and four were rated as weak (Brunt & Schafer, 1997; Dukeshire et al., 2014; Kees et al., 2014; Mnerie et al., 2015). Five of the 'strong' quality rated studies were classified as having a 'very promising' intervention promise (Kreuter et al., 2002; Miller et al., 2017, 2019; Taylor-Davis et al., 2000). The remaining 'strong' quality rated studies, four of the 'moderate' quality rated studies and two of the 'weak' quality rated studies were classified as having a 'quite promising' intervention promise (Dooley et al., 1998; Dukeshire et al., 2014; Esfandiari et al., 2020; Graham et al., 2015; Kees et al., 2014; Miller et al., 2018; Pennings et al., 2014; Souza et al., 2016). One 'moderate' and two 'weak' quality rated studies were classified as non-promising (Brunt & Schafer, 1997; Lindhurst et al., 2007; Mnerie et al., 2015).

2.4 Discussion

The systematic review reported in this chapter addressed Thesis Objective 1. It systematically reviewed and evaluated the effectiveness of existing single-component nutrition label engagement interventions targeting healthy adults.

2.4.1 Summary of the Main Findings

The systematic review synthesised findings from across 15 unique interventions reported in 16 studies which met the eligibility criteria from the 18,227 initially identified unique studies. Twelve of the included nutrition label engagement interventions were categorised as ‘quite/very’ promising as they improved nutrition label engagement. This answered the first review question, as most of the single-component nutrition label engagement interventions were statistically significant (effective) at improving engagement levels with back-of-pack nutrition labels and/or multiple traffic light front-of-pack nutrition labels. The remaining three studies reported improvements in nutrition label engagement but did not report inferential statistics. As a result, based on the intervention promise guidelines, these interventions were categorised as ‘non-promising’. This highlighted the responsibility of researchers to report appropriate statistical tests. In addition, researchers should consistently report effect sizes, so that the effectiveness of the implemented intervention can be assessed and comparisons can be made across studies.

In answer to the second review question, 10 BCTs were coded from the interventions included within the review spanning across nine BCT categories. Of the coded BCTs all were considered promising as they had a promise ratio of at least 2. The most effective BCTs, with promise ratios of 4 or more, were: ‘prompts/cues’, ‘instruction on how to perform the behaviour’, ‘demonstration of the behaviour’ and ‘credible source’. There may be BCTs that were not coded within this review that may be important to consider when designing interventions. For example, there are BCTs which may support some of the coded BCTs highlighted in this review, such as incorporating ‘action planning’ and ‘commitment’ as BCTs to support where ‘goal setting (behaviour)’ is implemented. Thus, where appropriate, incorporation of the promising BCTs reported within this review alongside ‘supporting’ BCTs may further strengthen the impact of future intervention development.

Overall, the existing nutrition label engagement interventions included in the review showed promise in relation to their effectiveness in improving nutrition label engagement levels, and in the effectiveness of a variety of BCTs informing the intervention design. However, the lack of detail in the intervention content and measures affect the ability for future replication.

2.4.2 Types of Interventions, Measures and Timepoints

Most interventions reviewed were written educational materials (Brunt & Schafer, 1997; Dooley et al., 1998; Esfandiari et al., 2020; Kreuter et al., 2002; Miller et al., 2017, 2018, 2019; Mnerie et al., 2015; Pennings et al., 2014; Souza et al., 2016; Taylor-Davis et al., 2000) which supported Moore et al.’s (2018a) justification for this type of intervention being the most commonly implemented. Only four interventions from Moore et al.’s (2018a) review were included after the screening process in the present review

(Dukeshire et al., 2014; Lindhurst et al., 2007; Miller et al., 2017; Pennings et al., 2014) and no papers synthesised from Schruff-Lim et al.'s (2023) review were included. This highlighted that the eligibility criteria for the present review returned additional nutrition label engagement studies focused on healthy adults to consider in the intervention development process in this thesis.

Ten of the interventions reviewed were delivered face-to-face with the consumer (Brunt & Schafer, 1997; Dooley et al., 1998; Dukeshire et al., 2014; Esfandiari et al., 2020; Graham et al., 2015; Lindhurst et al., 2007; Miller et al., 2019; Mnerie et al., 2015; Pennings et al., 2014; Souza et al., 2016) and 13 of the interventions were delivered in a single session (Brunt & Schafer, 1997; Dooley et al., 1998; Dukeshire et al., 2014; Esfandiari et al., 2020; Graham et al., 2015; Kees et al., 2014; Kreuter et al., 2002; Lindhurst et al., 2007; Miller et al., 2017, 2018, 2019; Pennings et al., 2014; Souza et al., 2016). These findings demonstrate that a single intervention session can be effective in encouraging improved nutrition label engagement (n = 11), but that this did not always translate to the effectiveness of face-to-face delivery.

Therefore, when considering future intervention development, whilst face-to-face interventions were the most common intervention type reported, the ratio of promising to non-promising interventions may indicate that remote/asynchronous interventions may be a promising avenue to explore. This is also important to consider as asynchronous interventions have been shown to be as effective as face-to-face interventions and are more time and resource efficient and cost-effective to deliver (Steele et al., 2009).

Therefore, caution should be observed when developing new interventions to ensure that they are scalable and feasible to the target audience.

The number and variety of measures used to assess the effectiveness of interventions across the studies reviewed demonstrated the lack of consensus in the field on how best to measure nutrition label engagement. This is reflective of the differences in how consumer engagement was established in Chapter 1. Therefore, research is needed to assess which task(s) and measure(s) are most effective at assessing consumer nutrition label engagement. Once this has been established, the developed measures can be used to assess the effectiveness of interventions. This will ensure the measures are replicable. This approach is taken in the empirical chapters presented in this thesis.

The most common timepoints implemented in the reviewed studies were baseline and immediate post-intervention timepoints (Brunt & Schafer, 1997; Dukeshire et al., 2014; Lindhurst et al., 2007; Miller et al., 2017, 2018, 2019; Pennings et al., 2014) and baseline and delayed post-intervention timepoints from 10 days up to 3-6 months (Dooley et al. 1998; Esfandiari et al., 2020; Kreuter et al., 2002; Souza et al., 2016; Taylor-Davis et al., 2000). Therefore, future studies may seek to employ baseline and immediate post-intervention measures to assess the immediate impact of the intervention. It is also recommended that for a health-related intervention a follow-up timepoint should be included, this was emphasised in studies included in the review (e.g., Dukeshire et al., 2014; Miller et al., 2018). Therefore, the follow-up timepoint may be informed by the length of time of the delayed post-intervention timepoints reported in this review.

2.4.3 Limitations of the Reviewed Studies

The studies provided promising insights to help inform the development of a novel intervention. However, there were limitations with the studies included within the review. Firstly, many of the studies did not report effect sizes and three studies did not report tests of significance. This had implications on the ability to calculate 'intervention promise'. Calculating 'intervention promise' based on effect sizes, which are less dependent on sample size than tests of significance, may have provided additional insights into the overall effectiveness of the reviewed interventions (Clark-Carter, 2019; Lewis et al., 2021). It is also important to note that there was a general lack of reporting of BCTs across the studies reviewed. This has been a limitation reported in previous systematic reviews (Lewis et al., 2021; Rigby et al. 2020). In the present review, some interventions were developed prior to the publication of the BCTT. Nevertheless, future interventions should make every effort to explicitly state the theories and BCTs included to improve the reporting of interventions and to allow for replication and comparison of intervention studies.

There were also limited demographic characteristics and no study inclusion/exclusion explicitly reported for some of the studies included in the review. Furthermore, none of the studies reviewed had a UK sample, which is the intended audience for the intervention developed within the thesis. Therefore, these factors may limit the generalisability of the findings to a healthy adult UK audience. As a result, further steps to investigate consumers' ideas and perspectives of the possible content, delivery and measures for the proposed intervention developed was important to explore in this thesis. This is especially important for the BCTs, to ensure that they are acceptable to the intended audience to inform the intervention development process.

2.5 A Summary of the Chapter Contributions

This chapter presented the findings from a systematic review. The findings addressed Thesis Objective 1, whereby the existing single-component nutrition label engagement interventions targeting healthy adults were systematically reviewed and evaluated. The studies reviewed showed 'intervention promise' for 12 of the interventions and 10 BCTs. There were also key considerations to inform the development of the intervention in this thesis relating to the format, delivery mode, measures and timepoints. The findings highlighted the need to assess the acceptability of different intervention approaches with the intended UK consumer audience. Furthermore, it showed that future interventions should be grounded in theory, robust measures and analyses to assess the effectiveness of the intervention implemented.

Chapter 3: Theoretical Framework

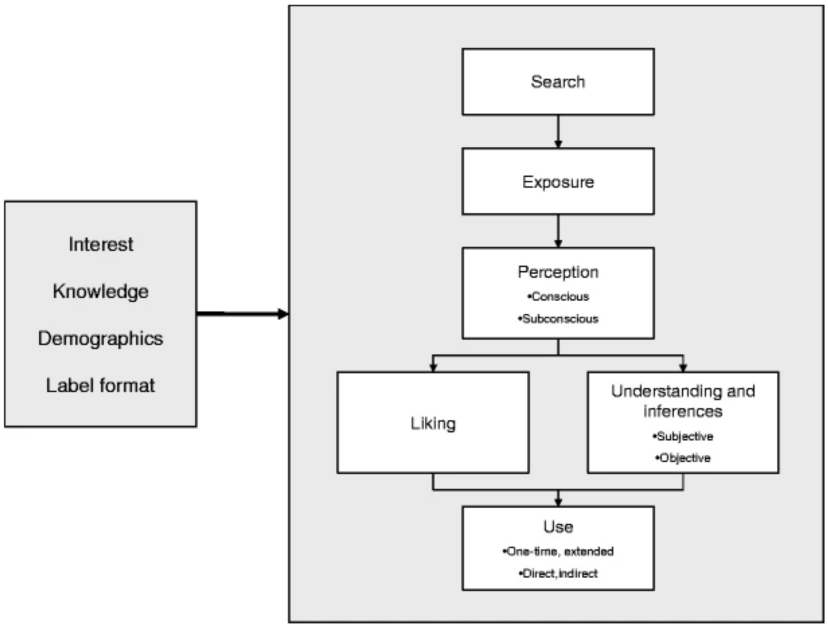
This chapter draws from the theories outlined in Chapter 2 and explores the theoretical underpinnings of the nutrition label engagement task developed and the intervention designed and implemented within this thesis. The chapter begins by reviewing and applying key relevant nutrition label engagement theories to a novel label food choice task, which was refined and implemented across the studies conducted in the thesis. Next, justification for the theoretical approach taken in the thesis to inform the nutrition label engagement intervention is presented. The chapter then outlines how the stages of the chosen behaviour change framework informed the intervention developed, implemented and evaluated in this thesis. The chapter concludes with a summary of the theoretical framework used in the thesis.

3.1 Nutrition Label Engagement Theories

Nutrition label engagement theories were reviewed to inform the development of the novel food choice task implemented in the thesis empirical studies. This was important to ensure that intervention effectiveness was assessed with appropriate measures. Grunert and Wills (2007) proposed the Theoretical Framework of Label Usage (Figure 3.1), which was informed by attitude formation and change literature and consumer decision-making from a cognitive perspective. The initial '*search*' stage of the conceptual framework suggested that consumers must first seek nutrition labels on prepacked products.

Figure 3.1

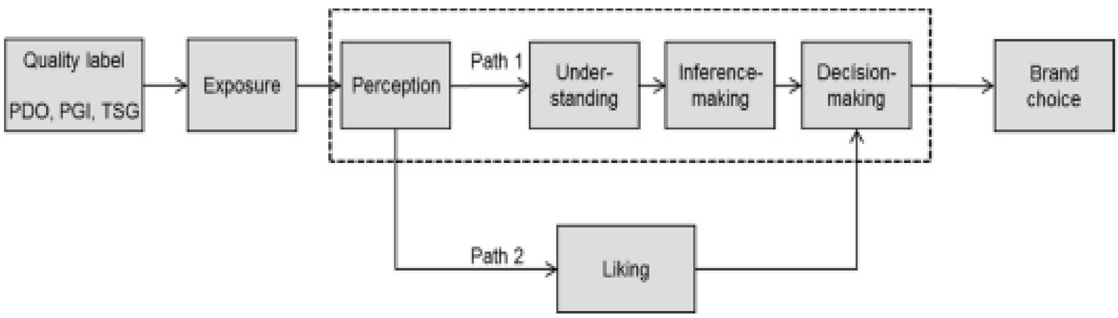
The Theoretical Framework of Label Usage (Grunert & Wills, 2007)



However, nutrition label engagement can happen due to external factors which can capture attention (Bix et al., 2015). Therefore, the '*search*' stage was not a precursor to the '*exposure*' stage. As a result, Grunert and Aachmann (2016) proposed the revised Hierarchy of Effects Model of Quality Labelling (Figure 3.2), which removed the '*search*' stage.

Figure 3.2

Hierarchy of Effects Model of Quality Labelling (Grunert & Aachmann, 2016)



The ‘*exposure*’ stage of the models reflects the Information Processing Approach (Eysenck & Keane, 2020), which highlights differences in bottom-up and top-down processing. Bottom-up processing of nutrition labels occurs when the consumer is reading or evaluating the information during exposure. Top-down processing of nutrition labels is where external factors, such as experiences and level of interest can impact engagement during exposure. These differences in information processing can impact the cognitive processes underpinning nutrition label engagement. The third stage is ‘*perception*’ (Grunert & Aachmann, 2016; Grunert & Wills, 2007), which can occur subconsciously or consciously, for example, where consumers self-report nutrition label engagement but do not consciously process them (Cowburn & Stockley, 2005). These differences in perceptions suggest a triangulation of measures is important to assess nutrition label engagement and the effectiveness of interventions.

The path to decision making splits into two in the models proposed by Grunert and Aachmann (2016) and Grunert and Wills (2007). Path 1 relates to ‘*understanding*’ and ‘*inference*’ (Grunert & Aachmann, 2016; Grunert & Wills, 2007) and draws on the deliberate process of the Dual Process Theory (Kahneman, 2011). The cognitive processes in this path are reason-based and driven by capability, opportunity and motivations for nutrition label engagement in the decision-making process (Higgs, 2016). The cognitive processes involved in this stage can be impacted by working memory, a multicomponent system that enables consumers to bring goals and knowledge held in long-term memory to the forefront when making food choices (Baddeley, 2012; Gruszka & Nęcka, 2017).

Working memory is responsible for selective attention towards stimuli, which is vital in a supermarket environment where consumers are unable to process every piece of information (Franken et al., 2025; Mirhoseini et al., 2025). However, this selective attention combined with reliance on long-term memory stores has the potential to lead to misinterpretations or false associations during nutrition label engagement (Leathwood et al., 2007). The variations in consumer information processing which inform decision-making may explain differences in consumer nutrition label engagement reported in Chapters 1 and 2.

Alternatively, path 2 relates to '*liking*' (Grunert & Aachmann, 2016; Grunert & Wills, 2007) and draws on the intuitive process of the Dual Process Theory (Kahneman, 2011). This path is based on automatic motivations and thinking, leading to fast and habit-based cognitive processes which are informed by positive emotions for food choice. This may lead to low nutrition label engagement, or for the nutrition label to be ignored, in the decision-making process as liking is prioritised (Grunert & Aachmann, 2016). This supports the suggestion that liking and taste can influence nutrition label engagement in the food choice decision-making process (Perez-Cueto, 2019).

The final stage of Grunert and Aachmann (2016) and Grunert and Wills (2007) models, is the resulting decision of nutrition label engagement during food selection, which is influenced by the preceding stages of the models. Therefore, to improve the efficacy of nutrition label engagement it is important to assess it during food decision-making tasks (Mawad et al., 2015; Ni Mhurchu et al., 2018). The nutrition label acquisition task implemented by Miller et al. (2018, 2019) was informed by the Information Processing Framework which assesses cognitive ability and motivation (Kanfer & Ackerman, 1989). Thus, incorporating theory into food choice tasks used to assess the effectiveness of interventions has been promising.

Furthermore, Marlow (2017) suggested that the extent to which nutrition labels are effective is dependent on the probabilities of: (1) consumer nutrition label engagement; (2) nutrition label engagement improving their healthier food choices; and (3) nutrition label engagement improving healthier food choices and the consumer experiencing improved overall health. This further supports the inclusion of food choice tasks to assess intervention effectiveness in this thesis as it aimed to improve the second probability outlined by Marlow.

The nutrition label engagement theories outlined in this section were important to consider in the design of the food choice task and measures to assess the effectiveness of the intervention developed in this thesis. The key learnings from this review of relevant theories and models were considered in the development of the food choice task.

3.2 Nutrition Label Engagement Food Choice Task Development

3.2.1 Justification for the Novel Food Task

There is no standardised instrument to assess nutrition label engagement (Christoph et al., 2015). The systematic review findings (Chapter 2) reported eight studies included a nutrition label or food task to assess engagement, but these were not easily replicable or had limitations to be addressed. Similar constraints and lack of consensus of intervention assessment instruments were also reported in Moore et al.'s (2018a) and Schruff-Lim et al.'s (2023) reviews. Ma and Zhuang (2021) reported food choice tasks simulate consumer nutrition label engagement when making food choices, which improves study external validity. Therefore, it was essential to develop a robust, replicable instrument, informed by nutrition label engagement theories, to assess the effectiveness of the nutrition label engagement intervention across different timepoints.

The approach to the food choice task was informed by Ma and Zhuang's (2021) review of 45 nutrition label engagement food tasks. They highlighted two common types of food task in the literature: (1) *choice tasks*, reported in 58% of the studies; and (2) *evaluation tasks*, reported in 20% of the studies. Choice tasks ask consumers to choose at least one food from alternatives e.g., to purchase (Graham & Jeffery, 2011; van Herpen & van Trijp, 2011). Evaluation tasks require consumers to evaluate a food product e.g., on overall or nutrient-specific healthiness (Jones & Richardson, 2007).

Choice and evaluation tasks have typically been implemented separately (Ma & Zhuang, 2021). However, combining the tasks within one study could yield greater insights into nutrition label engagement, such as whether accuracy in nutrition label comparisons (choice) is influenced by the evaluation requested (Azman & Sahak, 2014). This approach was employed in the empirical studies conducted as it provided insights into the complexities of nutrition label engagement, especially when complex decision-making is required. The novel instrument is referred to as '*food choice task*' for ease of identification in the thesis, but it combined '*choice*' and '*evaluation*' elements.

To account for differences in nutrition label engagement, back-of-pack and front-of-pack labels were included in the food choice task. The Dual Process Theory (Epstein, 1994; Kahneman, 2011) suggests back-of-pack nutrition labels appeal to the *deliberate* process, due to the consumer needing to spend more time to engage with values to justify their food choices (Sanjari et al., 2017). This is due to the label being non-directive in nature, as it does not provide evaluation of the nutrient values presented in relation to the overall healthiness of the product (Ma & Zhuang, 2021; Mhurchu et al., 2017). In contrast, the front-of-pack nutrition label appeals to the *intuitive* strand of the Dual Process Theory (Epstein, 1994; Kahneman, 2011). Multiple traffic light front-of-pack nutrition labels are semi-directive and interpretive, as nutrition values are presented alongside salient colour features to indicate the nutrient-specific healthiness of the product (Hodgkins et al., 2012; Mhurchu et al., 2017; Sanjari et al., 2017).

3.2.2 Food Choice Task - Stimuli Development

Chilled and frozen ready meals were chosen as the prepacked food product for the stimuli used across the research conducted in this thesis. Ready meals were chosen for several reasons: (a) ready meals are popular prepacked food products, which account for a large proportion of food sales in the UK (Scarborough et al., 2015); (b) ready meals do not require consumers to add ingredients to them (Costa et al., 2001) and the products chosen were 400g to ensure consistency in serving sizes (Harrington et al., 2019); and (c) ready meals must display nutrition labels and are a food category with considerable nutritional variance (Anderson et al., 2008; Scarborough et al., 2015). This ensured variation in the extracted nutritional values for the food choice task designed. The ready meals were paired for the food choice task, as comparisons between two products is the most popular task undertaken for nutrition label engagement (Higginson, 2002a). The stimuli product characteristics were standardised to reduce variability in packaging features. This approach reduced product familiarity but ensured that decision-making was reflective of food choices and not limited to presenting paired nutrition labels in isolation (Graham & Jeffery, 2012; Jones & Richardson, 2007; Miller et al., 2019).

The stimulus exposure time was informed by Spence and Piqueras-Fiszman (2012), who reported that consumers take an average time of 2.5 seconds to make a food choice in supermarkets. Furthermore, Graham and Jeffery (2011) reported that consumers spend approximately 1 second looking at nutrition information when making food choices. A switch between the product orientation was important to provide realistic engagement and enable consumers to engage with each strand of the Dual Process Theory (Epstein, 1994; Kahneman, 2011), which reflected the non-directive (back-of-pack) and the semi-directive (front-of-pack) nutrition labels. Therefore, to reflect usual behaviours, participants viewed each paired ready meal trial for a maximum of 10 seconds when making each food choice. The 10 second exposure time was selected to reflect the pairing of products and the front and back view of the products shown separately. Thus the 2.5 seconds was multiplied by 4 to inform the maximum exposure time of 10 seconds.

In Study 1, participants were able to freely ‘switch’ between front-of-pack and back-of-pack product displays as frequently as they wished during the 10 second exposure. The total switch count for the “purchase’ condition was 1040 switches (*M* = 0.65 switches, range = 0-36 switches across 20 stimuli). The total switch count for the 'health-related' condition was 978 switches (*M* = 0.61 switches, range = 0-35 switches across 20 stimuli). The total switch count for the 'nutrient-specific' condition was 849, (*M* = 0.53 switches, range = 0-33 switches across 20 stimuli). The number of switches were similar across 'label difficulty' (easy *M* = 0.59 vs. moderate *M* = 0.61 vs. hard *M* = 0.60). These statistics demonstrated that participants used the switch option throughout the tasks to support their decision-making but that on average this was less than 1 time per trial. Therefore, for Studies 2 and 3, only one switch was permitted per trial. This approach aligned with the average number of switches and ensured the exposure time was not negatively impacted by too many switches when the food choice task was employed in a different setting.

3.2.2.1 Food Choice Task – Stimuli Template Development. The paired ready meal stimuli were created in Microsoft PowerPoint (Figures 3.3 and 3.4). The background packaging tray was a licensed Shutterstock photograph, ID 739741579. Each tray measured 8.25cm x 12.09cm and the white sleeve, which contained the product information, measured 8.25cm x 7.25cm. One of the paired stimuli was presented to the left and the other to the right of the screen. The pairings were presented equal distance from the centre of the slide, 0.5cm vertically and 0cm horizontally. To ensure the stimuli were standardised, the first stimulus was used as a template to edit product information into for subsequent stimuli. The information presented on the ready meal packaging was spaced at sufficient distances to ensure that the format was consistent, to minimise 'noise' in the eye-tracking data

(Orquin et al., 2016). The full display measured 1920px x 1080px with a participant viewable screen size of 50.80cm x 28.58cm. This resulted in a visual angle of 42.69^0 x 24.80^0, from a viewing distance of 65cm for Study 1.

The content for the stimuli were informed by the list of mandatory features outlined in Regulation 1169/2011: (a) the name of the food product (standardised across stimuli); (b) a list of ingredients, with quantities stated for certain ingredients and allergies or intolerances presented in bold typeface; (c) net quantity (400g for all products); (d) expiration date (standardised across stimuli); (e) storage requirements and food preparation instructions; (f) country of origin and manufacturers name and address (standardised across stimuli); and (g) nutrition declaration.

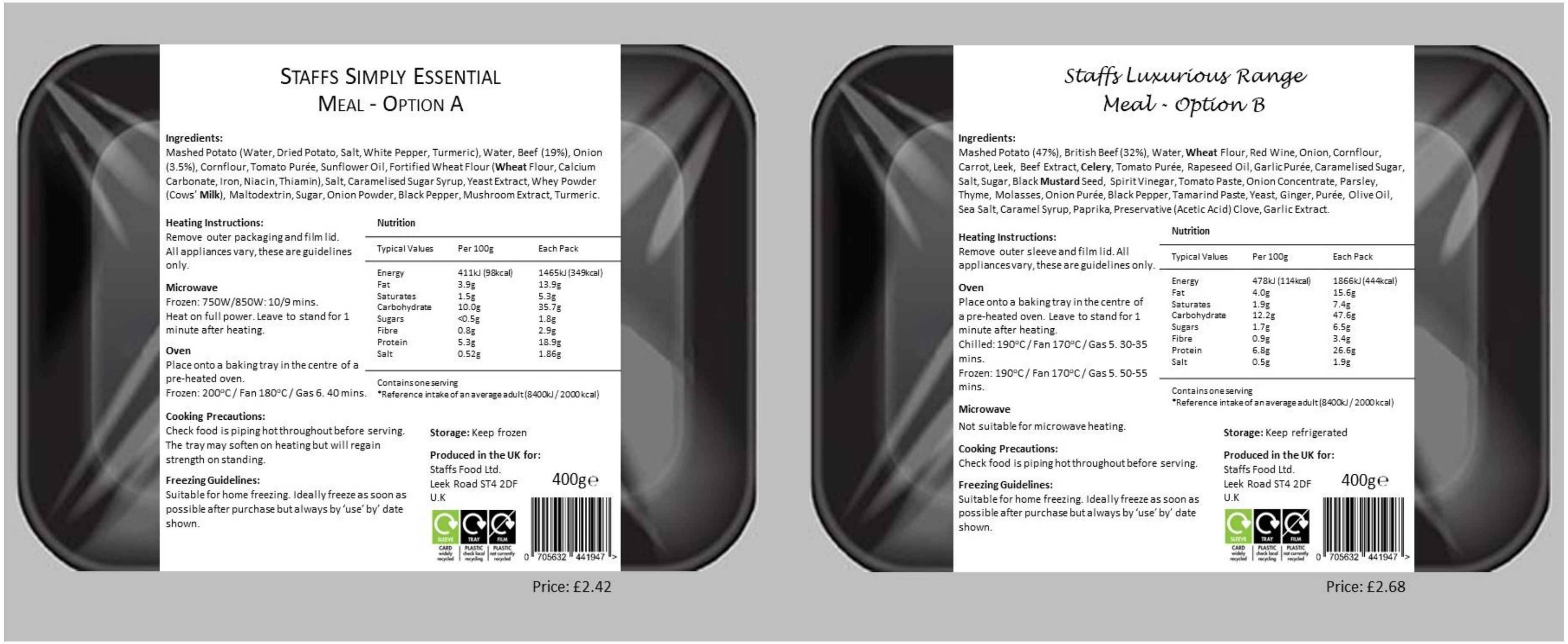
The food images presented on the packaging were extracted from the ready meal packages of the chosen meals presented on supermarket websites (e.g., Tesco, Sainsbury's and Waitrose). The images were presented using the 'picture fill' option to format the 'delay' shape in PowerPoint. The images were presented on the right of the product packaging, all measuring 3.54cm x 3.78cm with the top of the shape on the 2cm ruler line. The images of the foods were enlarged by 100% to 400% depending on the original image and made blurry so that the food could not be automatically recognised. This approach was taken to ensure familiarity with product imagery was controlled for, but ensured the colours presented in the images were reflective of products available to purchase.

Figure 3.3

Example Front-of-Pack Standardised Template used for the Paired Ready Meal Stimuli

Figure 3.4

Example Back-of-Pack Standardised Template used for the Paired Ready Meal Stimuli



3.2.2.2 Food Choice Task – Origins of Extracted Product Characteristics.

The information presented on the paired ready meal stimuli, including the nutrient composition data, was standardised or obtained from ready-to-purchase ready meals available in UK supermarkets. This decision was taken to simulate real-life comparison decision-making where possible and maintain ecological validity of the food choices made (Harrington et al., 2019; Jones & Richardson, 2007; Siegrist et al., 2015). The pairings were created based on both meals belonging to the same type of ready meal e.g., both meals were lasagne, so the comparisons were comparable to dietary choices made in a supermarket environment (Higginson et al., 2002a). The pilot testing and implementation for the present stimuli focused on the experimental effects of the manipulation of nutrition labels. Future manipulation checks may provide insights into the effects wider product information has on food choices e.g., the effectiveness of the product slogans in influencing food choice (Ejelöv & Like, 2020; Hauser et al., 2018).

The nutrition information was standardised using Regulation 1169/2011 and UK Department of Health (2016) guidelines. The nutrition labels were presented in a standardised format across the products, and the front-of-pack nutrition information was checked to ensure the colours were appropriate for the values presented. The brand and name of the ready meals were standardised to minimise familiarity effects (Antúnez et al., 2013; Oliveira et al., 2016). The brands presented on the packaging were either

‘Staffs Luxurious Range’ or ‘Staffs Simply Essential’ to control for brand preference. The terminology of ‘*luxurious*’ and ‘*essential*’ reflect commonalities in UK supermarket ready meal ranges (Scarborough et al., 2015). Each meal had an associated slogan based on the brand presented, the ‘*Simply Essential*’ slogan was ‘*food simply prepared for you*’ and the ‘*Luxurious Range*’ slogan was ‘*our fabulous range specially prepared for you*’.

In addition, the ingredients list, heating instructions, cooking precautions and storage information were extracted and transferred to the standardised templates (see Figure 3.3 and Figure 3.4). All products had the same fictitious address, barcode, expiry date and grams. The expiry date was updated for each of the research studies. The product attributes were counterbalanced so that the nutrition information was displayed across the different product characteristics. Consequently, the nutrition information was swapped within each pair across the experimental conditions to assess nutrition label engagement, irrespective of the broader product characteristics.

The price was displayed on the right below each of the products (Figures 3.3 and 3.4). The prices were determined by the average cost of the products for that meal type on supermarket websites and +/- 5% calculated. For example, if the food type was lasagne and the two product prices for perceived lower and higher brands were £1.00 and £1.60 the average was £1.30. In this example, the luxurious product would be assigned a price of 5% greater than the average (£1.37), and the essential product is assigned a price of 5% lower than the average (£1.24). This method was chosen so that if price was a motivator there was a difference between the ranges but that the price difference was not too large that it could impact choices of those not as price conscious (Burns et al., 2013; Fernqvist et al., 2024). The pricing was updated to reflect the price of products when each of the three empirical studies was conducted to ensure relevance to the respective shopping environment and cost of living.

3.2.3 Food Choice Task – Question Type

In the novel food choice tasks, participants evaluated paired stimuli to choose one product from each pair based on the type of question posed. This was to establish differences in nutrition label engagement based on different decision-based motivators (Azman & Sahak, 2014). Therefore, how each product was perceived compared to its pair (choice task) based on the question posed (evaluation task) were both important aspects to measure within the food choice (Siegrist et al., 2015). The questions posed to participants during the food choice task were informed by the nutrition label engagement theories outlined in Chapter 3.

The frameworks proposed by Grunert and Wills (2007) and Grunert and Aachmann (2016) outlined that perception of the choice and external factors influence food choices. Therefore, drawing upon the Dual Process Theory (Kahneman, 2011) the questions posed during the food choice task differed in task demand to reflect ‘deliberate processing’ of evaluating nutrition labels to answer the question posed and ‘automatic processing’ of consumer motivations and habits. This approach also encompasses the cognitive ability and motivation constructs outlined in the Information Processing Framework (Kanfer & Ackerman, 1989) which was used to inform the food choice task used by Miller et al. (2018, 2019) in the studies reviewed in Chapter 2. Based on these conclusions, there were three question types included in the novel food choice task (Figure 3.5).

Figure 3.5

Food Choice Task Question Types

Purchase	Health-related	Nutrient-specific
• '*Which of these products would you choose if you were looking to* ***purchase*** *one?*' • Examined 'automatic processing' and 'automatic motivations' based on habits and motivations	• '*Which of these products would you choose if you were looking to select the* ***healthier*** *option'* • Examined 'deliberative processing', 'psychological capability' and 'reflective motivations' for prompted health motivator	• '*Which of these products would you choose if you were looking to reduce your* ***[specific nutrient]*** *intake?*' • Examined 'deliberative processing' and 'psychological capability' for singular comparisons

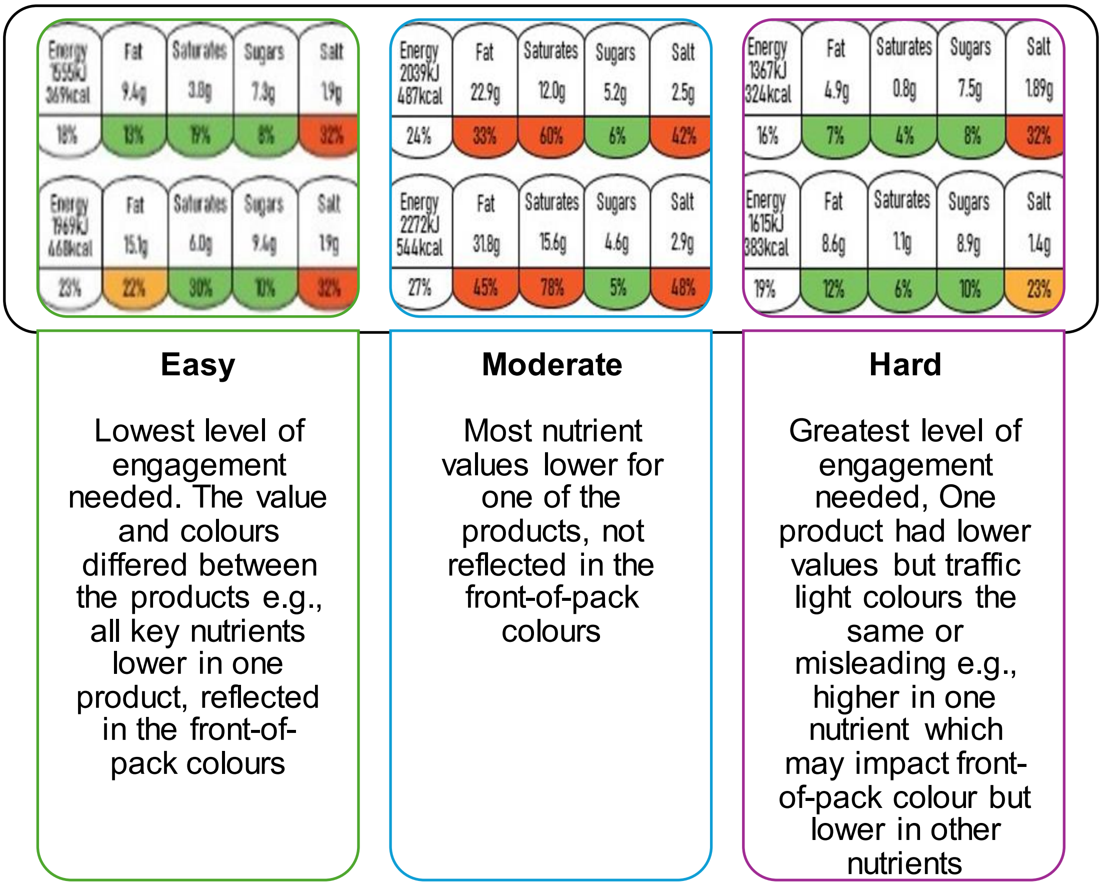
The nutrient-specific question varied based on each of the key public health nutrients of concern, the five front-of-pack nutrition label nutrients (calories, fat, salt, saturated fat and sugar), with each nutrient included an even number of times across the trials. The nutrient-specific condition was not included in the food choice task employed to assess the effectiveness of the intervention (Study 3). In Studies 1 and 2 participants consistently performed better in the nutrient-specific condition, demonstrating consumer awareness of how to locate the nutrition label which was consistent with the previous literature (Azman & Sahak, 2014). Furthermore, the researcher did not want to highlight singular nutrient comparisons as a potential ‘skill’ gained from the intervention. This clarity for consumers was important, as the intervention aimed to improve engagement across the key five nutrients of public health concern when making food choices.

3.2.4 Food Choice Task – Label Difficulty

The pairings used in the food choice task employed within the research studies in this thesis were rated on difficulty based on the amount of engagement required to select the healthier choice (Figure 3.6). As one of the question types focused on nutrient-specific comparisons it was important to include each of the five key nutrients, calories, fat, salt, saturated fat, and sugar across the pairings. Therefore, there needed to be a minimum of five pairings for each ‘label difficulty’ condition.

Figure 3.6

Food Choice Task Label Difficulty Conditions



In Study 1, for each of the three question types there were five ‘easy’, five ‘moderate’ and ten ‘hard’ rated pairings. This resulted in 20 pairings, which were repeated, but randomised in presentation, for each question type so that comparisons of nutrition label engagement could be made. In Study 2, the ‘hard’ rated pairings were refined to retain the hardest five stimuli (one per each key nutrient) based on the results from Study 1; this resulted in 15 pairings. In Study 3, the ‘easy’ and ‘hard’ rated pairings were retained but the ‘moderate’ rated pairings were removed from the food choice task. This task refinement was necessary to reduce participant burden, and the ‘moderate’ findings were less reliable in making distinctions of task performance across Studies 1 and 2. Therefore, in Study 3 there were 10 pairings, which were repeated in a randomised order for each question type and each timepoint.

3.3 Behaviour Change Theoretical Frameworks

Chapter 2 emphasised the importance of drawing upon appropriate theoretical frameworks to inform the design and evaluation of an intervention to encourage nutrition label engagement. The findings in Chapter 2 highlighted that many of the articles synthesised did not use theoretical frameworks to underpin the intervention. This lack of theoretical basis for interventions has been noted as a common issue within behaviour change research (Michie et al., 2011). In addition, for studies in Chapter 2 that did mention a theoretical underpinning, there was no theoretical framework that consistently informed these interventions. Therefore, the effectiveness of the frameworks could not be established to clearly recommend which framework to use to inform the intervention process in this thesis.

Furthermore, for the articles evaluated, the theoretical framework reported to guide the intervention was often minimal or loosely applied, rather than embedded and integral to the intervention reported. Michie and Prestwich (2010) reported that this approach of claiming an intervention is theoretically informed but presenting an unclear or weak account is common across psychology and public health-related research. This has led to a wider debate on how to successfully implement theoretical frameworks in intervention and behaviour change research (Coulson et al., 2016; Michie et al., 2011). The systematic review conducted by Schruff-Lim et al. (2023) structured their review findings in relation to the MOA framework (Motivation, Opportunity, Ability framework; MacInnis & Jaworski, 1989; Rothschild, 1999) despite the studies reviewed not employing the framework individually.

The literature highlights advantages of theory-informed interventions (Michie & Prestwich, 2010). A theory-informed intervention has clear identification of concepts which can influence the target behaviour. This identification can increase the likelihood of behaviour change when the concepts are targeted within interventions (Michie & Prestwich, 2010). Furthermore, the inclusion of theory within intervention design can aid researchers to assess the effectiveness of an intervention across behaviours, populations and contexts (Michie et al., 2011). The replication and transparency of an intervention can provide a basis for intervention refinement, the development of the theoretical frameworks and future research (Michie & Prestwich, 2010). Based on the findings reported in Chapter 2 and the wider literature context, it was important that the processes of intervention design in this thesis was informed and guided by an appropriate theoretical framework.

To decide on the appropriate theoretical framework, it was important to recognise that a nutrition label engagement intervention is focused on behaviour change. The intervention aims to influence consumer cognitive and behavioural patterns relating to nutrition label engagement. Therefore, it was appropriate to draw upon behaviour change theory to underpin the main theoretical approach taken within this thesis. The chosen theoretical framework was known across disciplines, including psychology, nutrition/dietetics and public health. This is important to support replication and evaluation of the effectiveness of the intervention due to nutrition label engagement being a cross-disciplinary topic of interest (Fernqvist et al., 2024). It is also important that appropriate training of how to implement the theoretical framework is given to ensure academic expertise and rigor to the application of the framework to the research conducted (Michie et al., 2011). Moore et al. (2018a) concluded that nutrition label engagement interventions underpinned by theory were more effective in changing behaviour.

The established theoretical frameworks of behaviour change were systematically reviewed and synthesised by Michie et al. (2011). Michie et al. (2011) identified 19 individual frameworks from across research disciplines to inform the development of a synthesised behaviour change framework. The authors argued that having a systematic method of identifying and understanding the target behaviour can inform the basis for effective intervention design. The authors also provide a practical guide and training for how to use the framework and associated content to ensure it is implemented accurately (Michie et al., 2013, 2014). The new framework has been widely adopted due to its versatility and evidence-based process to inform intervention design across disciplines, including research conducted in psychology, public health and policy (Michie et al., 2011; Odgen, 2019). Therefore, based on the research evidence this behaviour change framework was adopted. The behaviour change framework will be outlined in the next subsections and examples drawn in relation to the thesis topic.

3.3.1 COM-B Model

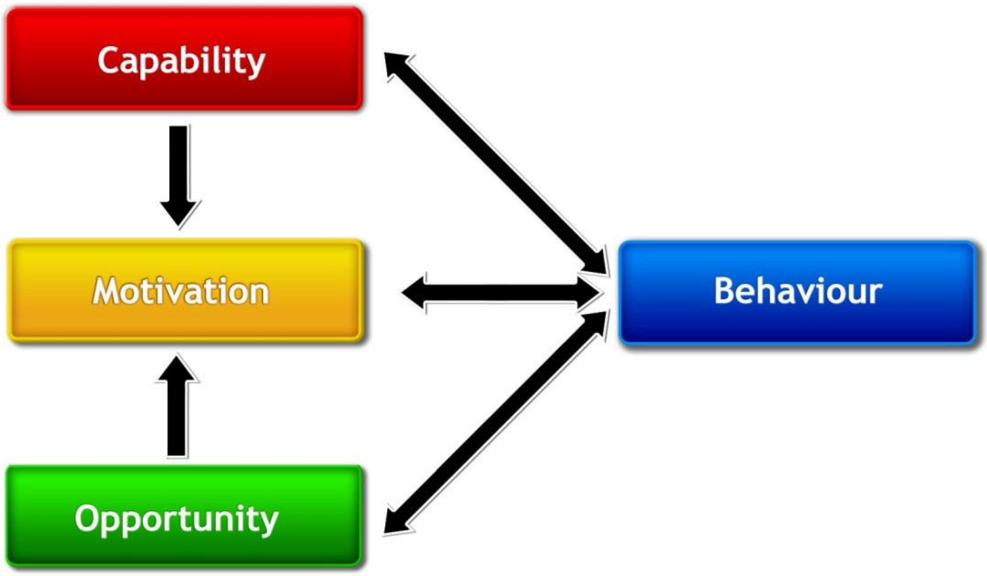
COM-B stands for ‘Capability’ ‘Opportunity’ ‘Motivation’ – ‘Behaviour’ and is a model for understanding behaviour (Michie et al., 2011). The COM-B model (Michie et al., 2011, 2014) is an integrated health psychology model that has been applied to changing eating behaviours (Atkins & Michie, 2015) and beyond health psychology research to other disciplines including behavioural neuroscience (Dobolyi, 2025); public health (Chater et al., 2023) and business (Li et al., 2023). The intervention study conducted by Miller et al. (2019) included within the thesis systematic review related their findings back to the COM-B model, demonstrating how the model can be applied to nutrition label engagement intervention findings. The COM-B model is grounded in psychological theory to ensure scientific rigor and the model is designed to be simple to apply in research and practice to develop effective strategies for targeting lifestyle changes, such as changing population-wide behaviours (Michie et al., 2011). It has become an instrumental model for designing, implementing and evaluating health-related interventions (Michie et al., 2014).

Each of the three main components of the COM-B model can be further differentiated to identify a total of six components (Figure 3.7). The definitions and examples of the COM-B model will now be outlined in relation to nutrition label engagement. The '**capability**' component relates to a consumer's ability to engage with nutrition labels. This component can be distinguished between *physical* capability e.g., capability to visually engage with the information on the nutrition label, and *psychological* capability e.g., capability to comprehend the information on the nutrition label. The '**opportunity**' component concerns the factors which influence or prompt the behaviour that lie outside of the individual. These factors can be differentiated between *physical* opportunity e.g., the time afforded to engaging with nutrition labels and the *social* opportunity e.g., the social cues and norms about nutrition labels which influence engagement.

The ‘**motivation**’ component refers to the brain processes that underlie and direct behaviours. There are two motivation processes which are outlined within this component, *reflective* motivations e.g. making plans to use nutrition labels, and *automatic* motivations e.g., how emotions, habits and/or impulses can affect nutrition label engagement. Figure 3.7 shows the potential influence between the components in the COM-B model, the arrows demonstrate how the three main components influence behaviour and how behaviour can influence the components.

Figure 3.7

The COM-B Model for Understanding Behaviour (Michie et al., 2011)

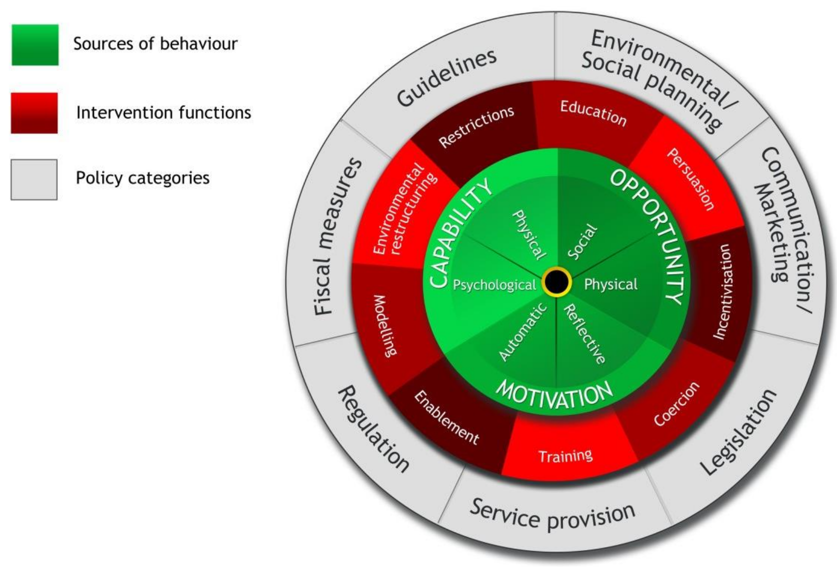


3.3.2 The Behaviour Change Wheel

The Behaviour Change Wheel (BCW; Michie et al., 2011, 2014), which incorporates the COM-B model, is the outcome of the synthesis of 19 individual frameworks identified in a systematic literature search and expert consultations. Therefore, the framework is derived from concepts that have been important within the literature. This has led to the framework being reliably applied to interventions since its initial conception (Michie et al., 2011). A key benefit of the BCW is that it encourages intervention designers to develop their understanding of their target behaviour change. It achieves this as researchers follow a systematic approach to the evaluation of theory and evidence to inform their final intervention (Michie et al., 2014). There are three 'wheels' to the BCW and the components of the wheel interact rather than being linear in nature (Figure 3.8).

Figure 3.8

The Behaviour Change Wheel (Michie et al., 2011)



At the centre of the BCW (Michie et al., 2011) is the COM-B model. The COM-B model ensures that a standardised diagnosis of the target behaviour is conducted. The COM-B model diagnosis needs to be supported by a systematic method to inform the design of effective interventions to target the identified factors (Michie et al., 2011). Therefore, the BCW integrates the COM-B model within a broader framework to provide a structured approach of developing behaviour change interventions through a comprehensive taxonomy of *intervention functions* and *policy categories*, which can be linked to specific *BCTs* (Michie et al., 2013).

The second wheel surrounding the COM-B model includes nine *intervention functions* which address deficits identified in one or more of the COM-B model essential conditions (Michie et al., 2011). The term ‘function’ depicts the notion that an intervention may have more than one function. For example, a campaign to improve nutrition label engagement may contain an element that is educational but also presented in a persuasive tone. Therefore, it would be unhelpful to categorise the intervention as either educational or persuasive, rather, it would be more accurate to report that the intervention performed educational and persuasive functions. Michie et al. (2009) reported that five of the intervention functions are commonly used in healthy eating interventions, these were education, enablement, incentivisation, persuasion and training. The remaining four intervention functions, coercion, environmental restructuring, modelling and restriction, were not commonly used, potentially due to their emphasis on external influences rather than personal agency (Michie et al., 2009).

The *intervention functions* in the BCW are supported and enabled by the seven *policy categories* which form the outer wheel to the framework (Michie et al., 2011). As policies can only influence behaviour (identified by the COM-B model) through interventions that they enable or support, they are placed on the outside of the wheel framework. As with the intervention functions, the policy categories are treated as non-overlapping policy-related content. Legislation or guidelines may be required or established to support the implementation of a public health intervention, and fiscal measures could be implemented to encourage or reduce a behaviour e.g., sugar taxation on high in sugar foods and drink.

3.3.3 The Behaviour Change Technique Taxonomy

To ensure that behaviour change interventions designed using the BCW can be replicated and implemented across disciplines, it is important that the content of the interventions is reported in an agreed language (Michie et al., 2013). As outlined in Chapter 2, the BCTT (Michie et al., 2013) is a method of specifying intervention content by their 'active ingredients'. The BCTs describe the active ingredients of an intervention using consensually agreed and reliable language which can be implemented across topics, disciplines and behaviours (Michie et al. 2013).

3.4 Designing a Behaviour Change Intervention using the Behaviour Change Wheel

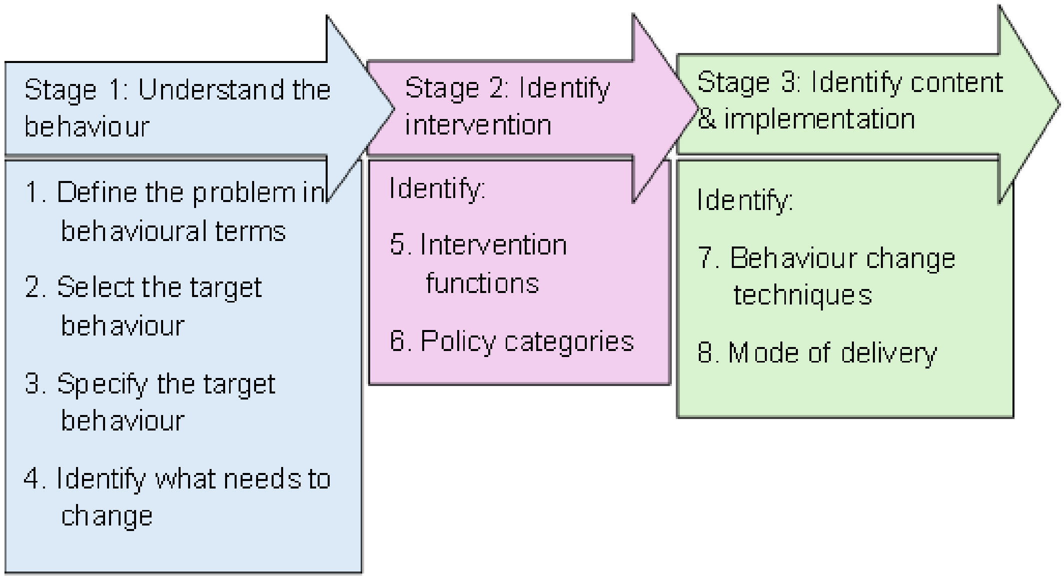
Michie et al. (2014) published a guide for how to design interventions using the BCW. Three distinct stages, which encompass eight steps, were outlined for how to design a behaviour change intervention. Whilst these stages were written in linear format, for the process of the intervention designed in this thesis there was some iteration and revisiting of the stages and steps throughout the design process. The content within this chapter outlines the stages and steps for designing a behaviour change intervention based on the knowledge at this stage of the thesis. For how this knowledge and understanding progressed and informed the implemented intervention please see Chapter 7.

3.4.1 Stages of the Behaviour Change Intervention Design Process

Michie et al. (2014) outline three stages to designing a behaviour change intervention (Figure 3.9). **Stage 1** of the guide relates to 'understanding the behaviour' and comprises four steps: *Step 1* 'define the problem in behavioural terms'; *Step 2* 'select the target behaviour'; *Step 3* 'specify the target behaviour'; *Step 4* 'identify what needs to change' (Michie et al., 2014, pg. 25). **Stage 2** is focused on identifying the intervention options and has two steps: *Step 1* 'identify the intervention functions' and *Step 2* 'identify the policy categories'. **Stage 3** identifies content and implementation options in two steps: *Step 1* 'identify the BCTs' and *Step 2* 'identify the mode of delivery'. At relevant points within the stages, relevant broader theories and models will be drawn upon to highlight how these have been used within the thesis alongside the BCW.

Figure 3.9

The Process of the Behaviour Change Wheel to Designing Interventions (Michie et al., 2014)



3.4.2 Stage 1: Understanding the Behaviour

3.4.2.1 Step 1: Defining the Problem in Behavioural Terms. Step 1 defines the problem in behavioural terms to ensure that the intervention is designed with clarity (Michie et al., 2014). These behavioural terms are considered in this thesis in relation to; (a) *the behaviour* – selecting healthier prepacked food products through nutrition labels; (b) *the location(s)* where the behaviour occurs – where consumers make prepacked food choices; and (c) *the population, group or individual involved in performing the behaviour* – all UK consumers are involved in performing the behaviour, with a focus on the healthy UK adult consumers for the work presented within this thesis.

3.4.2.2 Step 2: Selecting the Target Behaviour. Step 2 involves considering which behaviour(s) to focus on in the intervention. Thus, an appraisal of all potential behaviours, which may be relevant to improving engagement with nutrition labels, was undertaken. This appraisal was informed by the literature and findings from Chapters 1 and 2 and it was determined that improving nutrition label engagement was an appropriate target behaviour for the intervention. Chapters 4-6 help to further narrow the focus for the target behaviour and this refinement is outlined in Chapter 7.

3.4.2.3 Step 3: Specifying the Target Behaviour. Step 3 focused on describing and specifying the target behaviour to ensure clarity in the stages of the development of the intervention. In this step, precision about the behaviour is beneficial to the behavioural analysis that will be performed. Based on Chapters 1 and 2 the target behaviour of engaging with nutrition labels was considered in relation to; (a) who needs to perform the behaviour; (b) what behaviour change is needed; (c) when is the behaviour change needed; (d) where is the behaviour change needed; (e) how often is the behaviour change needed; and (f) with whom, if anyone, is the behaviour change completed with (Michie et al., 2014). The description of the behaviour is presented in Table 3.1.

Table 3.1

The Concept and Descriptions for Specifying the Target Behaviour for the Intervention

Concept	Description
Target behaviour	Improved engagement with nutrition labels when making prepacked food choices
Who needs to perform the behaviour?	All adult consumers of prepacked food products in UK
What do they need to do differently to achieve the desired change?	Consider the nutrition information as part of the decision-making process
When do they need to do it?	When choosing a prepacked food product to purchase
Where do they need to do it?	In a shopping environment e.g., in a supermarket
How often do they need to do it?	• When choosing between two similar products • When choosing between two differing products • When choosing a novel product • When deciding which product they prefer • When determining the overall balance of their diet
With whom do they need to do it?	Alone or with others when purchasing prepacked food products

3.4.2.4 Step 4: Identifying what Needs to Change. Step 4 of understanding the behaviour focuses on identifying what needs to change to achieve improved engagement with nutrition labels (Michie et al., 2014). As outlined earlier in this chapter, the COM-B model is pivotal to determining which components may need to be addressed as part of diagnosing the target behaviour (Michie et al., 2011, 2014). It is vital that researchers fully understand the target behaviour and the more accurate this appraisal is, the higher the likelihood that the intervention will lead to behaviour change. Chapters 1 and 2 highlighted the complexities of identifying what needs to change and how nutrition label engagement can be affected by a range of factors, experiences and individual differences. There were limitations identified in the literature presented in the earlier thesis chapters which are addressed in the empirical studies conducted within the thesis. Therefore, the full identification of what needs to change is presented in Chapter 7.

3.4.3 Stage 2: Identifying Intervention Options

Stage 1 has provided insights into the behavioural diagnosis performed to inform the intervention design. Stage 2 links the behavioural diagnosis to intervention functions and policy categories, the two wheels outside of the COM-B model (Michie et al., 2011, 2014).

3.4.3.1 Step 5: Identifying Intervention Functions. Intervention functions, as outlined in Section 3.3.2, are the ways in which the behaviours that need to be changed (identified in Stage 1) can be addressed (Michie et al., 2011). To assist with Step 5, the APEASE criteria (Michie et al., 2014) was considered. The APEASE criteria (Michie et al., 2014) have been developed to support the design of interventions through six criteria: (a) *affordability*, can the intervention be delivered and accessed on budget; (b) *practicality*, is the intervention achievable and feasible to deliver in the way proposed; (c) *effectiveness and cost-effectiveness*, how does/will the intervention work and what effect sizes are yield; (d) *acceptability*, the extent to which the intervention is considered appropriate by designers, recipients and broader stakeholders e.g., political level; (e) *side-effects / safety*, consider any unintended consequences of the intervention and whether it is ok to proceed; and (f) *equity*, the extent to which the intervention may reduce or increase health disparities.

How the intervention functions, COM-B components and APEASE criteria have been considered at this stage of the research and are outlined in Table 3.2. The intervention functions of '*education*', '*enablement*' and '*persuasion*' were the strongest intervention functions mapped to the COM-B components from the behavioural diagnosis.

Table 3.2

Identification of Intervention Functions and How They Related to COM-B Components and the APEASE Criteria

Candidate intervention functions	**COM-B component**	**Meet APEASE criteria?**
Education	Psychological capability and reflective motivation	Yes, but would need to be a population-based campaign as individual education not feasible or affordable to influence population-level behaviour change
Persuasion	Reflective and automatic motivation	Yes, but would need to consider strength of persuasion within the intervention to encourage behaviour and challenge beliefs

Candidate intervention functions	COM-B component	Meet APEASE criteria?
Incentivisation	Reflective and automatic motivation	Possible, but would need to focus on health benefits as population-based monetary incentives may not be acceptable to key stakeholders and may be difficult to implement
Coercion	Reflective and automatic motivation	No, freedom of choice is important to consumers and so this is unlikely to be acceptable
Training	Psychological capability and reflective motivation	Unlikely, need to be mindful of costs and time commitment as if these are too high then may not be acceptable
Restriction	Physical Opportunity	Not practical currently as supermarkets will continue to stock prepacked food products
Environmental restructuring	Physical Opportunity	Not practical as this would require input from food retailers and manufacturers
Modelling	Social opportunity. reflective and automatic motivation	Yes, could consider interactive content to encourage engagement
Enablement	Physical Capability, reflective and automatic motivation	Yes, could be considered to support nutrition label engagement e.g., through goal setting

3.4.3.2 Step 6: Identifying Policy Categories. The last step of Stage 2 in the behaviour change intervention design process is to consider which policies would support the delivery of the intervention functions identified in Step 5 (Michie et al., 2014). There are seven policy categories (Section 3.3.2) that relate to the measures that relevant stakeholders can implement. The work conducted in this thesis aims to inform future policy categories, therefore, existing policy categories are discussed here. *Service Provision* has not been discussed as this policy category is not applicable to nutrition label engagement.

3.4.3.2.1 Environmental Planning. Nudge interventions are examples of environmental planning. A nudge intervention aims to predictably change or encourage an individual towards a desirable outcome. For example, supporting consumers to select healthier foods, without restricting freedom of choice through mandates or bans, and without offering or amending economic incentives towards the desired choice (Reisch et al., 2017; Thaler & Sunstein, 2008). Nudge interventions can have a greater success than traditional economic interventions as they do not rely on influencing the cost-benefit calculations undertaken by consumers during the decision-making process (Benartzi et al., 2017).

Nudges are an innovative policy tool and can target consumer cognition, affect and behaviour during food purchasing decisions to encourage healthier eating (Cohen et al., 2016). Cognitive-orientated nudge interventions are focused on influencing the knowledge of the consumer, affective-orientated nudge interventions are centred on influencing how the consumer feels and behaviour-orientated nudge aim to influence what consumers do (Cadario & Chandon, 2020). Nutrition labels on prepacked foods are an example of a cognitive-oriented nudge intervention as they aim to nudge consumers towards a greater awareness of the nutritional content of prepacked food products (Cadario & Chandon, 2020). Therefore, these nutrition label cognitive-orientated nudges on prepacked products are considered to guide consumers towards making healthier dietary choices (Azman & Sahak, 2014; Roberto & Khandpur, 2014).

3.4.3.2.2 Fiscal Measures. Taxation on food products is an example of a fiscal measure implemented by the UK government. The National Food Strategy (2021) suggested a policy recommendation to introduce a salt and sugar reformulation tax. The proposed reformulation tax was on salt and sugar sold to manufacturers to include as ingredients in processed food products. This initiative focuses on improving the overall healthiness of all foods manufactured in line, with the recommendation by the Department of Health and Social Care (2021). The aim of the reformulation tax is to encourage and incentivise food manufacturers to reformulate their products, to avoid the increased costs associated with purchasing the targeted ingredients and maintain the appeal of their products by minimising or removing the transfer of any additional production costs to the consumer (National Food Strategy, 2021). These reformulations would be presented on nutrition labels to demonstrate the improved healthiness of the food.

However, Marlow (2017) suggested that manufacturers may reduce the content of a particular nutrient in their product to avoid economic penalty but that the product may not be significantly healthier as the quantity of another nutrient may be increased. Therefore, taxes are unlikely to slow or reverse the ongoing rising prevalence rates of excessive body weight as the links between taxes and the consumption of products is weak (Hoffer et al., 2015). Hoffer et al. (2015) suggested that taxes may be somewhat ineffective and regressive in their nature as they may penalise consumers purchasing products, but do not affect the consumers' consumption behaviours or knowledge about food and how to make healthier dietary choices. Therefore, governments have sought alternative types of interventions to change consumer behaviour to supplement the traditional economic interventions (Benartzi et al., 2017).

3.4.3.2.3 Legislation, Regulation and Guidelines. These three policy categories have been combined for this overview but are separate categories. As outlined in Chapter 1, there are existing laws, practices and guidelines to support consumers with nutrition label engagement. There is Regulation 1169/2011 which provides the mandatory regulation information for back-of-pack nutrition labels. There is front-of-pack nutrition label guidance for manufacturers and retailers (Department of Health, 2016). Therefore, in the UK there is existing support for the implementation of the current nutrition labels.

3.4.3.2.4 Communication and Marketing. Mass media campaigns on healthy eating have been promoted within the UK e.g., the national campaign known as 5-a-day (NHS, 2018). There have been marketing restrictions in the UK relating to when unhealthy foods can be shown on TV to aid the reduction in impulse food motivations (Sapio et al., 2025). Future policy makers may consider a campaign on nutrition label use, similar to the campaign implemented in the US when the Nutrition Facts Label was updated. This builds on established communication strategies but ensures they are accessible on a population level. The nutrition label regulation and guidance have written content for how to communicate nutrition labels and key messages on how to aid consumer engagement with back-of-pack and front-of-pack nutrition labels (Department of Health, 2016).

Furthermore, there are public friendly websites where consumers can find information which communicates about nutrition labels, e.g., the NHS website has a page on food labels (NHS, 2022a). On the NHS webpage there are also some food shopping tips for improving engagement with nutrition labels. However, the likelihood of the population seeking out these resources unless interested is small. Therefore, interventions which communicate the information on engaging with nutrition labels in an accessible, population level way may be of importance for policy makers to consider (Perez-Cueto, 2019). Nutrition label communication and marketing may be an important avenue to explore, with any implementation rigorously evaluated to determine the acceptability and effectiveness of the intervention (Christoph et al., 2015).

3.4.4 Stage 3: Identifying Content and Implementation Options

3.4.4.1 Step 7: Identifying Behaviour Change Techniques. The BCTT (Michie et al., 2013) is a common language that is replicable and has been designed to identify and implement active ingredients within a behaviour change intervention. The ten ‘active ingredients’ from the articles reviewed in Chapter 2 were: (a) ‘prompts/cues’; (b) ‘instruction on how to perform the behaviour’; (c) ‘demonstration of the behaviour’; (d) ‘credible source’; (e) ‘material reward (behaviour)’; (f) ‘information about health consequences'; (g) 'behavioural practice/rehearsal'; (h) 'habit formation'; (i) 'feedback on outcome(s) of behaviour'; and (j) 'goal setting (behaviour)'. These will be considered as empirical studies are conducted to assess the factors and experiences that impact consumer nutrition label engagement. Consumers will be asked for their rating and feedback of these BCTs to assess their perceived acceptability. The conclusions from the consumer evaluation and summary of how the empirical findings informed this stage of the intervention design process are outlined in Chapter 7.

3.4.4.2 Step 8: Identifying the Mode of Intervention Delivery. There was heterogeneity in the mode and length of intervention delivery reported in the articles reviewed in Chapter 2. This was also a limitation identified in the existing systematic reviews conducted by Moore et al. (2018a) and Schruff-Lim et al. (2023). Therefore, this was an area addressed within the empirical research presented in the thesis to further establish the acceptability of the mode of intervention delivery by the consumer. The findings and implications from these explorations are reported in Chapter 7 when outlining the determined mode of intervention delivery implemented in Chapter 8. In addition to the mode of intervention delivery, the systematic review highlighted the need for interventions to be evaluated after implementation, particularly how the recipient felt about the intervention received. Therefore, intervention evaluation was collected and reported as part of Study 3 and the findings are reported in Chapter 9.

3.5 A Summary of the Chapter Contributions

This chapter explored the theoretical underpinnings which influence engagement levels with UK nutrition labels and reviewed relevant literature to consider how this can inform future intervention measures. It outlined the development of the food choice task used in the empirical studies reported in the thesis. The need to develop an intervention that is informed by a theoretical framework was emphasised and that this approach is novel within nutrition label engagement intervention design. The chapter introduced the COM-B Model and the BCW (Michie et al., 2011; Michie et al., 2014) as the theoretical framework that informed the behaviour change intervention development process used in the thesis. The stages of the framework were outlined and descriptions of how the current knowledge from Chapters 1 and 2 informed the current application of the framework were presented. The next steps have been identified in terms of where further information is needed to inform the development of the intervention in this thesis. The empirical studies reported in Chapters 5 and 6 address this need for information, before the behaviour change intervention design process is revisited and updated in Chapter 7.

Chapter 4: Methodology

This chapter outlines the rationale for the methodological approaches adopted to address the thesis aim and objectives. It builds upon the previously identified literature, as discussed in Chapters 1 and 2, and considers the most appropriate methodology in light of the theoretical framework and food choice task presented in Chapter 3. This chapter discusses the research paradigm and philosophical underpinnings which informed the researcher's approach to study design and methodology. It justifies the measures, data collection approaches and data analyses used in the empirical studies. The chapter concludes with a summary of the contributions made to the thesis objectives.

4.1 Research Paradigm

The research paradigm is a universal philosophical underpinning regarding assumptions a researcher holds about the world they are studying (ontology), what constitutes meaningful knowledge (epistemology) and how these assumptions inform research questions, methods and analysis techniques (methodological approaches) (Braun & Clarke, 2022; Omodan, 2024; Willig, 2023). The pragmatist research paradigm encourages a flexible and pluralistic approach to research (Teddlie & Tashakkori, 2009). It rejects there is a single, absolute truth and focuses on practicality and integration of methods that best answer the posed research question(s) (Omodan, 2014). This paradigm is considered towards the central point on the research paradigm continuum. Thus, the paradigm has a flexible epistemological approach, recognising reality is multifaceted and complex. Using quantitative and qualitative approaches it recognises different data types can provide complementary insights to answer the research question(s) (Migiro & Magangi, 2011).

The first dominant research paradigm was the positivist approach, based in the realism side of the ontological continuum where data is taken at face-value (Willig, 2023). This approach focused on applying scientific methods to social research with the aim of discovering the single reality and true knowledge through the implementation of objective, quantitative methodologies, this paradigm values objectivity and replicable generalisable results (Omodan, 2024). However, investigating nutrition label engagement from a purely positivist approach would miss critical nuances of the consumer experiences and perceptions of nutrition label engagement as it is only concerned with the observable, objective, quantitative data.

In contrast, the interpretive research paradigm is situated towards the relative side of the ontological continuum. The relativist position means that data is viewed in relation to how the participants are constructing and sharing meaning and experiences from their lives (Willg, 2023). This approach believes truths are subjective, contextual and dynamic, it focuses on needing to understand the subjective meanings people attribute to their experiences and uses qualitative methodologies to explore the complexities of the human experience (Omodon, 2024). However, investigating nutrition label engagement from a purely relativist approach assumes that there is no objective reality, but for nutrition label engagement the researcher believes that consumers can use this information to choose healthier choices.

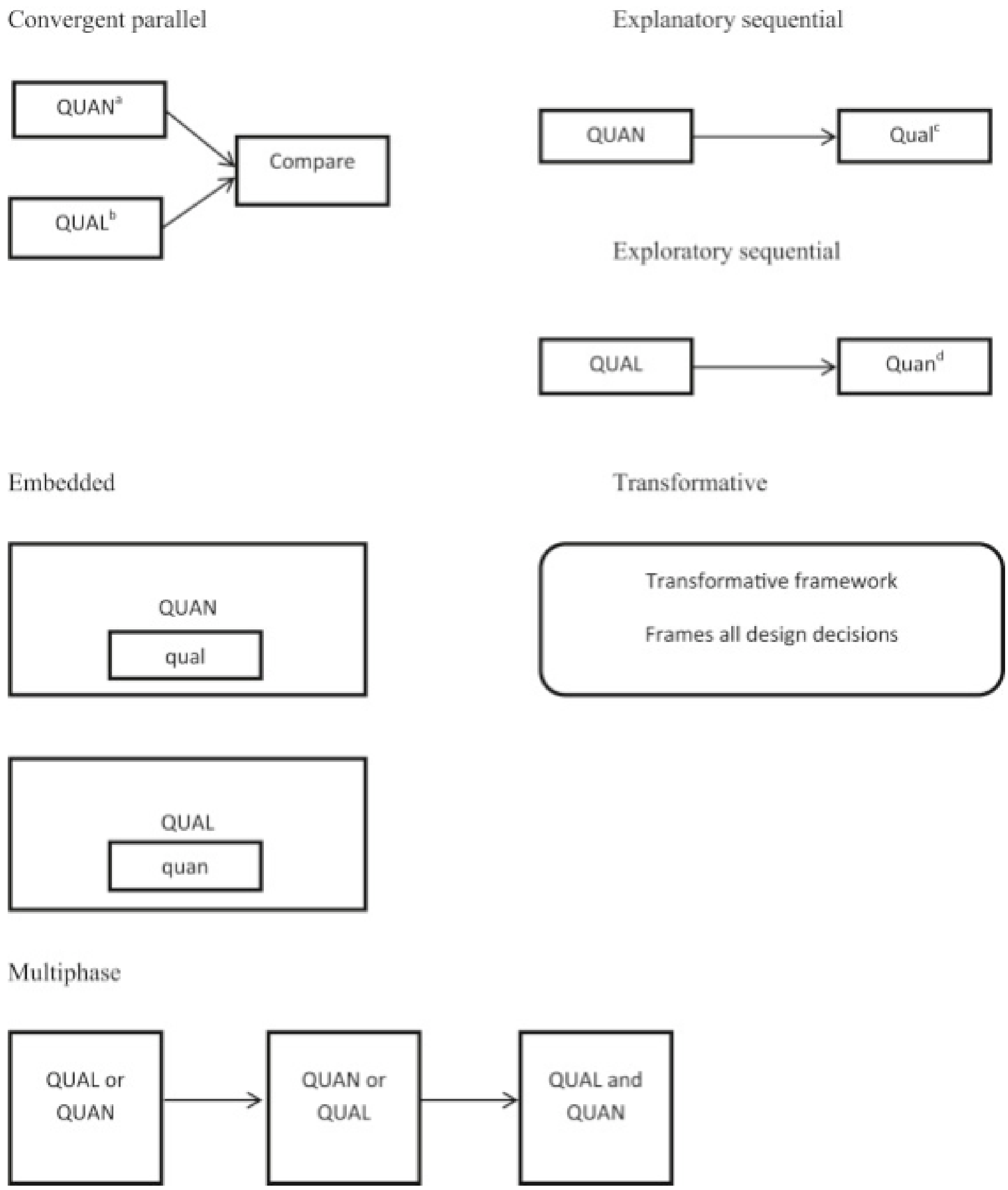
The pragmatist approach believes that there is an objective reality that can be measured, such as selecting healthier food choices, but that there is a subjective interpretation element to the experience, such as perceptions and experiences influencing nutrition label engagement. This methodological approach is termed ‘mixed-methods’ research as researchers seek to combine quantitative and qualitative methods (Zoellner & Harris, 2017). A mixed-methods approach to research may lead to a more complete understanding of the phenomena and enable the research question(s) to inform the research design (Zoellner & Harris, 2017). This is particularly important for health-related interventions, where external and internal factors can be interlinked in the health behaviours displayed (Odgen, 2019). A review of systematic reviews on food choice and nutrition conducted by Perez-Cueto (2019), reported mixed-methods articles provided deeper insights into the determinants of food choice and measurable effects. This supported the benefits of a mixed-methods approach to nutrition label engagement to understand the complex picture of how the nutrition labels influence food choice and ultimately how an intervention may be designed to target these behaviours.

Therefore, mixed-methods research and a pragmatist philosophy underpinned the empirical studies in this thesis. The approach employed is concerned with the importance of the research question(s) as the driver for the methodology and approach taken (Migiro & Magangi, 2011; Teddlie & Tashakkori, 2009). By combining qualitative and qualitative methodologies it allows for a robust analysis, as it nurtures the strengths of both approaches

(Teddlie & Tashakkori, 2009). Zoellner and Harris (2017) reported that there are six mixed-methods research designs used in the literature (Figure 4.1).

Figure 4.1

Mixed-Methods Research Design Diagram (Zoellner & Harris, 2017)



This research used a mixed-methods multiphase design, with a pragmatic approach, to address the thesis objectives outlined in Chapter 1. A multiphase design was chosen as the research questions posed required both quantitative and qualitative methodologies within and across different study data collection phases (Figure 4.2). The chosen research paradigm was important to capture the complexity of decision making in relation to food choices by exploring nutrition label engagement through experimental, individual differences and personal experience approaches (Stankov & Lee, 2014).

Figure 4.2

The Research Paradigm used in the Thesis

Study 1	Study 2	Study 3
• Embedded quantiative approach • Think-aloud protocol as qualitative data collection method but analysed quantiatively	• Multiphase, mixed-methods • Phase one - quantitative (replication) • Phase two - qualitative (experiences of nutrition label engagement)	• Quantiative approach to the implemented intervention • Mixed-methods evaluation: quantitative (ratings) and qualitative (exploration of perceptions and experiences of the intervention received)

4.2 Food Choice Task – Performance, Attention and Individual Difference Measures

As outlined in Section 1.4, there is diversity in the common terms used to refer to consumer interactions with nutrition labels, including ‘read’, ‘understand’ and ‘use’ and this extended to the range of measures assessed in the intervention studies included in Chapter 2 (Section 2.3.2.4). This variation in terms and single behaviours highlights the complexity of the behaviours required to engage with nutrition labels in an effective way to lead to behaviour change (Marlow, 2017). This thesis operationalised nutrition label engagement as interlinked specific behaviours, in which each behaviour in isolation would not lead to the desired behaviour change. Therefore, nutrition label engagement within this thesis is focused on a consumers’ ability to read, understand and interpret nutrition labels to inform healthier dietary choices in the food choice task.

The findings from the systematic review (Chapter 2) highlighted the variety and diversity in the types of self-reported and objective quantitative measures previously implemented to determine the effectiveness of nutrition label engagement interventions. Across the empirical studies in this thesis, a series of measures were consistently implemented to provide triangulated insights into nutrition label engagement. This approach was a key strength to the research conducted; it ensured the food choice task was robust in detecting changes in nutrition label engagement to determine the effectiveness of the novel intervention. Furthermore, the approach enabled intra and inter study nutrition label engagement comparisons to inform the design of the novel intervention.

This section is focused on the introduction and evaluation of the measures implemented in the empirical research presented in this thesis. Where appropriate, previous research is drawn upon to justify the measures implemented. In addition, descriptions of the measures and psychometric properties of scales implemented in the studies reported in the subsequent thesis chapters are reported in this section to reduce repetition across the thesis.

4.2.1 Self-Reported and Performance-Based Accuracy Measures

Self-reported nutrition label engagement provides an indicator of perceived consumer engagement when making food choices. A single item to determine self-reported nutrition label engagement is a common approach within the literature (Graham et al., 2015; Kreuter et al., 2002; Miller et al., 2018, 2019). A single item as part of wider study measures can also reduce participant burden (Fisher et al., 2016). Therefore, self-reported nutrition label engagement was measured in the thesis empirical studies using an existing scale item developed by Cha et al. (2014). The question posed was: '*how often do you use the food label when making a food selection?*' and responses were given on a 5-point Likert scale from 1 (never) to 5 (always).

In addition, in Studies 1 and 2 (Chapters 5 and 6), consumers' self-reported attitudes and behaviours towards nutrition labels were measured using the Label Reading Survey (Marietta et al., 1999). This measure was used to provide additional insights across a range of nutrition label attitudes and behaviours. This type of measure was the outcome of interest for some studies reviewed in Chapter 2 (Esfandiari et al., 2020). The attitude subscale comprised five items (e.g., '*nutrition information that is provided in the* *nutrition facts label is accurate*'), rated on 5-point Likert scales from 1 (strongly disagree) to 5 (strongly agree). The scores were summed and the strongest positive attitude score was 25. There was acceptable reliability for the attitude subscale in thesis Studies 1 ($\alpha = .74$, $\lambda = .76$) and 2 ($\alpha = .71$, $\lambda = .72$).

The general behaviour subscale of the Label Reading Survey (Marietta et al., 1999) comprised three items (e.g., '*when you purchase a food product for the first time, do you look at the nutrition facts label on the package?*'), rated on 5-point Likert scales from 1 (never) to 5 (always). The scores were summed, and the highest predictive behaviour score was 15. There was adequate reliability measured for the behaviour subscale in thesis Study 1 ($\alpha = .64$, $\lambda = .68$) and acceptable reliability in Study 2 ($\alpha = .74$, $\lambda = .76$). Finally, the nutrient checking behaviours provided a list of 17 items presented on nutrition labels, (e.g., 'calories', 'serving size', 'sugar'). Participants indicate 'yes' or 'no' to whether they engage with each of the items on the nutrition label. Where a participant indicated engagement of an item one point was awarded. The points were summed to provide the overall total for the subscale, which has a maximum score of 17. There was acceptable reliability measured for the subscale in thesis Studies 1 ($\alpha = .77$, $\lambda = .79$) and 2 ($\alpha = .81$, $\lambda = .82$)

As outlined in Chapters 1 and 2, consumer self-reported nutrition label engagement (e.g., use and attitudes) can be problematic (Cowburn & Stockley, 2005). In the thesis systematic review, some studies reported baseline and post-intervention changes in self-reported nutrition label engagement (e.g., Dooley et al., 1999; Esfandiari et al., 2020; Kreuter et al., 2002). The validity of these self-reported nutrition label engagement measures was questioned due to issues related to the potential for consumers to over-report and over-estimate or inflate their engagement (Esfandiari et al., 2020; Souza et al., 2016). There were also concerns related to the potential ceiling effect in self-reported measures, which can make it challenging to determine the effectiveness of an intervention (Kreuter et al., 2002; Souza et al., 2016).

Therefore, alongside self-reported measures of nutrition label engagement, it has been suggested researchers also objectively measure nutrition label engagement. For the food choice task employed in the thesis studies a range of performance measures were recorded. Accuracy was a food choice task performance measure reported across the empirical studies. Accuracy was calculated as the healthier option selected from the paired stimuli. The healthier option was chosen as the measure of accuracy as nutrition labels aim to guide and encourage healthier food choices, thus nutrition label engagement is reflected in healthier food decisions. The accuracy measure was used across the question types, (including the purchase condition to determine whether participants selected healthier options without being prompted). The paired stimuli were repeated for each block to ensure that the accurate trials remained consistent across the conditions with the counterbalanced measures employed to reduce demand characteristics and practice effects. Participants were also able to select that they were unable to reach a decision to emulate real-life decision-making and these were recorded as inaccurate trials (Graham et al., 2016).

The accurate response for each trial was calculated based on the overall healthfulness of the products using the five key nutrients of calories, fats, saturated fats, salt and sugar. These nutrients were selected as they are present on both the front-of-pack and back-of-pack nutrition labels in the UK and are the key nutrients identified as a public health concern. The healthfulness of each product was determined by the guidelines provided for nutrition label interpretation (Table 4.1). The nutrition label with the most nutrients in the lower categories were categorised as the healthier option within each paired stimuli, and therefore the accurate response across all conditions. To enable comparisons to be made within and across the research studies, raw accuracy scores were converted to percentage values. This was achieved by dividing the sum of the accuracy scores achieved per condition by the total number of trials for the condition and multiplying the value by 100.

Each ready meal was named '*Meal One/A*' or '*Meal Two/B*' for participants to select their choice. The ready meal names were changed between Study 1 (Chapter 5) and Study 2 (Chapter 6). This change was a result of some participant confusion that the names of 'Meal One' and 'Meal Two' indicated the number of portions within the product. These misunderstandings were resolved within Study 1, as the researcher was present during the laboratory study, but this would not have been possible in the online environment for studies 2 and 3. Therefore, the action to amend the stimuli names to 'Meal A' and 'Meal B' for subsequent studies was deemed appropriate

Table 4.1

The Guidelines Used to Determine the Healthfulness of Each Product

Nutrient	Low per 100g	Moderate per 100g	High per 100g
Calories	<74 kcal	75 – 449 kcal	>450 kcal
Fat	<2.7g	2.8g – 16.4g	>16.5g
Salt	<0.08g	0.09g – 0.47g	>0.48g
Saturates	<0.8g	0.9g – 4.9g	>5.0g
Sugar	<1.9g	2.0g – 11.4g	>11.5g

4.2.2 Measures of Confidence

In addition to accuracy, during the food choice task, confidence ratings were recorded as a task performance measure following each food choice to understand the certainty of each decision (Jackson & Kleitman, 2014; Kleitman, 2008). It is argued that measuring confidence related to task performance has higher predictive validity than self-reported measures of confidence relating to behaviour (Kleitman, 2008; Morony et al., 2013). Furthermore, this approach enabled comparisons of confidence ratings across trials (Stankov et al., 2014). Across the empirical studies in the thesis, trials where a food choice was made a visual analogue scale was presented for participants to select a confidence rating from 0% (not confident at all) to 100% (extremely confident). It is important to combine numerical percentages (e.g., 100%), with scale anchors (e.g., 'absolutely certain'), to aid interpretation of the scale (Schiöth et al., 2015; Stankov & Lee, 2014).

This type of confidence measure has been shown to be understood by adults (Williams & Gilovich, 2008) and can provide insights into the certainty of decisions made to help individuals to think critically about food choices (Watson et al., 2014). This differs from consumers' confidence of general nutrition label engagement (Dukeshire et al., 2014).

As recommended in prior research, percentage confidence ratings were calculated for accurate trials by averaging ratings across 'question type' and 'label difficulty' conditions (Jackson & Kleitman, 2014; Kleitman, 2008; Stankov & Lee, 2014). There are high psychometric properties for the confidence judgments during choice tasks (Kleitman, 2008; Stankov et al., 2014). Furthermore, confidence bias scores were calculated to provide insights into how well an individual calibrated their confidence ratings (Schraw, 2009; Stankov et al., 2014). Confidence bias scores were calculated as the difference between the average confidence rating and average accuracy across judgments (Stankov & Lee, 2014). Confidence bias scores ranged from 1 to -1, with the polar values indicating either over-confidence or under-confidence respectively (Lichtenstein & Fischhoff, 1977). A bias score close to 0 indicated strong calibration in confidence ratings to selecting accurate choices (Stankov et al., 2014). This approach accounted for individual differences in confidence rating tendencies to provide further comparisons within and across the studies conducted (Kleitman, 2008).

Research suggests over-confident individuals make more errors and are less likely to be affected by task demands than under-confident individuals, who may be more hesitant (Stankov & Lee, 2014). Over-confident consumers may make errors in judgements but are unlikely to retrain or engage in activities to improve understanding of nutrition labels, due to their belief they are engaging with them appropriately. Under-confident consumers may lack confidence in their ability to engage with nutrition labels and may have potential barriers to engagement, due to misunderstandings or lack of confidence when engaging with nutrition labels. Thus, percentage confidence ratings and confidence bias scores were important measures to assess nutrition label engagement and inform the development of the intervention.

4.2.3 Think-Aloud Protocol and Thought Listing

A think-aloud protocol provides insights into nutrition label engagement during food choice tasks, this data can be used to make inferences about the cognitive processes employed by consumers when making food choices (Fonteyn et al., 1993). Cowburn and Stockley's (2005) review included studies which employed think-aloud protocols to supplement self-reported measures of nutrition label engagement. From the think-aloud data, consumers did look at the nutrition labels but did not process the information further due to confusion in how to interpret the technical and numerical nutrition information. In addition, Higginson et al. (2002b) suggested a think-aloud protocol can provide insights into conscious thoughts during the problem-solving process of selecting food products, without consumers interpreting or embellishing their thoughts.

There are two think-aloud measures frequently used within the nutrition label literature, these are *concurrent* think-aloud and *retrospective* think-aloud protocols (Birns et al., 2002). Both think-aloud protocols are considered to yield greater depth and insights than retrospective interviews (Ericsson & Simon, 1998). Study 1 implemented a concurrent and immediate retrospective ‘thought listing’ think-aloud verbal protocol for each trial to reflect the decision-making processes during nutrition label engagement (Tullis & Albert, 2013). During the concurrent think-aloud protocol, participants were asked to verbalise their thoughts as they made food choices to provide real-time insights into their first reactions and cognitive processes (Birns et al., 2002; Ericsson & Simon, 1998). Accordingly, concurrent think-aloud protocols can reveal (mis)understanding and reasoning during the decision-making process; as the verbalisations are relatively uninfluenced by experiences and events relating to the outcome and re-evaluation of a trial (Ericsson et al., 1993).

In Study 1, the combination of the concurrent and immediate retrospective think-aloud protocols provided realistic insights into the cognitive processes both during and immediately after each food choice (Birns et al., 2002; Ericsson, 2006). The immediate retrospective think-aloud protocol was preferrable to the delayed retrospective think-aloud protocol, as it can be a stronger measure of reasoning (Noushad et al., 2024). The real-time nature of the concurrent and immediate retrospective think-aloud protocols reduced the time for participants to rationalise their thoughts (Higginson et al., 2002b). This approach minimised any inaccuracies or underrepresentation’s of participants’ thought processes during the food choice tasks, as they were more likely to be reflective of the cognitive processes at the point in time the food choice was made (Birns et al., 2002; Ericsson et al., 2006).

Thought listing was employed as a measure in one of the studies reviewed in Chapter 2. Kees et al. (2014) asked participants to outline nutrition-related thoughts after nutrition label engagement. In Study 1, there was no guidance given on the remit of the think-aloud reasons that participants could share. This approach broadened the focus to any factors which impacted a participants' decision(s) beyond the nutrition information to be more reflective of the complexities of making food choices (Kees et al., 2014). The participants received the same written instructions presented on the screen and had a practice phase so that the researcher could encourage the think-aloud protocol if required. The participants were not asked to verify the verbal data obtained, which is often required in qualitative analysis. This was because the think-aloud data was synchronous with participants' thinking as they completed the task and any retrospection after task completion may have impacted how reflective the data was of the decisions made (Ericsson & Simon, 1998; Higginson et al., 2002b).

Think-aloud data in Study 1 was recorded using a webcam to capture the trial along with the think-aloud measure. The think-aloud data was transcribed verbatim for each participant for each of the 60 experimental trials. Once transcribed, the think-aloud data were coded and a frequency-based content analysis conducted. From the familiarisation and coding of the data only physical elements of the products were shared as the reasons for the food choices. Therefore, these elements provided the coding system for the content analysis. This informed the reasons participants selected from after each food choice during the immediate retrospective thought listing protocol employed in Studies 2 and 3 (Figure 4.3). Think-aloud measures reported across all studies were named ‘reasons’. They were calculated based on when nutrient-5 reasons were shared per trial (calories, fat, salt, saturated fat, sugar, and/or reference to the multiple traffic light colours). The reasons were grouped based on whether the nutrient-5 information was mentioned (presence) for accurate (healthier choice selected) and inaccurate (less healthy choice selected) trials. The summed scores for each food choice task ‘question type’ condition were collated and converted into a percentage of instances where the nutrition label was provided as a reason or not for both accurate and inaccurate trials (Higginson et al., 2002b).

Figure 4.3

The Pre-Determined Thought Listing Reasons used in Studies 2 and 3

Please select as **many reasons as appropriate** to reflect the decision you just made

☐ Brand	☐ General packaging	☐ Salt content
☐ Calories/energy content	☐ Ingredients list	☐ Saturated fat content
☐ Carbohydrate content	☐ Location of production	☐ Slogan
☐ Cooking instructions	☐ Nutrition label colours	☐ Storage guidelines
☐ Expiration date	☐ Picture of the food	☐ Sugar content
☐ Fat content	☐ Price	☐ No reason
☐ Fibre content	☐ Protein content	☐ Other

4.2.4 Eye-tracking Measures

In addition to the task performance measures, eye-tracking was employed in Study 1 (Chapter 5) to objectively measure visual attention during the food choice task as this measure (Graham et al., 2012). Eye-tracking measures the visual attention directed to nutrition labels using high speed cameras (Duchowski, 2007; Hendrickson & Ailawadi, 2014). Therefore, eye-tracking provides a precise measure of instinctive visual search strategies consumers employ when making food choices (Graham et al., 2012; Van Loo et al., 2018), which are less susceptible to over-reporting than self-report measures (Ares et al., 2014; Graham & Jeffery, 2011; Grunert et al., 2010). In three of the reviewed studies (Chapter 2), eye-tracking measures were reported, demonstrating the appropriateness of the measure to yield insights into nutrition label engagement (Graham et al., 2015; Miller et al., 2019; Pennings et al., 2014).

In Study 1, eye-tracking was employed to determine the effectiveness of the novel food choice task in directing visual attention to the nutrition labels across conditions (Bialkova & van Trijp, 2011; Graham et al., 2012). The eye-tracking measures in Study 1 were recorded using SR Research's EyeLink 1000 desktop eye-tracker and extracted using SR Research Data Viewer. Study 1 analyses focused on visual attention paid to the pre-determined nutrient-5 interest area region, which contained back-of-pack and front-of-pack features of '*calories*', '*fat*', '*salt*', '*saturates'* and '*sugar*', to inform the intervention designed in this thesis. Ma and Zhuang (2021) reviewed 45 nutrition label studies which employed eye-tracking measures. They highlighted that the terminologies for eye-tracking measures varied across studies but related to the same measure, such as 'gaze duration' and 'dwell time' referring to time spent within an interest area based on the sum of fixation durations. A 'fixation' is a period of relatively still eye movement directed towards the stimuli being measured.

The recommended terminology from Ma and Zhuang's review were used in Study 1. 'Total fixation time' was calculated as the total of all fixation times in the nutrient-5 interest area region for accurate trials to indicate depth of information processing. The total calculated was converted to a percentage to enable comparisons across conditions due to the variability in stimuli exposure times based on response times. 'Average fixation duration' was calculated as the total time within the nutrient-5 area interest region for accurate trials (duration) divided by the total number of fixations (frequency) for the interest area region. This measure indicates the level of attraction or difficulty for processing the content in the interest area region. 'Time to first fixation' was calculated for accurate trials based on the fastest time for visual attention to enter the nutrient-5 area of interest after the calibration drift correct (the drift correct ensures eye-tracking precision between trials).

4.2.5 COM-B Self-Evaluation Questionnaire Measure

The intervention targeted changes in COM-B components, therefore in Study 3 (Chapter 8), changes in perceived *capability*, *opportunity*, *motivation* and *behavioural intent* in nutrition label engagement were assessed using an adapted version of the COM-B self-evaluation questionnaire (Michie et al., 2014). To reduce repetition and overlap in measures related to nutrition label engagement attitudes and behaviours, the Label Reading Survey (Marietta et al., 1999) was not implemented in Study 3. Michie et al. (2014) recommend using the original questionnaire items as a basis to inform a questionnaire that addresses the target behaviour; thus 11 items from the original 22 items were included in the scale as they were relevant to nutrition label engagement. The terminology 'food label' rather than ‘nutrition label’ was used to reflect the intervention delivered (see Chapter 7).

The questionnaire implemented comprised four subscales, one for each COM-B component (Figure 4.4). Perceived behavioural intent was added to the original three subscales, as it was important to assess this concept alongside the objective food choice task behaviour changes. The two items for the subscale were informed by existing scales to best capture the effects of the intervention on perceived behavioural intent. Perceived capability was measured by three psychological capability items, as the intervention targeted knowledge and psychological skills. Perceived opportunity was measured by four items, capturing both *physical* and *social* aspects of opportunity. The original ‘have more money’ item is relevant to food choice, but it was not targeted within the intervention as it was unlikely to change across the intervention timepoints, so it was not included in the questionnaire. Perceived motivation was measured by four items; the ‘*develop a better plan for doing it*’ item was already addressed for nutrition label engagement from the earlier opportunity questions relating to time, accessibility and prompts and so was not included.

Figure 4.4

COM-B Self-Evaluation Questionnaire Implemented

Perceived capability subscale

- '*Know more about why food labels are important to use when making dietary choices*'
- '*Know more about how to use food labels when making dietary choices*'
- '*Have more mental strength e.g., stronger resilience against cravings to use food labels when making food choices*'

Perceived opporutnity subscale

- '*Have more time when food shopping to be able to read food labels when making food choices*'
- '*Have the food labels more easily accessible*'
- '*Have more triggers to prompt you to use food labels when making food choices*'
- '*Have more support from others to encourage you to use food labels when making food choices'*

Perceived motivation subscale

- '*Feel like you want to use food labels when making food choices*'
- *'Feel that you need to use food labels when making food choices*'
- '*Believe that using food labels would be a good thing to do*'
- '*Develop a habit of using food labels when making food choices*'

Perceived behavioural intent subscale

- *'How likely are you to use food labels when making food choices?*'
- *'How likely do you think you will be to use food labels when making food choices in the future?*'

Participants responded to the questionnaire items on a visual analogue scale from 0 (definitely not) to 100 (definitely) of how they felt each item would help them to engage with nutrition labels and could provide an optional brief explanation for each rating. A 'rate all that apply' rather than a 'check all that apply' evaluation was taken because of the benefits of this approach in food-based research (Ares, Bruzzone et al., 2014). In addition, participants were able to select ‘N/A’ if they did not feel that an item was relevant to them. Existing psychometric properties are not available for the original scale. Table 4.2 shows the reliability statistics for the application of the scale in Study 3, which demonstrated acceptable reliability (Clark-Carter, 2024).

Table 4.2

Reliability Statistics for the COM-B Self-Evaluation Questionnaire

Concept	Baseline		Post-intervention		Follow-up	
	α	λ	α	λ	α	λ
Capability	.78	.79	.79	.81	.83	.83
Opportunity	.84	.84	.82	.82	.81	.81
Motivation	.79	.80	.83	.84	.83	.83
Behavioural intent	.89	.89	.92	.92	.95	.95

4.2.6 Demographic Measures

Chapter 1 outlined the importance of considering demographic factors when investigating nutrition label engagement. However, the systematic review (Chapter 2) highlighted a lack of individual difference reporting in the existing nutrition label engagement intervention research (Dooley et al., 1998; Miller et al., 2019; Mnerie et al., 2015; Souza et al., 2016). Therefore, the empirical studies conducted within the thesis measured a range of demographic factors to consider their potential impact on nutrition label engagement and the intervention development process. Age and sex were measured across the empirical studies conducted in the thesis. This was important as the previous research has consistently reported that middle-to-older aged adults and females have higher levels of nutrition label engagement compared with other age groups and sexes (Cowburn & Stockley, 2005; Campos et al., 2011).

Body mass index (BMI) was measured across the three empirical studies. In study 1, participants were asked to remove their shoes and any heavy coats/jackets before the researcher measured their height using a stadiometer and their weight using calibrated weighing scales (Ortega et al., 2016). In Studies 2 and 3 participants self-reported their height and weight measurements due to the research taking place online. Height was recorded in metres and weight recorded in kilograms (conversion charts were provided in Studies 2 and 3) and BMI was calculated as weight in kilograms divided by height in metres squared (NHS, 2023b). The request for weight measurement was clearly outlined at study sign up and the values measured in Study 1 were entered without showing the participant to reduce any potential psychological distress.

There are four BMI categories, and these are the same for both sexes, across age groups and across ethnicities. A BMI of 18.4 kg/m^2 or below is classed as underweight. A normal or healthy weight status relates to a BMI of between 18.5-24.9 kg/m^2. Excessive body weight is categorised by a BMI of greater than 25.0 kg/m^2. A BMI of between 25.0-29.9 kg/m^2 is categorised as overweight and a BMI of 30.0 kg/m^2 or greater is categorised as obese (NHS, 2023b). Using BMI defined excessive body weight categories is an internationally accepted method, and the measure is used worldwide due to its simplicity and inexpensive nature to directly measure excessive body weight (Ortega et al., 2016).

It has also been established within the research that a consumer's own weight perception can influence their engagement with nutrition labels (Rasberry et al., 2007). Therefore, this measure was considered alongside BMI measures to consider the role of self-perceived weight on nutrition label engagement and in the intervention design process. Across the three empirical studies self-perceived weight was measured using a 5-point Likert scale in relation to a single item (Robinson et al., 2018). Participants were asked '*how do you think of yourself in terms of weight?*'. Participants responded by choosing one of the following options: 1 (very underweight); 2 (slightly underweight); 3 (about the right weight); 4 (slightly overweight); or 5 (very overweight). This measure was selected as the responses mapped across to BMI and the construct did not require multiple facets to be assessed to capture its meaning (Cuvillier et al., 2021). Due to the use of a single item, reliability statistics were not calculated for this measure.

4.2.7 Health Literacy Measure

Nutrition label health literacy refers to a consumers' capacity to obtain, process, understand and draw appropriate health-based decisions based on their literacy and numeracy skills (Weiss et al., 2005). Health literacy is associated with social determinants of health (e.g., ethnicity, education status and socioeconomic status) but the association with health behaviour (e.g., nutrition label engagement) persists when these determinants are controlled for (Baker et al., 1997; McNichol & Rootman, 2016). Therefore, in the three empirical studies the *Newest Vital Sign* (Weiss et al., 2005) was used as a health literacy measure. The version adapted for a UK population, to reflect UK nutrition labels and terminology, was implemented (Rowlands et al., 2013). The Newest Vital Sign (Rowlands et al., 2013) was selected as it had a relatively short administration time (<5 minutes) and has had success when adapted for computerised self-administration (Lindly et al., 2024; Mansfield et al., 2018).

The UK version of the Newest Vital Sign measures comprises three items to measure reading (e.g., *'is it safe for you to eat this ice cream?'*) and three items to measure numerical (e.g., '*if you are advised to eat no more than 60 grams of carbohydrate for dessert, what is the maximum amount of ice cream you could have?*') health literacy in relation to an ice cream back-of-pack nutrition label showcard (Figure 4.5). Nutrition label health literacy was scored from the sum of the items and had a maximum score of six points. A score of zero or one indicated a 50% or greater likelihood of limited health literacy, a score of two or three indicated a 25% possibility of limited health literacy. A score of four or higher indicated adequate health literacy. This measure has been used as an outcome measure in nutrition label interventions (Malloy-Weir & Cooper, 2016; Moore et al., 2018a).

The Newest Vital Sign has acceptable reliability statistics in the literature (e.g., $\alpha = .74$; Rowlands et al., 2013). Table 4.3 shows the acceptable reliability for the Newest Vital Sign measure for the empirical studies, with slightly lower reliability scores in Study 2 (Clark-Carter, 2024).

Figure 4.5

The Newest Vital Sign Nutrition Declaration Showcard

Product Description: Ice Cream		
Serving Size:	100ml	
Servings per container:	4	
NUTRITIONAL INFORMATION		
TYPICAL VALUES		***Per 100ml***
Energy		**1050 kJ**
		250 kcal (calories)
Protein		**4 g**
Carbohydrate		**30 g**
of which sugars		23 g
Fat		**13 g**
of which saturates		9 g
of which monounsaturates		0 g
of which polyunsaturates		3 g
of which trans fats		1 g
Fibre		**0 g**
Sodium		**0.05 g**

Ingredients: Cream, Skimmed Milk, Sugar, Whole Egg, Stabilisers (Guar Gum), Peanut Oil, Vanilla Extract (0.05%).

Table 4.3

Reliability Statistics for the Newest Vital Sign

Study	α	λ
Study 1	.72	.73
Study 2	.60	.65
Study 3	.75	.77

4.2.8 Motivations for Food Choice Measure

Dietary choice motivations are consumers' individual differences which can influence their engagement with nutrition labels (Ares et al., 2014;

Grunert & Wills, 2007). These motivations are centred on the features of a product which are of greatest importance to the individual consumer, for example, the convenience, price or expected taste and liking of a product (Steptoe et al., 1995; Turner et al., 2014). The Eating Motivation Survey (TEMS; Renner et al., 2012) was devised from 331 motives of eating behaviour reported in previous research and findings from experts, including nutritionists. This is an advantage compared to other measures, such as the Food Choice Questionnaire (Steptoe et al., 1995; Onwezen et al., 2019).

The full version of the TEMS scale comprises 78-items, which are categorised into 15 distinct motivation subscales. In addition, there is a validated brief 45-item form, The Eating Motivation Survey-Brief (TEMS-B), to reduce participant burden when completing the measure (Renner et al., 2012). The TEMS-B was implemented in the empirical studies reported in this thesis. The scale has high stability across its factors for different subpopulations, including sex, age and BMI which is vital for nutrition label engagement research. The TEMS-B responses are recorded on a 7-point Likert scale from 1 (never) to 7 (always). The responses for each subscale are averaged for analysis. The greater the score the higher the motivation for the subscale. The TEMS-B items were presented in a pseudo-randomised order in the empirical studies, using an online randomiser so that participant demand characteristics for the subscales were minimised. Six subscales of the TEMS-B are reported for each study, chosen based on the food choice motivations outlined in Chapter 1. Table 4.4 shows the subscales and their acceptable reliability ratings across the empirical studies (Clark-Carter, 2024).

Table 4.4

Reliability Statistics for the TEMS-B

Motivation	Study 1		Study 2		Study 3	
	α	λ	α	λ	α	λ
Convenience	.91	.91	.82	.83	.83	.83
Habits	.75	.75	.75	.75	.74	74
Health	.89	.89	.85	.85	.85	.85
Liking	.84	.85	.74	.74	.70	.70
Price	.76	.77	.80	.80	.76	.77
Weight control	.76	.77	.85	.85	.83	.83

4.3 Data Collection Approaches

The research studies reported in this thesis were sequential so that the study design, data collection protocol and analyses could inform the next study. This approach was important to build a holistic picture of nutrition label engagement to inform the design and implementation of the nutrition label intervention. The population group of interest in this thesis were healthy adults living in the UK, this is due to the nutrition labelling policy in the UK being a population-level initiative (Azman & Sahak, 2014). Based on legislation in the UK, the research was only concerned with individuals aged over 18 years old (Arnett, 2007). In the context of this thesis the term 'healthy' referred to any adult who does not have a diet-related condition, for example colitis, diabetes, eating disorders, allergies or intolerances (Rose et al., 2018). Individuals with diet-related conditions may have received nutrition label advice and education to help them manage their condition, which can impact nutrition label engagement (Post et al., 2010). The term 'healthy' included all categories of BMI so that the research was reflective of the overall UK population.

4.3.1 Ethical Considerations and Approvals

Full ethical approvals were sought and granted from University of Staffordshire for the empirical research presented in the thesis and all participants received required information, consent and debrief materials (Appendices C-O). The information sheet outlined participation was voluntary and withdrawal rights. An element of deception was used during recruitment as participants were recruited on the premise the research was interested in how they made food choices rather than nutrition label engagement. This was imperative to ensure that natural behaviours during the food choice tasks were measured. Therefore, the debrief sheet for each study provided a detailed overview of the aims of the research and the option for the participant to withdraw their data if they were no longer happy to contribute to the aims of the study (this did not occur across any of the studies conducted). The debrief contained signposting to NHS materials used to inform the intervention for participants who wished to improve their nutrition label engagement. Furthermore, whilst strict eligibility criteria were employed, the risk of distress to individuals with unknown eating or weight-related conditions was important to minimise and so participants were not exposed to any additional risk than they would be in everyday life. Furthermore, the debrief included signposting to support eating support, and GP services.

4.3.2 Study Settings and Participant Incentives

Study 1 was an eye-tracking study, conducted within a research laboratory at University of Staffordshire. Whilst technology advances have led to the introduction of mobile eye-tracking and virtual reality integrated eye-tracking, the sampling rate is lower than desktop-based systems which can reduce precision (Valliappan et al., 2020). In addition, the data coding process is currently cumbersome if values rather than visualisations are needed for analysis (Meißner & Oll, 2019). Therefore, a laboratory environment using a desktop eye-tracker was the most appropriate data collection approach to yield comprehensive insights for nutrition label engagement during the food choice task.

The laboratory environment controlled for external factors and measured dedicated attention to the food choice task. However, the findings from Study 1 were limited to a mostly homogenous sample. This was due to the sample needing to be able to attend the laboratory in-person and so most of the participants were associated with the university either as students or staff. There were limited incentives offered for participation in Study 1, with research credits offered to psychology students and no further incentives offered. Thus, recruitment to the 45-minute study was challenging after the initial couple of months, especially the recruitment of male participants who were lower in student numbers on psychology courses and staff than females. Recruitment strategies were successful in achieving the power required for the study ahead of laboratory closure due to covid-19 pandemic.

Study 2 aimed to replicate and refine the study design from the first study in a less homogenous sample of healthy UK adults to reflect the broader population target for the intervention. This mixed-methods study also required participants to reflect upon and write about their nutrition label engagement and thoughts about interventions. Therefore, it was determined that an online study was an appropriate avenue for data collection. This addressed the need to access a more diverse population group and reduced the potential barriers to engagement due to the COVID-19 pandemic. The study was built using *Qualtrics*, as the University's preferred GDPR compliant platform. This platform enabled an anonymous link to be shared with participants to complete the study remotely. *Qualtrics* is traditionally a survey tool. Therefore, to present the food choice task and randomisation required the JavaScript and advanced functions within *Qualtrics* were utilised. The recruitment tool *Prolific* was used to host the *Qualtrics* survey link and recruit participants from across the UK. Funding was secured from a University of Staffordshire internal funding call to provide payment to participants for their time. There are a range of crowdsourcing research platforms available to recruit participants from; *Prolific* was selected as research has argued that the platform can yield high data quality in a time efficient way compared to similar platforms such as *Amazon MTurk* (Douglas et al., 2023).

Prolific has a minimum payment of £6.00 per hour for participants and the research duration can vary from short single-timepoint studies to multi-timepoint longer studies. The current research explored healthy participant engagement with nutrition labels, and as such is not focused on a specific disease or treatment which may require higher reimbursement (Tishler & Bartholomae, 2013). The reimbursement was set around minimum wage or equivalent and was not lucrative, to reduce any impacts on the quality of the data collected or ethical concerns related to incentivising an individual to engage in the study if they would not usually choose to (Tishler & Bartholomae, 2013; Vandormael et al., 2021). *Prolific* has a calculator tool to determine a 'fair' payment for research studies. As Study 2 had an anticipated duration of 60 minutes, required some timed tasks and written responses it was determined that an inducement of £9.00 per hour was appropriate reimbursement.

Study 3 was conducted online and also used *Prolific* as a recruitment tool and offered an equivalent of £7.50 per hour. This was a lower incentive than Study 2, due to the differences in study requirements, but was a higher incentive than similar research, such as Vandormael et al. (2021) who offered a £6.00 per hour equivalent to meet the minimum payment on the platform. The incentive offered for Study 3 was the first point that the payment was considered a 'fair' rather than 'low' payment using the *Prolific* calculator. This was deemed appropriate as the study duration was longer than similar research (Vandormael et al., 2021) and was a two-part study which required greater engagement from participants who signed up to participate. This approach to data collection was decided as Study 2 had successfully transferred the study design into an online format that could be used to deliver the intervention as per consumer preferences (Chapter 7). This approach had a greater likelihood of recruiting a diverse sample and would enable scalability of the online intervention.

4.4 Methodology - Data Analysis

4.4.1 Quantitative Analyses

To reduce duplication in empirical chapters data screening checks, assumption thresholds and justifications for quantitative analytic approaches are outlined in this chapter. Data screening checks were conducted at the start of each quantitative analysis: 1) No non-sensible values were identified across the empirical studies, confirming the values were appropriate for each measure. Therefore, this check is not reported across the analyses to reduce repetition. 2) Missing values were only identified due to task performance or lack of completion of the follow-up phase in Study 3, for these instances, the action taken is outlined in the respective analyses. Where no missing values were present the check is not reported to reduce repetition in the results reported (Clark-Carter, 2024).

After initial data screening checks, univariate outliers were identified from calculated *z* scores. Where *z* scores were within acceptable thresholds of -3 to 3 (Clark-Carter, 2024) the check was not reported to reduce repetition as no action was taken. Where outliers were identified, sensitivity analyses were conducted to determine if results were affected by outliers (Clark-Carter, 2024). When sensitivity analyses confirmed the original analyses, they were not reported in the results section. This approach was taken to streamline the results reported for each empirical study. Where the sensitivity analysis did not confirm the findings from the original analysis, the sensitivity analyses are reported and the implications stated within the respective study.

The univariate assumption checks for normal distribution were checked across the empirical studies. Thresholds for skewness and kurtosis values for most analyses reported were within the acceptable -2 to 2 thresholds, when outliers were removed (George & Mallery, 2010). For some analyses kurtosis thresholds were widened to a moderate -3 to 3 threshold. This is common when analysing eye-tracking data, rather than using data transformations, due to the range in datapoints produced (Sáiz Manzanares et al., 2020). Repeated-measures Analysis of Variances (rmANOVAs) and mixed Analysis of Variances (ANOVAs) were conducted to test differences of means in different conditions. These inferential tests have been reported to be robust to non-normality and violated assumptions when comparing means (Clark-Carter, 2024; Rahrig, 2024). Therefore, a wider moderate kurtosis threshold was considered appropriate (Blanca et al., 2023).

Mauchly's test of Sphericity was checked for three or more levels to a repeated-measures independent variable. When significant, the Greenhouse-Geisser statistic was reported in the inferential statistics. In Studies 1, 2 and baseline of Study 3 for significant rmANOVAs main effects, Bonferroni post hoc pairwise comparisons were conducted (Tabachnick & Fidell, 2007). This ensured all combinations of levels were compared to gain insights into consumer nutrition label engagement in the food choice task developed. For significant interactions, simple effects were conducted for all comparisons to understand where differences were. This approach is recommended to understand simple effects of each repeated-measures variable (Verma, 2015) and is noted as appropriate practice when exploring task performance (Tremblay et al., 2022). Analysis of Covariance (ANCOVA) was conducted for some analyses in Study 3 to control for baseline and individual difference measures, as these analyses were limited to this study only the assumption checks are outlined there.

Standard multiple regressions with simultaneous entry were conducted on the individual differences' predictor variables. This approach was taken to explain as much of the variance in each dependent variable for each analysis (Clark-Carter, 2024). Based on previous literature, it was evident individual differences should explain variance for each dependent variable, it was also important to see relative contributions from each predictor variable (Clark-Carter, 2024). Task performance measures were not added as predictors for regression analyses as inclusion inflated the variance explained. Therefore, only individual differences were included in analyses to provide insights into their impact on the ability to select healthier options (accuracy). Regressions were reported for 'purchase' condition, to determine impact of individual differences on choices made without health-related direction; and 'health-related' condition to review if individual differences accounted for variance when health motivation was prompted. Nutrient-specific decisions were not included as a dependent variable for these analyses as making predictions based on performance for this block would not reflect the encouraged behaviours in healthy adults.

In addition to univariate thresholds outlined above additional checks were performed for multiple regression analyses. Scatterplots were created and showed linear relationships for predictor variables and outcome variables across the analyses, these were not reported in empirical studies. Bi-variate correlations were conducted to check collinearity between predictor variables, this check was met across datasets as correlation coefficients were less than 0.8 (Clark-Carter, 2019). A scatterplot of Cook's Distance and Centred Leverage values was created for each regression analysis. A rule of thumb for each scatterplot was used to interpret outcomes of multivariate outlier check (KrDas & Gogoi, 2015). Where the check was met this was not reported to streamline results, where multivariate outliers were present sensitivity analysis was conducted and reported as was for univariate outliers. The assumption of multicollinearity was met across analyses as tolerance values were less than 1 and VIF values were less than 10 (Clark-Carter, 2019). The distribution of residuals histogram showed normal distribution for each analysis and the assumption of homoscedasticity was met across datasets as the scatterplots of standardised residuals against predicted values was evenly dispersed around 0 (Clark-Carter, 2019).

4.4.2 Thematic Analysis

Thematic analysis was the chosen method of analysing the qualitative data collected in studies 2 and 3. Thematic analysis was chosen as it is a flexible approach to analyse the patterned meaning in experiences and perceptions shared by participants for the research questions posed in the thesis (Braun & Clarke, 2022). The aim of the qualitative analyses were not to focus on theoretical framework (grounded theory), to quantify data (content analysis), focus on language use (discourse) or to focus on lived experience (IPA), but to focus on consumer experiences and perceptions of nutrition label engagement and the intervention received. Reflexive thematic analysis (Braun & Clarke, 2022) was the chosen thematic analysis approach taken within the empirical studies in the thesis.

Braun and Clarke (2022) provide guidance on how to conduct a reflexive thematic analysis. Researchers can adopt an inductive approach, whereby the codes and themes are strongly linked to the data, or a deductive approach, where the researcher's theoretical interests drive the analysis and thus may provide a less in-depth exploration of the whole data set. Therefore, the qualitative analyses presented in Chapter 6 and 9 adopt an inductive approach, to explore the experiences and perceptions of consumers related to nutrition label engagement and to the intervention they received. In addition, the findings from Study 2 were deductively mapped to COM-B (Michie et al., 2011) to provide additional insights to inform the intervention development process.

4.4.2.1 Stages of Reflexive Thematic Analysis. Six phases were engaged with, as described by Braun and Clarke (2022). *Stage 1* focused on familiarisation with the extracted data, where SH read through the responses noting initial thoughts on interesting content shared and initial reflections. It was decided through discussions between SH and RP that there was sufficient detail in the qualitative responses collected to enable reflexive thematic analysis to be performed. This familiarisation helped SH to formulate an appropriate coding strategy. Furthermore, one participant's qualitative responses were removed from Study 2 due to suspected artificial intelligence use as the responses were generic 'answers' to the questions posed rather than the individual's experiences.

Stage 2 of the reflexive thematic analyses involved inductive coding of the datasets. Semantic and latent codes were used to explore the experiences of nutrition label engagement in Study 2 and perceptions of the nutrition label intervention in Study 3. This stage was engaged with systematically for each dataset and data was only coded where relevant to the respective research question. In addition, after the write-up of the inductive thematic analysis for Study 2 was completed, deductive coding of the dataset was performed to map the data to COM-B components to further inform the development of the nutrition label intervention. *Stage 3* drew together the inductive codes to capture meaning across the dataset and initial candidate themes were proposed.

During *Stage 4* SH went back to each dataset and had discussions with RP to develop and review the themes. The themes were considered based on how they could connect to tell a compelling story. At this stage, for each analysis, changes were made to the groupings of codes and the initial candidate themes with some narratives discarded at this stage. A theme was decided based on Braun and Clarke's (2022) notion that it is a pattern of meaning that is unified and underpinned by a central semantic or latent idea. Subthemes were used sparingly or not at all as recommended by Braun and Clarke, as this can suggest topic summaries rather than shared meaning themes are presented. In addition, a table for the deductive mapping analysis was created as part of Study 2 to draw together the deductive coding in relation to COM-B components.

Stage 5 involved naming the final themes and defining them. The key story within each theme was summarised to help provide context at the start and a summary at the end of each theme. The theme names were reflective of the key message from each theme and in some cases drew upon extracts from within the theme itself. *Stage 6* focused on the writing of the analyses presented in the thesis. During the stages of each reflexive thematic analysis the researcher maintained a reflexive diary to support the development of the analysis and to consider their role within the research and analysis.

4.5 A Summary of the Chapter Contributions

This chapter outlined the research paradigm taken in relation to the study design, data collection and data analysis in the empirical research reported within this thesis. In addition, it described and evaluated methodological approaches and measures in the literature which build on from the identification of concepts and theories in Chapters 1 to 3. The chapter justified the decisions taken during the research process and the pragmatic, mixed-methods approach taken across the scope of this research. It demonstrated the importance of considering the research paradigm prior to and during study development, especially in intervention-based research where multiple studies may be needed to understand the target behaviour.

Chapter 5: An Eye-Tracking and Think-Aloud Study Investigating Factors Influencing Consumer Nutrition Label Engagement when Making Food Choices

This chapter reports the rationale, methods and findings from the first empirical study conducted within this thesis. This study was an experimental eye-tracking and think-aloud study to investigate differences in nutrition label engagement across a triangulation of measures to address Thesis Objective 2. The rationale for the study is justified at the start of the chapter by drawing and building on key pieces of literature presented earlier in this thesis. This rationale leads into the research aims and hypotheses for the study in relation to Thesis Objective 2 and then the methods for the study are outlined. The findings from the study are reported and these findings are discussed in relation to the research aims, the previous literature and their implications in the discussion. The chapter concludes by outlining the key chapter contributions to inform the next stage of the thesis.

5.1 Rationale and Aims

Nutrition label engagement has been a considerable area of focus for researchers (Anastasiou et al., 2019; Fernqvist et al., 2024). However, there have been a limited number of studies focused on triangulating measures to provide detailed insights into factors which impact engagement (Ares et al., 2014; Cowburn & Stockley, 2005). Researchers have recommended that a triangulation of measures can build a detailed understanding of factors influencing nutrition label engagement (Christoph et al., 2015). Therefore, attention, performance and individual differences measures were included in the present study to triangulate consumer nutrition label engagement. This is of importance within the thesis, as these insights will inform the design of a novel nutrition label engagement intervention. Furthermore, the study investigated the effectiveness of the novel food choice task. This piloting and refinement of the food choice task after initial development was important to ensure that it was an effective nutrition label engagement instrument to assess the effectiveness of the intervention implemented.

Study 1 focused on contributing findings to Thesis Objective 2. It explored factors which can influence nutrition label engagement in UK adult consumers and tested the food choice task and measures within a single study. To contribute findings to Thesis Objective 2, Study 1 tested three non-directional research hypotheses:

Hypothesis 1: There will be differences in eye-tracking attention measures (percentage total dwell time, average fixation duration and time to first fixation) for accurate food choice task trials.

Hypothesis 2: There will be differences in task performance measures (percentage accuracy, average percentage confidence ratings for accurate trials, confidence bias scores and reasons) for the food choice task.

Hypothesis 3: Measured individual differences (nutrition label health literacy, BMI, self-perceived weight, six motivators for food choice (convenience, habit, health, liking, price and weight concerns), self-reported nutrition label use, age and sex) will predict accuracy in the ‘purchase’ and in the ‘health-related’ conditions of the food choice task.

5.2 Method

5.2.1 Design

The current study used an experimental, laboratory-based, repeated-measures design. The study was approved by University of Staffordshire's Ethics Committee in January 2019 (Appendix C).

5.2.1.1 Food Choice Task – 'Question Type' Variable. 'Question type' was a repeated-measures independent variable with three levels in the current study: (1) the 'purchase' condition ("*which of these products would you choose if you were looking to **purchase one**?*"); (2) the 'health-related' condition ("*which of these products would you choose if you were looking to **select the healthier one**?*"); and (3) the 'nutrient-specific' condition ("*which of these products would you choose if you were looking to **reduce your [specific nutrient] intake**?*") (Section 3.2.3 outlined a full explanation of this variable).

5.2.1.2 Food Choice Task – 'Label Difficulty' Variable. 'Label difficulty' was a repeated-measured independent variable with three levels ('easy' vs. 'moderate' vs. 'hard') in the current study (Section 3.2.4 provided a full explanation of this variable).

5.2.1.3 Food Choice Task – 'Attention' Variables. Attention for accurate trials during the food choice task was measured by three dependent variables: (a) percentage total fixation time; (b) average fixation duration; and (c) time to first fixation. The attention variables were based on when participants looked at the target 'nutrient-5' information as these are the nutrients of public health concern and the target for the intervention designed in the thesis. How these measures were defined and calculated was outlined in Section 4.2.4.

5.2.1.4 Food Choice Task – 'Performance' Variables. Food choice task performance was measured by four dependent variables (a) average percentage accuracy for selecting the healthier choices; (b) average percentage confidence ratings for accurate choices; (c) confidence bias scores; (d) nutrient-5 reasons. How these measures were defined and calculated was outlined in Section 4.2.

5.2.1.5 Individual Difference Variables. The measures of individual difference collected for this study were: (a) objectively measured BMI; (b) self-perceived weight; (c) six motivation subscales for food choices (convenience, habit, health, liking, price and weight control); (d) attitudes towards nutrition labels; (e) behaviours towards nutrition labels; (f) nutrition label health literacy; (g) self-reported nutrition label use; (h) age; and (i) sex. The full details of the scales, including their psychometric properties where appropriate, were reported in Section 4.2.

5.2.2 Participants

An a-priori power analysis was conducted, and 80 participants were required to achieve a desired power of 0.8 with a medium eta-squared effect size to conduct the analyses identified (Clark-Carter, 2019). Cohen (1992) suggested using a medium effect size to approximate the average sample size observed across various fields. Due to variation in the effect sizes across the different measures reported in the literature (e.g., reviews by Anastasiou et al., 2019; Graham et al., 2012), this guideline was deemed appropriate to use for the effect size calculation for this study. A total of 84 participants were recruited from opportunistic sampling from posters, advertising using an online recruitment tool within the institution (SONA) and sharing social media posts. Participants who were enrolled on a psychology course at the institution were awarded study credits for their participation. Four participants were excluded from the analyses based on issues with eye-tracking (n = 3) and not demonstrating an understanding of the tasks (n = 1).

All participants met the eligibility criteria; the criteria were outlined on the information sheet (Appendix D) and consent form (Appendix E). The inclusion criteria listed that participants must have lived in the UK for a minimum of three years since 2011, as this was the date Regulation 1169/2011was publicised. The participants had to purchase prepacked products and be fluent in English. These criteria were important to ensure that the participants could read the stimuli presented within the allocated timeframe. The participants had to be aged 18 years or older as they are more likely to be making independent dietary choices. The participants had normal or corrected-to-normal full colour vision to engage with the stimuli presented. The exclusion criteria outlined that the participants must not have any eating-related conditions, including diabetes, colitis, anorexia, bulimia, food allergies or intolerances, as they can influence engagement with nutrition labels. Participants were also excluded from participating if they had photosensitive epilepsy, due to the infrared light sensors used by the eye tracker to track eye movements.

5.2.3 Materials and Procedure

5.2.3.1 Consent and Practice Phase. Electronic participant informed consent was obtained (Appendices D and E) before participants were asked to sit facing the stimulus monitor for the experiment. The participants adjusted their seating position so that their eyebrows were resting on the forehead rest. A chin rest was available and lowered to facilitate the participants being comfortable to talk during the think-aloud phases of the study. Once the participants were seated, the researcher conducted the rest of the experiment from a control room. A screen-based 9-point calibration and validation procedure was completed. This calibration and subsequent calibration drift correct screens ensured that all right eye recordings had a mean spatial error of <0.5 degrees.

Next participants were presented with the practice phase. The practice phase was included to reduce the stimuli novelty effect and enable participants to familiarise themselves with the nutritional classifications for the front-of-pack (Figure 5.1) and back-of-pack (Figure 5.2) nutrition labels, which were presented for 30 seconds each. Task instructions were presented on the stimulus monitor, which outlined the steps for each trial of the experimental phase. Participants were informed that a question would be presented on the screen but at this stage were unaware of the question type blocks (purchase, health-related, nutrient-specific). Participants were asked to engage in the think-aloud protocol as they made their meal choices, and that they could switch between the front and back views of the product by using the ‘switch’ button on the response box. Once participants had read the first set of instructions they pressed ‘next’ on the response box to continue.

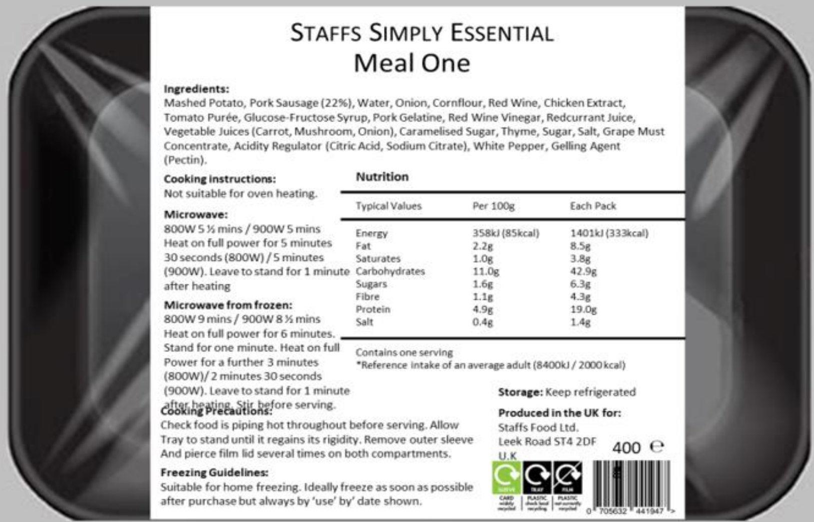
Figure 5.1

The Front-of-Pack Nutrition Classifications and Initial Study Instructions used in the Practice Phase

Figure 5.2

The Back-of-Pack Nutrition Classifications and Initial Study Instructions used in the Practice Phase

Please familiarise yourself with the following back of pack examples, these are similar to the products that you will be presented with.



Price: £1.50

Price: £3.00

Enlarged nutritional classifications for awareness:

Lowest nutritional value classifications per 100g

Typical Values	Per 100g
Energy	
Fat	≤ 3.0g
Saturates	≤ 1.5g
Carbohydrates	
Sugars	≤ 5.0g
Fibre	
Protein	
Salt	≤ 0.3g

Medium nutritional value classifications per 100g

Typical Values	Per 100g
Energy	
Fat	> 3.0g - ≤ 17.5g
Saturates	> 1.5g - ≤ 5.0g
Carbohydrates	
Sugars	> 5.0g – ≤ 22.5g
Fibre	
Protein	
Salt	> 0.3g - ≤ 1.5g

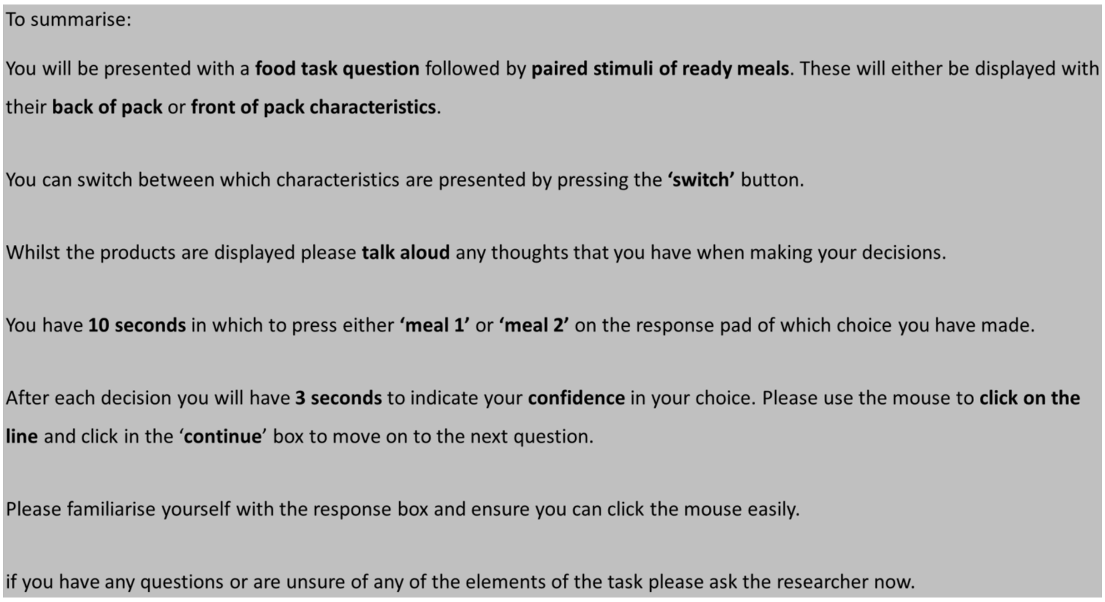
Highest nutritional value classifications per 100g

Typical Values	Per 100g
Energy	
Fat	> 17.5g
Saturates	> 5.0g
Carbohydrates	
Sugars	> 22.5g
Fibre	
Protein	
Salt	> 1.5g

The second task instruction screen outlined that each paired stimuli was presented for 10 seconds and that meal choices for the question posed were made by pressing the ‘meal 1’ or ‘meal 2’ button on the response box. There was a reminder that the stimulus displayed could be switched as frequently as necessary to reach a decision within the 10 second exposure time. Next, instructions were presented on how to use the confidence rating scale and then a summary of the task instructions was presented (Figure 5.3).

Figure 5.3

Summary Task Instructions Before the Practice Phase


To summarise:

You will be presented with a **food task question** followed by **paired stimuli of ready meals**. These will either be displayed with their **back of pack** or **front of pack characteristics**.

You can switch between which characteristics are presented by pressing the **‘switch’** button.

Whilst the products are displayed please **talk aloud** any thoughts that you have when making your decisions.

You have **10 seconds** in which to press either **‘meal 1’** or **‘meal 2’** on the response pad of which choice you have made.

After each decision you will have **3 seconds** to indicate your **confidence** in your choice. Please use the mouse to **click on the line** and click in the ‘**continue**’ box to move on to the next question.

Please familiarise yourself with the response box and ensure you can click the mouse easily.

if you have any questions or are unsure of any of the elements of the task please ask the researcher now.

Two practice trials were presented to familiarise the participants with the stimuli and procedure for the experimental stage of the research. The practice trials began with the question ‘*which of these products would you choose if you were looking to **eat** one?*’, so that the task demand was different to the experimental tasks and did not lead to familiarity or demand characteristics for the test phases. After the question was posed a drift correct 1-point calibration was performed, to ensure precision in the eye-tracking recorded, before showing the practice phase paired ready meal stimuli for a maximum time of 10 seconds. The chosen meal was selected by pressing ‘Meal 1’ or ‘Meal 2’ on the response box. During the stimuli exposure time the participants’ eye movements were recorded and a think-aloud protocol employed. Once the screen had moved on (a choice had been made or had timed out) there was a holding screen where participants could make their choice and/or complete the think-aloud protocol.

To help the participants to feel confident with the think-aloud protocol during the practice phase the researcher was able to remind the participant to think aloud. This approach helped to reduce the possible memory constraints which may have been present in previous research. This is because it allowed the process to be clearer for the participant so that they were aware of the stimuli that they need to attend to during the tasks (Birns et al., 2002). Aside from this reminder in the practice phase the researcher kept any ‘keep thinking aloud’ prompts to a minimum to not interfere with the participants’ flow of thoughts (Fonteyn et al., 1993). This protocol enabled the collection of real time cognitive data during the completion of the tasks. After completing the think-aloud protocol, participants moved on to the next screen where they were asked to complete their confidence rating on a visual analogue scale for the decision that they had just made. They completed this process for two practice trials before being reminded of the task instructions and moving on to the experimental phase of the study.

5.2.3.2 Food Choice Task Experimental Phase. In the experimental phase there were 20 trials for each 'question type' condition (60 trials in total). The question changed based on the question block presented. The first block was the 'purchase' condition, which assessed natural engagement with nutrition labels when making purchase-based food choices. The 'question type' for health-related and nutrient-specific conditions were counterbalanced to control for order effects (p >.05). Across and within the 'question type' blocks the paired ready meal stimuli were counterbalanced on: (a) whether the front or back of the paired stimuli were viewed first; (b) whether the healthier (accurate response) food product was presented on the left vs. right of the pairing; and (c) whether the healthier (accurate response) food product was assigned to the "luxurious range" or the "simply essential" range. The stimuli were randomised within each 'question type' condition based on 'label difficulty', these measures were taken to reduce demand characteristics.

Each food choice task trial began with a screen which posed the question (purchase vs. health-related vs. nutrient-specific) that the next food choice should be based on. After the question was displayed, a drift correct 1-point calibration was performed to ensure precision in the eye-tracking measures recorded. If there were issues with the drift correct a full 9-point calibration was completed and the participant was reminded of the question that was asked. Next the paired ready meal stimuli were presented for a maximum of 10 seconds, including any 'switch' responses which the participants were able to press as many times as they liked within the exposure time. During the exposure time, participants looked at the paired ready meal stimuli and using a response box indicated whether they would choose ‘meal 1’ or ‘meal 2’ based on the question asked. If a meal was selected before the 10 second exposure-limit, or the 10 seconds was reached, the study automatically moved on to the next screen. During the stimuli exposure time eye movements were tracked and recorded and participants engaged with the think-aloud protocol when reaching a decision.

Once the screen had moved on there was a holding screen where participants who were unable to reach a decision within the 10 second exposure period were asked their food choice and there was an opportunity to complete the think-aloud protocol for the decision made. Once the participant was ready, they pressed ‘next’ on the response box to provide their confidence rating on a visual analogue scale (0 = not confident at all to 100 = extremely confident) for the food choice they had just made. After participants had completed the rating, they pressed ‘next’ on the response box to move on to the next trial. This completed the experimental phase, and participants were asked to move to a separate laptop to complete the next stages of the research.

5.2.3.3 Measures of Individual Differences and Debrief. In the next phase of the research participants were asked to complete the scales for: (1) motivations for food choices; (2) self-perceived weight; (3) nutrition label health literacy; (4) self-reported nutrition label use; (5) attitudes and beliefs towards nutrition labels and (6) age and sex. These were presented in order outlined to limit demand characteristics. Once participants had completed these questionnaires the researcher returned to the laboratory and measured and recorded the participant’s height and weight. The researcher thanked the participants for their time, provided a verbal and written debrief (Appendix, F). The study duration was approximately 45-minutes in total.

5.2.4 Analysis

Hypotheses 1 and 2 were tested by six rmANOVAs and hypothesis 3 was tested by two multiple regressions. The justification for data screening and assumption check thresholds and the stages of the analyses were outlined in Section 4.4.1. There were missing values observed across the dataset due to task performance outcomes (i.e., no attention paid to the nutrition label and/or no food choice was reached so subsequent measures were not asked); in these instances, the participant(s) were not included in the respective analysis. When univariate outliers were present, sensitivity analyses were conducted to exclude outliers from the analysis. The original analyses are reported in this chapter (Clark-Carter; 2019), but the sensitivity analysis outcomes are referred to when the finding outcomes differed. When Mauchly's test of sphericity was violated the Greenhouse-Geisser statistic was reported. For significant rmANOVA main effects, Bonferroni post hoc pairwise comparisons were conducted. For significant interactions, simple effects were conducted for all comparisons to understand where the differences were. This approach has been recommended to understand the simple effects of each repeated-measures variable (Verma, 2015).

5.3 Results

5.3.1 Participant Demographics

This analysis was conducted on 80 participants. All participants resided in the local Stoke-on-Trent, UK area. The mean participant age was 28.30 years (*SD* = 11.13, range 18-58 years) and 50% self-identified as female. The participant sample was representative of the weight categorisation of the population in the UK, with 67.50% objectively measuring as having excessive body weight based on their BMI calculation (*M* = 28.30kg/m^2, *SD* = 5.67kg/m^2). Participant self-perceived weight scores (*M* = 3.80, *SD* = 0.85), indicated relatively good participant awareness compared to BMI scores, but less self-perceived weight awareness in participants categorised as obese (Table 5.1).

Table 5.1

Self-Perceived Weight and BMI Participant Characteristics

Characteristic	*n*	%
Self-perceived weight		
Very underweight	1	1.25
Underweight	3	3.75
About the right weight	23	28.75
Slightly overweight	37	46.25
Very overweight	16	20.00
BMI		
Underweight	2	2.50
Normal weight	24	30.00
Overweight	26	32.50
Obese	28	35.00

Nutrition label health literacy scores indicated that 82.50% of the sample had adequate levels and 5.00% of participants had a 50% or greater likelihood of limited health literacy. Self-reported nutrition label use was moderate (M = 3.63, SD = 1.06, range 1-5). There were moderate nutrition labels attitude ratings (M = 17.75, SD = 3.36, range = 9-24) and moderate self-reported nutrition label behaviour ratings (M = 9.21, SD = 2.55, range 3-14). Self-reported nutrients typically looked for on the nutrition label ranged from 0-17 (M = 7.03, SD = 3.50). The participant sample showed higher motivations for eating foods based on *liking* and *convenience* and lower motivations for *weight control* (Table 5.2).

Table 5.2

Motivations for Food Choices Participant Characteristics

Food choice motivator	*M*	*SD*
Liking	5.98	0.97
Convenience	5.20	1.36
Habits	5.09	1.28
Price	4.76	1.29
Health	4.39	1.60
Weight control	3.77	1.43

5.3.2 Hypothesis 1: Food Choice Task – Attention Analyses

The means in Table 5.3 indicated longer total fixation times, longer average fixation times and faster times to first fixation in ‘nutrient-specific’ and ‘easy’ conditions. The means showed shorter total fixation times, shorter average fixation times and slower times to first fixation for the ‘purchase’ condition, and shorter average fixation times and slower times to first fixation in the ‘hard’ condition. Slightly longer total fixation times were observed for the ‘moderate’ condition. Based on the combined ‘question type’ and ‘label difficulty’ conditions, the means indicated longer total fixation times, longer average fixation times and faster times to first fixation in the ‘nutrient-specific moderate’ condition and shorter total fixation times, shorter average fixation times and slower times to first fixation in the ‘purchase hard’ condition.

Table 5.3

The Means and Standard Deviations for the Food Choice Task Attention Measures for Each Condition

Label Type	Purchase		Health-related		Nutrient-specific		Total	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
			Percentage Total Fixation Time (%) (*N* = 80)					
Easy	30.52	22.09	62.35	19.72	65.40	13.16	52.76	13.38
Moderate	30.04	24.08	62.06	20.66	66.66	13.88	52.92	14.45
Hard	27.56	22.57	60.23	20.88	65.21	12.74	51.00	14.26
Total	29.38	21.50	61.56	19.20	65.76	11.76		
			Average Fixation Time (*ms*) (*N* = 70)					
Easy	215.27	50.61	232.09	31.58	244.88	40.13	230.75	32.08
Moderate	211.06	37.45	232.62	37.21	246.01	44.35	229.90	31.93
Hard	209.93	35.54	230.89	33.85	245.27	32.33	228.70	29.55
Total	212.09	34.31	231.87	31.78	245.38	36.43		
			Time to First Fixation (*ms*) (*N* = 70)					
Easy	2,176.85	1,933.02	1,057.19	654.73	907.10	533.22	1,220.88	577.26
Moderate	2,007.89	1,519.31	1,145.35	875.67	827.76	430.08	1,188.55	590.49
Hard	2,320.28	1,387.02	1,205.36	699.65	877.92	385.09	1,288.73	473.64
Total	2,167.93	1,292.25	1,142.43	631.20	872.38	361.48		

5.3.2.1 Percentage Total Fixation Time Analysis. A 3 ('question type') by 3 ('label difficulty') rmANOVA was conducted on percentage nutrient-5 total fixation time for accurate trials (N = 80). There was a significant main effect of 'question type' on total fixation time, $F_{(1.79,\ 141.16)}$ = 149.72, p <.001, η^2 = .55. Table 5.4 shows that total fixation time was significantly higher in 'health-related' and 'nutrient-specific' conditions compared to the 'purchase' condition. There was no significant difference in total fixation time between 'nutrient-specific' and 'health-related' conditions.

There was a significant main effect of 'label difficulty' on total fixation time, $F_{(2,\ 158)}$ = 3.99, p = .020, η^2 = .002. Table 5.4 shows that total fixation time was significantly higher in 'easy' and 'moderate' conditions compared to the 'hard' condition. There was no significant difference in total fixation time between 'moderate' and 'easy' conditions. There was a non-significant interaction between 'question type' and 'label difficulty' on total fixation time ($F_{(4,\ 316)}$ = 0.55, p = .702, η^2 = .001).

Table 5.4

Bonferroni Post Hoc Pairwise Comparisons for the Significant Main Effects of 'Question Type' and 'Label Difficulty' on Percentage Total Fixation Time

Comparisons	*M* Diff (%)	95% CI		*p*
		LL	*UL*	
Health-related vs. purchase	32.17	26.04	38.30	<.001
Nutrient-specific vs. purchase	36.38	30.33	42.44	<.001
Nutrient specific vs. health-related	4.21	-0.34	8.76	.079
Easy vs. hard	1.76	0.02	3.49	.046
Moderate vs. hard	1.92	0.19	3.64	.024
Moderate vs. easy	0.16	0.02	3.49	1.000

Note. Bonferroni adjustments made so alpha level to determine significance held at *p* <.05. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.

5.3.2.2 Average Fixation Time Analysis. A 3 (‘question type’) by 3 (‘label difficulty’) rmANOVA was conducted on average nutrient-5 fixation time for accurate trials ($N = 70$). There was a significant main effect of ‘question type’ on average fixation time, $F_{(1.81, 124.86)} = 45.25$, $p <.001$, $\eta^2 = .11$. Table 5.5 shows average fixation time was significantly higher in ‘health-related’ and ‘nutrient-specific’ conditions compared to the ‘purchase’ condition and significantly higher in the ‘nutrient-specific’ compared to the ‘health-related’ condition. There was a non-significant main effect of ‘label difficulty’ on average fixation time ($F_{(2, 138)} = 0.54$, $p = .584$, $\eta^2 = .0004$) and a non-significant interaction between ‘question type’ and ‘label difficulty’ on average fixation time ($F_{(3.03, 208.74)} = 0.41$, $p = .749$, $\eta^2 = .001$).

Table 5.5

Bonferroni Post Hoc Pairwise Comparisons for the Significant Main Effect of 'Question Type' on Average Fixation Time

Comparisons	*M* Diff (%)	95% CI		*p*
		LL	*UL*	
Health-related vs. purchase	19.78	11.92	27.64	<.001
Nutrient-specific vs. purchase	33.30	23.36	43.24	<.001
Nutrient-specific vs. health-related	13.52	5.56	21.47	<.001

Note. Bonferroni adjustments made so alpha level to determine significance held at p <.05. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.

5.3.2.3 Time to First Fixation Analysis. A 3 (‘question type’) by 3 (‘label difficulty’) rmANOVA was conducted on average nutrient-5 time to first fixation for accurate trials (N = 70). There was a significant main effect of ‘question type’ on time to first fixation, $F_{(1.30, 89.66)} = 53.49$, $p < .001$, $\eta^2 = .22$. Table 5.6 shows significantly slower time to first fixation in the ‘purchase’ condition compared to ‘health-related’ and ‘nutrient-specific’ conditions. Furthermore, there was significantly slower time to first fixation in the ‘health-related’ compared to the ‘nutrient-specific’ condition.

There was no significant main effect of ‘label difficulty’ on time to first fixation ($F_{(2, 138)} = 2.16$, $p = .119$, $\eta^2 = .002$). However, when outliers (n = 9) were removed in the sensitivity analysis, there was a significant main effect of ‘label difficulty’ on time to first fixation, $F_{(2, 120)} = 5.84$, $p = .004$, $\eta^2 = .01$. Therefore, caution should be employed when drawing conclusions as the analysis was influenced by the presence of outliers. There was a non-significant interaction between ‘question type’ and ‘label difficulty’ on time to first fixation ($F_{(2.13,\ 147.13)} = 1.19$, $p = .308$, $\eta^2 = .003$).

Table 5.6

Bonferroni Post Hoc Pairwise Comparisons for the Significant Main Effect of 'Question Type' on Time to First Fixation

Comparisons	*M* Diff (%)	95% CI		*p*
		LL	*UL*	
Purchase vs. health-related	1,032.38	654.80	1,409.95	<.001
Purchase vs. nutrient-specific	1,297.41	914.55	1,680.28	<.001
Health-related vs. nutrient-specific	265.04	97.19	432.89	<.001

Note. Bonferroni adjustments made so alpha level to determine significance held at p <.05. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.

5.3.3 Hypothesis 2: Food Choice Task – Performance Analyses

The means in Table 5.7 indicated higher percentage accuracy, higher confidence ratings for accurate trials and the most under-confidence for ‘nutrient-specific’ and ‘easy’ conditions (and ‘moderate’ condition for percentage confidence). The means showed lower accuracy, lower confidence ratings and the least under-confidence in ‘purchase’ and ‘hard’ conditions. Based on the combined ‘question type’ and ‘label difficulty’ conditions, the means indicated the highest accuracy, highest confidence ratings and the most under-confidence in the ‘nutrient-specific easy’ condition. The means showed the lowest accuracy, lowest confidence and the most over-confidence for the 'purchase hard' condition.

Table 5.7

The Means and Standard Deviations for the Food Choice Task Performance Measures for Each Condition

Label Type	Purchase		Health-related		Nutrient-specific		Total	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
	Percentage accuracy (%) (*N* = 80)							
Easy	65.75	22.55	87.75	16.69	93.00	11.95	82.17	11.90
Moderate	60.25	20.74	77.75	20.37	92.00	15.46	76.67	11.07
Hard	58.63	19.21	72.38	17.30	90.13	12.06	73.71	12.00
Total	61.54	14.74	79.29	12.21	91.71	9.91		
	Percentage confidence for accurate trials (%) (*N* = 79)							
Easy	72.83	14.78	73.59	15.23	78.68	13.53	75.03	12.20
Moderate	72.63	16.10	73.00	15.48	79.46	14.46	75.03	13.23
Hard	70.40	15.15	71.20	14.75	77.78	13.73	73.13	12.42
Total	71.95	13.98	72.60	14.22	78.64	12.85		
	Confidence bias scores (*N* = 80)							
Easy	.06	.27	-.15	.21	-.16	.15	-.08	.16
Moderate	.11	.24	-.06	.25	-.13	.17	-.03	.16
Hard	.11	.25	-.03	.22	-.14	.17	-.02	.17
Total	.09	.20	-.08	.18	-.14	.14		

5.3.3.1 Percentage Accuracy Analysis. A 3 (‘question type’) by 3 (‘label difficulty’) rmANOVA was conducted on percentage accuracy (*N* = 80). There was a significant main effect of ‘question type’ on accuracy, $F_{(2, 158)}$ = 155.93, *p* <.001, η^2 = .32. Table 5.8 shows accuracy was significantly higher in ‘health-related’ and ‘nutrient-specific’ conditions compared to the ‘purchase’ condition and significantly higher in the ‘nutrient-specific’ compared to the ‘health-related’ condition. There was a significant main effect of ‘label difficulty’ on accuracy, $F_{(2, 158)}$ = 16.40, *p* <.001, η^2 = .03. Table 5.8 shows that accuracy was significantly higher in the ‘easy’ condition compared to ‘moderate’ and ‘hard’ conditions. There was no significant difference in accuracy between the ‘moderate’ condition and the ‘hard’ condition.

Table 5.8

Bonferroni Post Hoc Pairwise Comparisons for the Significant Main Effects of 'Question Type' and 'Label Difficulty' for Accuracy

Comparisons	*M* Diff (%)	95% CI		*p*
		LL	*UL*	
Health-related vs. purchase	17.75	13.50	22.00	<.001
Nutrient-specific vs. purchase	30.17	25.62	34.71	<.001
Nutrient specific vs. health-related	12.42	8.65	16.18	<.001
Easy vs. moderate	5.50	2.11	8.89	<.001
Easy vs. hard	8.46	4.58	12.34	<.001
Moderate vs. hard	2.96	-0.75	6.67	.164

Note. Bonferroni adjustments made so alpha level to determine significance held at *p* <.05. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.

There was a significant interaction between ‘question type’ and ‘label difficulty’ on accuracy, $F_{(3.15, 248.54)} = 3.87$, $p = .009$, $\eta^2 = .01$. Table 5.9 shows that accuracy was significantly higher across all ‘label difficulty’ conditions for ‘health-related’ and ‘nutrient-specific’ conditions compared to the ‘purchase’ condition. In addition, accuracy was significantly higher in the ‘nutrient-specific moderate’ condition compared to the ‘health-related moderate’ condition and significantly higher in the ‘nutrient-specific hard’ condition compared to the ‘health-related hard’ condition. There was no significant difference in accuracy between ‘nutrient-specific easy’ and ‘health-related easy’ conditions.

In addition, Table 5.9 shows percentage accuracy was significantly higher in the ‘health-related easy' condition compared to ‘health-related moderate’ and 'health-related hard’ conditions and for the ‘purchase easy’ condition compared to the ‘purchase hard’ condition. No further significant differences were reported for percentage accuracy for ‘question type’ across ‘label difficulty’ conditions.

Table 5.9

The Simple Effects Results for the Significant Interaction for Each Comparison for Percentage Accuracy

Comparisons	*M* Diff (%)	95% CI		*p*
		LL	*UL*	
		Easy		
Heath-related vs. purchase	22.00	15.28	28.72	<.001
Nutrient-specific vs. purchase	27.25	21.08	33.42	<.001
Nutrient-specific vs. health-related	5.25	-0.24	10.74	.065
		Moderate		
Heath-related vs. purchase	17.50	9.37	25.64	<.001
Nutrient-specific vs. purchase	31.75	24.33	39.17	<.001
Nutrient-specific vs. health-related	14.25	7.96	20.54	<.001
		Hard		
Heath-related vs. purchase	13.75	8.02	19.48	<.001
Nutrient-specific vs. purchase	31.50	25.93	37.07	<.001
Nutrient-specific vs. health-related	17.75	13.08	22.42	<.001
		Purchase		
Easy vs. moderate	5.50	-1.68	12.68	.193
Easy vs. hard	7.13	0.70	13.55	.025
Moderate vs. hard	1.63	-5.75	9.00	1.00
		Health-related		
Easy vs. moderate	10.00	3.20	16.80	.002
Easy vs. hard	15.36	9.06	21.70	<.001
Moderate vs. hard	5.38	-0.65	11.40	.096
		Nutrient-specific		
Easy vs. moderate	1.00	-3.34	5.34	1.00
Easy vs. hard	2.86	-1.05	6.80	.230
Moderate vs. hard	1.88	-2.37	6.12	.849

Note. Bonferroni adjustments made so alpha level to determine significance held at p <.05. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.

5.3.3.2 Percentage Confidence Ratings Analysis. A 3 (‘question type’) by 3 (‘label difficulty’) rmANOVA was conducted on the average percentage confidence ratings for accurate trials (*N* = 79). There was a significant main effect of ‘question type’ on percentage confidence ratings, $F_{(2, 156)} = 17.17$, $p < .001$, $\eta^2 = .04$. Table 5.10 shows percentage confidence ratings were significantly higher in the ‘nutrient-specific’ condition compared to ‘purchase’ and ‘health-related’ conditions. There was no significant difference in percentage confidence ratings between ‘heath-related’ and ‘purchase’ conditions.

There was a significant main effect of ‘label difficulty’ on percentage confidence ratings, $F_{(2, 156)} = 4.73$, $p = .010$, $\eta^2 = .004$. Table 5.10 shows that percentage confidence ratings were significantly higher in ‘easy’ and ‘moderate’ conditions compared to the ‘hard’ condition. There was no significant difference in percentage confidence ratings between ‘easy’ and ‘moderate’ conditions. There was a non-significant interaction between ‘question type’ and ‘label difficulty’ on percentage confidence ratings ($F_{(4, 312)} = 0.41$, $p = .805$, $\eta^2 = .0004$).

Table 5.10

Bonferroni Post Hoc Pairwise Comparisons for the Significant Main Effects of 'Question Type' and 'Label Difficulty' for Percentage Confidence Ratings for Accurate Trials

Comparisons	*M* Diff (%)	95% CI		*p*
		LL	*UL*	
Health-related vs. purchase	.64	-2.75	4.04	1.000
Nutrient-specific vs. purchase	6.68	3.80	9.57	<.001
Nutrient specific vs. health-related	6.04	3.11	8.97	<.001
Easy vs. moderate	.004	-1.79	1.79	1.000
Easy vs. hard	1.91	0.36	3.45	.010
Moderate vs. hard	1.90	0.01	3.80	.049

Note. Bonferroni adjustments made so alpha level to determine significance held at p <.05. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.

5.3.3.3 Confidence Bias Analysis. A 3 (‘question type’) by 3 (‘label difficulty’) rmANOVA was conducted on confidence bias scores (N = 80). There was a significant main effect of ‘question type’ on confidence bias scores, $F_{(1.82, 143.66)} = 70.70$, p <.001, $\eta^2 = .17$. Table 5.11 shows significantly higher over-confidence in the ‘purchase’ condition compared to ‘health-related’ and ‘nutrient-specific’ conditions. Under-confidence was significantly lower in the ‘nutrient-specific’ condition compared to the ‘health-related’ condition. There was a significant main effect of ‘label difficulty’ on confidence bias scores, $F_{(2, 158)} = 10.35$, p <.001, $\eta^2 = .01$. Table 5.11 shows significantly higher under-confidence in the ‘easy’ condition compared to ‘moderate’ and ‘hard’ conditions. There was no significant difference in confidence bias scores between ‘moderate’ and ‘hard’ conditions.

Table 5.11

Bonferroni Post Hoc Pairwise Comparisons for the Significant Main Effects of 'Question Type' and 'Label Difficulty' for Confidence Bias Scores

Comparisons	*M* Diff (%)	95% CI		*p*
		LL	*UL*	
Purchase vs. health-related	.17	.12	.23	<.001
Purchase vs. nutrient-specific	.24	.17	.29	<.001
Health-related vs. nutrient-specific	.06	.02	.11	.001
Easy vs. moderate	-.05	-.09	-.02	<.001
Easy vs. hard	-.07	-.10	-.03	<.001
Moderate vs. hard	-.01	-.05	.03	1.000

Note. Bonferroni adjustments made so alpha level to determine significance held at p <.05. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.

There was a non-significant interaction between ‘question type’ and ‘label difficulty’ on confidence bias scores ($F_{(3.38, 267.02)}$ = 2.40, p = .061, η^2 = .01). However, when outliers (n = 5) were removed in the sensitivity analysis, there was a significant interaction between ‘question type’ and ‘label difficulty’ on confidence bias scores, $F_{(3.43, 253.66)}$ = 2.96, p = .027, η^2 = .01. Therefore, caution should be taken when drawing conclusions from the interaction between ‘question type’ and ‘label difficulty’ for confidence bias scores as the analysis was influenced by the presence of outliers.

5.3.3.4 Reasons Analysis. The transcribed think-aloud data was content analysed per 'question type' across the 60 trials (N = 1,600 trials). The data is reported descriptively using percentages to provide insights into when participants provided nutrient-5 reasons for their food choices. Table 5.12 shows the nutrient-5 reasons were shared across the three 'question type' conditions. The percentages indicated the highest nutrient-5 reasons in the 'nutrient-specific' condition and least in the 'purchase' condition for accurate trials. For decisions which were not accurate the highest percentage of the nutrient-5 information given was in the 'health-related' condition.

Table 5.12

Percentage of Nutrient-5 Reasons Across Accurate and Inaccurate Decisions for Each Question Type

Condition	Accurate (%)		Inaccurate (%)	
	Label as a reason	Label not as a reason	Label as a reason	Label not as a reason
Purchase	30.69	28.50	11.94	28.88
Health-related	68.06	9.06	16.63	6.25
Nutrient-specific	83.81	6.38	6.06	3.75

Percentages were calculated for overall accurate and inaccurate choices per 'question type' to provide additional insights into nutrient-5 reasons. The percentages showed 92.93% of accurate 'nutrient-specific' trials had nutrient-5 reasons (*n* = 1,443 trials), compared to 88.25% of health-related' trials (*n* = 1,234) and 51.85% of 'purchase' trials (*n* = 947). The percentages indicated 72.68% of inaccurate 'health-related' trials had nutrient-5 reasons (*n* = 653 trials), compared to 61.78% of 'nutrient-specific' trials (*n* = 157 trials) and 29.25% of 'purchase' trials (*n* = 653 trials).

5.3.4 Hypothesis 3: Individual Differences as Predictors

The descriptive statistics for the variables used in the regression analyses were outlined in Section 5.3.1. All individual differences were included as predictors of task performance.

5.3.4.1 Individual Differences as Predictors of Purchase Percentage Accuracy Task Performance. A simultaneous multiple regression was conducted to explore the predictive relationship between measured individual differences and overall 'purchase' percentage accuracy (N = 80). The overall regression model was not significant (R^2 = .22, $F_{(14,65)}$ = 1.32, p = .219). Of the predictors, weight control was significant (β = .42, p = .027, 95% CI = 0.52, 8.18) but no other predictors were significant (Table 5.13). Adjusted R^2 = .05 and R^2_{Press} = -.22 statistics were not similar to the original R^2 statistic and questioned the validity of the model.

Table 5.13

Individual Differences as Predictors of Purchase Food Choice Task Percentage Accuracy

Predictor	β	95% CI		*p*
		LL	*UL*	
Constant		21.02	95.68	.003
Label use	.26	-1.23	8.53	.140
Label attitudes	.07	-0.83	1.46	.586
Label behaviours	-.05	-2.65	2.05	.802
Age	-.05	-0.44	0.30	.700
Sex [a]	.04	-6.99	9.28	.779
Health literacy	-.06	-3.21	2.04	.658
BMI	.09	-0.66	1.14	.601
Self-perceived weight	-.19	-9.64	3.19	.320
Liking	.06	-3.26	5.00	.676
Habit	.03	-3.76	4.38	.880
Health	-.33	-6.63	0.50	.091
Convenience	-.14	-5.14	2.05	.394
Price	-.11	-4.45	2.07	.469
Weight control	.42	0.52	8.18	.027

Note. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.
[a] 0 = male, 1 = female.

5.3.4.2 Individual Differences as Predictors of Health-Related Percentage Accuracy Task Performance. A simultaneous multiple regression was conducted to explore the predictive relationship between measured individual differences and overall ‘health-related’ percentage accuracy. The overall regression model was not significant (R^2 = .21, $F_{(14,65)}$

= 1.20, p =.296). Of the predictors, self-reported nutrition label use was significant (β = -.37, p = .044, 95% CI = -8.51, -0.11) but no other predictors were significant (Table 5.14). Adjusted R^2 = .04 and R^2_{Press} = -.22 statistics were not similar to the original R^2 statistic and questioned the validity of the model.

Table 5.14

Individual Differences as Predictors of Health-Related Food Choice Task Percentage Accuracy

Predictor	β	95% CI		p
		LL	*UL*	
Constant		54.06	118.34	<.001
Label use	-.37	-8.51	-0.11	.044
Label attitudes	.08	-0.71	1.27	.569
Label behaviours	.18	-1.45	2.60	.573
Age	-.03	-0.35	0.29	.852
Sex [a]	.16	-3.01	11.00	.259
Health literacy	.19	-0.62	3.90	.153
BMI	-.004	-0.78	0.77	.984
Self-perceived weight	-.04	-6.16	4.89	.819
Liking	-.24	-6.59	0.52	.093
Habits	.26	-0.97	6.03	.153
Health	-.16	-4.34	1.79	.410
Convenience	-.09	-3.91	2.28	.601
Price	-.11	-3.88	1.74	.449
Weight control	.33	-0.44	6.16	.088

Note. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.
[a] 0 = male, 1 = female

5.4 Discussion

This study investigated nutrition label engagement using a novel food choice task in UK adults. Triangulating attention, performance and individual differences measures within a single study to gain insights into nutrition label engagement, is one of the first known studies to achieve this. Findings supported differences in nutrition label engagement in the food choice task and accuracy was independent from known individual differences to food choice. The findings supported the effectiveness of the food choice task developed within the thesis, as a tool to assess nutrition label engagement, and suggested that replication was needed to further strengthen its application as a measure. Results suggested an intervention aimed at improving nutrition label engagement for purchase-based and health-related food choices across label difficulties should be considered as part of the intervention design process.

5.4.1 Hypothesis 1: Discussion

The findings supported the first hypothesis; that there would be differences in eye-tracking attention measures for accurate trials in the food choice task. Three eye-tracking measures indicated significantly less depth of processing (percentage total fixation time), less attraction to (average fixation time) and slower initial attention (time to first fixation) to the nutrient-5 information when making purchase-based choices. Resulting in lower nutrition label engagement when consumers made purchase-based food choices. This reduced engagement may reflect the external factors which can impact nutrition label engagement that were incorporated in the Theoretical Framework of Label Usage (Grunert & Wills, 2007). Furthermore, reduced attention measures on nutrition labels for purchase-based decisions demonstrated the food choice task provided differentiation between both paths outlined in the Hierarchy of Effects Model of Quality Labelling (Grunert & Aachmann, 2016). For purchase-based food choices, it is possible participants were relying on automatic motivations (Michie et al., 2011) and the 'liking' path (Grunert & Aachmann, 2016; Grunert & Wills, 2007) to make decisions.

This argument was strengthened by significantly favourable attention measures when making nutrient-specific decisions. The findings from the nutrient-specific attention measures suggested that participants were aware of where to locate the nutrition labels when sufficiently motivated to, this aligns with the Information Processing Framework (Kanfer & Ackerman, 1989), which helped inform design of the food choice task. Due to lower attention measures to nutrition labels when making purchase-based decisions compared to nutrient directed decisions, it suggested the behaviour was not a priority for some participants when making food choices, which is reflected in the wider literature (An et al., 2021; Graham et al., 2012). This aligns to the COM-B model (Michie et al., 2011), whereby consumers may need encouragement to engage in reflective motivation for nutrition label engagement, so paying attention to nutrition labels when making food choices becomes automatic. Understanding motivations behind attention to nutrition labels in greater depth informs the intervention design process to consider how automatic motivations could be challenged and overridden.

Significantly less depth of processing was evidenced by lower percentage total fixation times, for harder nutrition label comparisons across question types when compared to easy and moderate conditions. This may be reflective of the Dual Process Theory (Kahneman, 2011), which helped inform development of the food choice task. Hard rated pairings relied on the *deliberate* strand of the theory, as participants needed to spend more time engaging with nutrition values presented on the labels, to justify food choices as multiple traffic light front-of-pack nutrition label colours displayed were the same or misleading. Therefore, reduced attention measures for these label pairs suggested participants disengaged with nutrition labels when interpretation of nutrient information required additional attention. Differences in attention across food choice task conditions demonstrated the task was able to differentiate between different attentional processes. This was important to assess to ensure the food choice task was effective at differentiating between attentional measures, which the findings suggest it achieved.

5.4.2 Hypothesis 2: Discussion

Findings supported the second hypothesis; that there would be differences in performance measures for accurate trials in the food choice task. Percentage accuracy and average percentage confidence ratings for accurate trials were significantly higher for nutrient-specific decisions. Suggesting that consumers had stronger capability and motivation for making singular nutrient comparisons, when prompted, compared to making health-related or purchase-based food choices. Demonstrating effectiveness of the food choice task at measuring changes in psychological capability and motivation for nutrition label engagement when the participants were asked to make single-nutrient comparisons (Michie et al., 2011). Stronger nutrition label engagement performance measures for nutrient-specific decisions reflects previous literature findings where consumers had greater capability to reach healthier food choices, when focused on comparing single nutrients (Antúnez et al., 2013; Ares, et al., 2012).

This finding was also supported by lower levels of under-confidence reported in nutrient-specific compared to the health-related choices. This may indicate consumers believed they were making healthier choices but were making erroneous dietary choices in the health-related condition (An et al., 2021). Findings suggested participants shared nutrient-5 reasons when making health-related choices but had a higher percentage of not selecting healthier options compared to other conditions when nutrition information was mentioned. This suggested psychological capability of how to make healthier choices across nutrients could be an opportunity for potential future interventions.

Whilst percentage confidence ratings were similar between health-related and purchase-based food choices, there was significant over-confidence for purchase decisions. Therefore, to re-calibrate confidence measures when making purchase-based food choices, interventions may target consumer motivation and opportunity to engage with nutrition labels. The significant interaction for percentage accuracy demonstrated significant differences in moderate and hard conditions when compared across question types. The findings suggested consumers determined the healthier option for nutrient-specific decisions irrespective of label difficulty, reinforcing the main effects. Therefore, the difficulties with determining the healthier option when making broader health-related decisions demonstrated reduced psychological capability. Thus, this may be an avenue to target in future interventions.

5.4.3 Hypothesis 3: Discussion

When testing the third hypothesis the results indicated no overall model significance of measured individual differences in predicting accuracy for purchase-based or health-related food choices. This indicated that the food choice task accuracy performance was not influenced by the combination of measured individual differences. However, the model confidence was low for each regression and even when removing factors this confidence remained low, thus the original regression models were reported. Therefore, the model validity was questioned for these analyses and path analyses were not conducted. These findings do not replicate previous literature, where there were relationships between individual differences and nutrition label engagement (Ares et al., 2014; Campos et al., 2011). Therefore, it would be advantageous to replicate the study in a more representative sample of individuals from across the UK to see whether individual differences were predictors of task performance in a diverse sample or whether the task did not discriminate based on known nutrition label engagement influencers.

5.4.4 Strengths and Limitations

A strength of the current study was the triangulation of attention, performance and individual difference measures within a single study. This provided insight into the barriers and facilitators to nutrition label engagement and examined the effectiveness of the novel food choice task. This approach was novel within the research area, and the current findings were important contributions to Thesis Objective 2 to later inform the design of the nutrition label engagement intervention. However, the participant sample for Study 1, whilst representative of the BMI weight categorisation dispersion of the UK population, did not reflect the wider UK population health literacy levels, as most of the sample had adequate health literacy (Rowlands et al., 2013). The participant sample were also local to the Stoke-on-Trent, UK area which resulted in a mostly homogenous sample (Heald et al., 2024). Therefore, nutrition label engagement in a broader representative sample from across the UK may help to further identify factors influencing consumer nutrition label engagement.

The laboratory setting was a strength of this study as it facilitated participant-researcher interactions, which helped to examine the effectiveness of the implemented food choice task. The incorporation of eye-tracking measures was a strength of this study as they provided insight into consumer physiological responses to nutrition labels by measuring their eye movements and this attention can be a precursor to consumer information processing of nutrition information (Ares et al., 2013; Grunert & Wills, 2007; Tanner et al., 2019). However, it is important to note that researchers have argued that consumer eye movements may reflect the ongoing cognitive processes involved in encoding information but do not reflect the mental processes involved in decision-making (Bojko, 2013; Godfroid & Spino, 2015; Jiang et al., 2016). Therefore, the eye-tracking measures can only indicate where visual attention is directed to. As observed in the findings reported, this resulted in changes based on attention in the food choice task but did not always lead to greater task performance outcomes. Therefore, as the insights provided in this chapter supported the effectiveness of the nutrition label task in directing visual attention, the eye-tracking measure was not implemented in the remaining empirical studies. Thus, the limitations in the implementation of the measure i.e., restriction to in-person data collection techniques was not carried forward into how the intervention needed to be developed.

A further strength of this study was the think-aloud protocol employed concurrently with task engagement. This provided insights into real-time food choice decisions which then informed the future thought listing options. However, a concurrent think-aloud protocol can potentially impact the data collected, as verbalising thoughts at the same time as making food choices is not a wholly natural process (Ericsson 2006). There is debate on whether a concurrent think-aloud protocol can interfere with the ongoing cognitive processes as it increases the level of mental energy needed to perform the task. Therefore, whilst a concurrent think-aloud protocol is less likely to impact familiar tasks (Noushad et al., 2024), such as making food choices, it may influence the cognitive processing compared to usual behaviour. Therefore, replicating the study with a thought listing immediate retrospective think-aloud protocol only will address the current study limitation.

5.5 A Summary of the Chapter Contributions

This empirical study addressed aspects of Thesis Objective 2. It explored factors which influenced nutrition label engagement in UK adult consumers in relation to a novel food choice task. The triangulated differences across attention and performance measures highlighted factors of nutrition label engagement to consider during the intervention design phase, such as the importance of improving nutrition label engagement during purchase and health-based to make healthier food choices. It was important to conduct replication analyses in a less homogeneous sample to further test the food choice task as an instrument to measure the effectiveness of the intervention and to further understand the impact of individual differences to inform the novel intervention. The next chapter reports the findings from the second empirical study, which replicated analyses from Study 1 and addressed the need for qualitative insights into the experiences of consumer nutrition label engagement to contribute further findings to Thesis Objective 2.

Chapter 6: An Online Mixed-Methods Study Exploring Nutrition Label Engagement in Healthy UK Adults

This chapter presents the findings from the second empirical study conducted within this thesis, which added further findings to address Thesis Objective 2. The chapter starts with the rationale, aim and method for the study, followed by the findings from the mixed-methods online study relating to consumer experiences engaging with nutrition labels. The quantitative findings are reported for a refined food choice task to establish whether the results from Study 1 could be replicated. This is followed by a Reflexive Thematic Analysis of the participants' experiences of engagement with nutrition labels with inductive and deductive approaches. The chapter concludes with a discussion of the findings, the contribution to knowledge and how the findings related to the objectives of the thesis.

6.1 Rationale and Aims

The findings from Study 1 (Chapter 5) showed significant differences in attention and performance measures for the food choice task. These findings demonstrated the effectiveness of the food choice task as a method of assessing nutrition label engagement. Therefore, it was important to seek to replicate these findings with refined outcome measures, stimuli and in a diverse population sample to establish whether the findings were robust. The first phase of the present mixed-methods study focused on quantitative replication. The outcome measures were refined based on the task performance measures implemented in Study 1. Measures of accuracy and confidence were collected from participants. However, a concurrent think-aloud protocol was not utilised and only immediate retrospective think-aloud thought listing after each food choice was made.

The eye-tracking attention measures were not employed in the present study as the findings from Study 1 showed that consumers were aware of how to locate the nutrition label, but this engagement was not always reflected in the task performance measures (e.g., participants looked at the nutrient-5 information but did not select the healthier choice). This showed the task was effective at directing attention but that there was complexity in how consumers engaged with the nutrition label information. This finding reflected the complexity of nutrition label engagement outlined in the theories presented in Section 3.1 that informed the development of the food choice task (e.g., Grunert & Aachmann, 2016; Grunert & Wills, 2007). Therefore, examining whether the performance findings from the food choice task could be replicated was important for the development of the measure before it was implemented in Study 3.

Furthermore, as outlined in Chapter 3, the food choice task had minor refinements to the variables based on the findings from Study 1. Based on the inconsistent findings between the moderate and hard pairings reported in Study 1, the number of hard pairings were reduced from two stimuli per each of the five key nutrients to one. The pairings which had the lowest levels of performance for each nutrient were retained to ensure the level of difficulty remained, resulting in 15 trials (total trials *n* = 45). Therefore, it was important to conduct a replication study with the revised food choice task to determine whether the differences in performance measures were robust. This reduction was also important to reduce the time of this phase of the study so that the total time for the study was not too onerous for participants to complete. The study was also conducted online to reach a more representative and less homogeneous sample of healthy UK adult consumers. This was important as the findings from Study 1 were limited based on the high levels of nutrition label health literacy and self-reported nutrition label use of the sample. Trialling the food choice task in an online environment was also important to establish whether this setting could be considered as part of the development of the intervention and could also be reflective of an online shopping environment.

In addition to the quantitative replication phase, the second phase of the present study focused on exploring consumer experiences of nutrition label engagement using qualitative methods. There have been limited qualitative studies conducted that focus on healthy adult nutrition label engagement. Todd et al. (2022) conducted a mixed-methods study and qualitatively explored consumer ideas on how South African front-of-pack nutrition labels could be improved (*N* = 49). Three themes were developed from the interviews that focused on label improvements of making nutrition labels clearer, simpler and smarter. However, the consumers reflected on nutrition labels that were not currently implemented for food products they purchase and so were not familiar with some of the label types. This may have impacted how the consumers reflected on their exposure to the different front-of-pack nutrition labels as they lacked familiarity and existing experiences of engaging with the label.

Wahlich et al. (2012) conducted semi-structured interviews with 25 young adult women living in the UK to explore their motivations and the context surrounding their nutrition label engagement when making everyday choices. The six themes identified in this study highlighted the need for clear and consistent nutrition labels. This research was based in the UK, which is the country of interest for this thesis, however it was conducted before the multiple traffic light nutrition label was standardised in the UK. Consequently, consumers may have different experiences and ideas for how the nutrition labels could be improved since the standardised front-of-pack nutrition label was introduced. Therefore, exploring the experiences of how healthy UK adults engage with nutrition labels, beyond the food choice tasks employed within the research, can provide additional insights to inform the development of the intervention in this thesis.

Study 2 focused on contributing findings to Thesis Objective 2. The quantitative replication (first) phase of the study focused on exploring the factors which could influence nutrition label engagement in UK healthy adult consumers, using a refined food choice task in an online setting. To contribute findings to Thesis Objective 2, two non-directional research hypotheses for Study 2 were tested to replicate the analyses conducted in Study 1 for the revised measures:

Hypothesis 1: There will be differences in task performance measures (percentage accuracy, average percentage confidence ratings for accurate trials, confidence bias scores and reasons) for the food choice task.

Hypothesis 2: Measured individual difference (nutrition label health literacy, BMI, self-perceived weight, six motivators for food choice (convenience, habit, health, liking, price and weight concerns), self-reported nutrition label use, age and sex) will predict accuracy in the 'purchase' condition and in the 'health-related' condition of the food choice task.

The qualitative (second) phase of the study focused on exploring experiences which could influence nutrition label engagement in UK healthy adult consumers. The research question for this phase of the study was:

Research Question: How do healthy UK adult consumers experience nutrition label engagement when making food choices?

6.2 Method

6.2.1 Design

The current study used an online mixed-methods design. The quantitative phase of the research used an online experimental, repeated-measures design for the primary analyses and a correlation design for the secondary analyses. The qualitative phase of the research utilised open-ended online survey responses. Ethics approval was gained by University of Staffordshire in July 2023 (Appendix G). The participant payment for this study was funded by University of Staffordshire in July 2023 from the Strategic Investment Funding call.

6.2.1.1 Food Choice Task – 'Question Type' Variable. 'Question type' was a repeated-measures independent variable with three levels in the current study: (1) the 'purchase' condition ("*which of these products would you choose if you were looking to **purchase one**?*"); (2) the 'health-related' condition ("*which of these products would you choose if you were looking to*

select the healthier one*?*"); and (3) the 'nutrient-specific' condition ("*which of these products would you choose if you were looking to* ***reduce your [specific nutrient] intake****?*"). Section 3.2.3 provided a full explanation of this variable.

6.2.1.2 Food Choice Task – 'Label Difficulty' Variable. 'Label difficulty' was a repeated-measured independent variable with three levels ('easy' vs. 'moderate' vs. 'hard') in the current study. Section 3.2.4 provided a full explanation of this variable.

6.2.1.3 Food Choice Task – 'Performance' Variables. Food choice task performance was measured by four dependent variables (a) average percentage accuracy for selecting the healthier choices; (b) average percentage confidence ratings for accurate choices; (c) confidence bias scores; and (d) selected thought listed nutrient-5 reasons. How these measures were defined and calculated was outlined in Section 4.2.

6.2.1.4 Individual Difference Variables. The measures of individual difference collected for this study were: (a) self-reported BMI; (b) self-perceived weight; (c) six motivation subscales for food choices (convenience, habit, health, liking, price and weight control); (d) attitudes towards nutrition labels; (e) behaviours towards nutrition labels; (f) nutrition label health literacy; (g) self-reported nutrition label use; (h) age; and (i) sex. The full details of the scales, including their psychometric properties where appropriate, were reported in Section 4.2.

6.2.2 Participants

A prospective power analysis was conducted for the quantitative analyses. A medium effect size was chosen based on the findings reported in Study 1 (Chapter 5) and the previous literature used to inform the power analysis for Study 1. A maximum of 120 participants were required to achieve a power of 0.8 and a medium eta-squared effect size. After interpolation a minimum of 109 participants were required for the quantitative analyses (Clark-Carter, 2019). This quantitative prospective analysis exceeded the recommended minimum of 50 participants needed for a large qualitative study (Braun & Clarke, 2013).

Participants were recruited from the online participant recruitment platform 'Prolific' and were provided with a monetary incentive of £9.00 for completing the 60-minute study. A total of 135 participants chose to sign up to the study in 'Prolific'. 111 participants completed the study and received the monetary incentive for their successful completion. Twenty-four participants returned their submission without completing the study (n = 2 did not complete consent; n = 2 withdrew when providing demographic characteristics of age/sex/height/weight; n = 1 withdrew during the practice phase; n = 17 withdrew during the food choice task and n = 1 during the individual differences questionnaires).

All participants met the following eligibility criteria which were outlined at study sign-up, on the information sheet (Appendix H) and consent form (Appendix I): (a) aged 18 or older; (b) had lived in the UK for a minimum of three years since 2011; (c) had previously or currently purchase prepacked food products; (d) were fluent in English; (e) had normal or corrected-to-normal full colour vision; (f) had not experienced or received a diagnosis for an eating-related disorder in the present or historically; and (g) were not managing a condition through diet, not vegetarian or vegan.

6.2.3 Materials and Procedure

6.2.3.1 Consent and Practice Phase. The study took place online via Qualtrics and was hosted on the participant recruitment site *Prolific*. Once participants signed up to participate in the research project, they accessed the Qualtrics study link within their Prolific dashboard. Upon launching the study, participants were presented with a reminder of the guidance relating to the technical requirements of the study. These requirements were outlined in the study filters during sign-up, including that the study must be completed on a device with a screen size of 14-inches or more for the stimuli to be presented correctly.

Once launched, participants were presented with an electronic information sheet (Appendix H) and electronic consent form (Appendix I). These documents informed the participants what would be expected from them during the study and their withdrawal rights. Participants were asked to provide their electronic consent by selecting the 'agree' option on the consent form, the screen did not move on without this confirmation. After consent was obtained, participants were asked to confirm their *Prolific* unique identifier code, which was presented as embedded text in Qualtrics. This unique identifier ensured anonymity and was the code provided by participants when messaging in the platform about any technical issues, or if they wished to withdraw from the study.

Prolific stores demographic data shared by each participant for researchers to download but participants were asked to share demographic details of age, gender, weight and height, to ensure accuracy of these characteristics as they were used in the analyses. Participants then moved on to the practice phase, which followed the same procedure as outlined for Study 1 with practice task instructions presented followed by two example trials. The instructions relating to the eye-tracker and think-aloud protocol were not included for Study 2, instead participants were asked to select from a pre-determined list their thought listing reasons after each food choice was made. For this study the food choices were labelled as ‘Meal A’ and ‘Meal B’ and participants clicked a radio button in Qualtrics to make their selection and switch between package orientation. Participants were provided with a summary of the task instructions before moving on to the experimental phase of the study.

6.2.3.2 Food Choice Task Experimental Phase. In the experimental phase there were 15 trials for each ‘question type’ condition (45 trials in total). The question changed based on the question block presented. The blocks were presented in the same order for each participant: (1) ‘purchase’; (2) ‘health-related’; and (3) ‘nutrient-specific’. Across and within the ‘question type’ blocks the paired ready meal stimuli were counterbalanced on: (a) whether the front or back of the paired stimuli were viewed first; (b) whether the healthier (accurate response) food product was presented on the left vs. right of the pairing; and (c) whether the healthier (accurate response) food product was assigned to the “luxurious range” or the “simply essential” range. The stimuli were randomised within each ‘question type’ condition based on ‘label difficulty’, this approach was taken to reduce demand characteristics.

Each food choice task trial began with a 3 second screen which posed the question (purchase vs. health-related vs. nutrient-specific) that the next food choice should be based on. After the question was displayed, a fixation point was displayed for 500ms in the centre of the screen before the paired ready meal stimuli were presented for a maximum of 10 seconds (including the one permitted ‘switch’ response per trial if selected). During the exposure time, participants looked at the paired ready meal stimuli and indicated whether they would choose ‘Meal A’ or ‘Meal B’ based on the question asked. Participants selected their response using a radio button beneath each of the paired stimuli. If a meal was selected before the 10 second exposure-limit, or the 10 seconds was reached (the average time for participants to make a food choice across the conditions was 6.42 seconds), the study automatically moved on to the next screen.

Once the screen had moved on, participants provided their confidence rating on a visual analogue scale (0 = not confident at all to 100 = extremely confident) for the food choice they had just made and selected as many of the thought listing reasons as appropriate for the decision made (Section 4.2.3). Participants clicked ‘next’ to continue or the screen automatically moved on after 12 seconds to begin the next trial. A countdown timer was displayed on the screen and the average time for participants to complete these measures was 8.42 seconds.

6.2.3.3 Measures of Individual Differences. In the next phase of the research, participants were asked to complete measures of individual difference which were presented in the same order for each participant to minimise demand characteristics: (1) randomised items from six subscales of 'The Eating Motivation Survey – Brief' (TEMS-B; Renner et al., 2012); (2) the self-perceived weight item "*how do you think of yourself in terms of weight?*" (Robinson et al., 2018). An option to withdraw was presented on the screen at this point due to the sensitivity of the question asked, which if selected took the participant to the debrief of the study. (3) If participants continued, they completed the self-report nutrition label use item "*how often do you use the nutrition label when making a food selection*" (Cha et al., 2014); (4) participants then completed the Newest Vital Sign, which measured nutrition label health literacy (Rowlands et al., 2013); and (5) attitudes and beliefs towards nutrition labels measured by the Label Reading Survey (Marietta et al., 1999).

6.2.3.4 Qualitative Open-Ended Survey Questions Phase. After completing the quantitative measures, two open-ended questions were presented to capture a range of experiences and ideas from the participants in relation to nutrition labels. The first question participants were asked was "*please tell me about your experiences of using and understanding nutrition labels when making food selections, please try to be as detailed as you can*". The following prompt was included to help participants to reflect on their experiences: "*in your response, you may wish to comment on your existing knowledge and understanding of nutrition labels, any influences on whether* *you use the labels or not and any helpful or unhelpful factors which may affect your experiences of using nutrition labels*".

The second question participants were asked was: "*please share with me any ideas that you have of things that could help you to use and understand nutrition labels when making food choices, please try to be as detailed as you can*". This had a prompt of: "*in your response you might consider some of the helpful and unhelpful factors you talked about when reflecting on your experiences and share ideas of how these could be improved e.g., any opportunities or motivations which may help*".

Participants responded to each of the qualitative questions in a separate essay style text box in Qualtrics, with each question presented on a separate screen. Once a participant was happy with their response to a question, they clicked a 'next' button to move on to the next screen. Responses were exported from Qualtrics for data analysis and pseudonyms were assigned to each participant. These pseudonyms were taken from a list generated by the researcher of unisex names to help the extracts to be anonymised but feel personable in the analysis.

6.2.3.5 Study Response Quality Measures and Debrief. After the qualitative experience-related questions, participants were asked about their preference for intervention BCTs, mode of delivery and duration; these findings are reported in Chapter 7. At the end of the study, participants were asked two questions relating to their study responses: (1) to what extent they felt they paid attention during the study; and (2) to what extent they felt they completed the study to the best of their ability. These questions were responded to on a continuous scale from 1 (highly distracted / not to the best of my ability) to 10 (highly attentive / to the very best of my ability). All participants passed these attention checks in Study 2. Upon completion participants were thanked for their time and presented with an electronic debrief (Appendix J). The study duration was approximately 60-minutes in total.

6.2.4 Analysis

The quantitative analyses focused on replicating analyses reported in Chapter 5 for the food choice task. Hypotheses 1 was tested by rmANOVAs and hypothesis 2 was tested by multiple regressions. The justification for data screening and assumption check thresholds and the stages of the analyses were outlined in Section 4.4.1.There were missing values observed across the dataset due to task performance outcomes (i.e., no food choice was reached, and so subsequent measures were not asked); in these instances, the participant(s) were not included in the respective analysis. When univariate outliers were present, sensitivity analyses were conducted to exclude the outliers from the analysis. The original analyses were reported in this chapter when supported by the sensitivity analyses (Clark-Carter; 2019). The sensitivity analysis outcomes are referred to when the finding outcomes differed. When Mauchly's test of sphericity was violated the Greenhouse-Geisser statistic was reported. For significant rmANOVA main effects, Bonferroni post hoc pairwise comparisons were conducted. This was to ensure that all combinations of the levels were compared to gain insights into consumer nutrition label engagement in the food choice task developed. Furthermore, for significant interactions, simple effects were conducted for all comparisons to understand where the differences were. This approach has been recommended to understand the simple effects of each repeated-measures variable (Tremblay et al., 2022; Verma, 2015).

Braun and Clarke's (2022) guidelines for reflexive thematic analysis were followed for the qualitative analysis (Section 4.4.2.1). The responses from the participants were downloaded from Qualtrics and the researcher (SH) read through the responses noting initial thoughts on interesting content shared and initial reflections. It was decided through discussions with a second researcher (RP) that there was sufficient detail in the responses collected to enable reflexive thematic analysis to be performed on the data (Braun & Clarke, 2022). This familiarisation helped to decide on the appropriate coding strategy. One participant's qualitative response was removed during data familiarisation due to suspected artificial intelligence use as their response was not based on their personal experiences but a reflection of how to answer the questions posed more theoretically.

Inductive coding was used to code the data. Semantic and latent codes were used to explore the experiences of nutrition label engagement shared by participants. Initial candidate themes were drawn from the inductive codes to capture shared meaning across the dataset; these were developed to consider the interesting patterning of the experiences. SH went back to the dataset and had two further meetings with RP to discuss the data and themes. The themes and codes were then considered in relation to the COM-B model (Michie et al., 2011) as part of a deductive approach to help inform the intervention designed in Chapter 7.

6.2.5 Reflexivity

For this study, the qualitative analysis was approached through a lens of understanding experiences to inform the design of a future nutrition label engagement intervention. An inductive approach was taken and the themes written, before a deductive lens was taken to consider how the data mapped to the COM-B components. Keeping the two approaches separate helped with engagement with the data. The main interest was to explore how consumers engage with nutrition labels based on their daily experiences and to understand how this engagement may be influenced by experiences. A reflexive log was kept during the analysis stages to aid reflexivity and discussion of ideas during supervision meetings. SH met with RP to discuss the coding and themes developed which helped to gain confidence in the story shared for the thematic analysis presented.

6.3 Results

6.3.1 Participant Demographics

This analysis was conducted on 111 participants. The participant mean age was 44.45 years (*SD* = 14.76, range 19-75 years) and 51.35% self-identified as female. BMI scores, calculated from self-reported height and weight measures, indicated 50.50% of the sample had excessive body weight (*M* = 27.16kg/m^2, *SD* = 8.16) which is lower than the weight categorisation of the UK population and Study 1. Participant self-perceived weight scores (*M* = 3.63, *SD* = 0.94), indicated relatively good awareness compared to BMI scores (Table 6.1).

Table 6.1

Self-Perceived Weight and BMI Participant Characteristics

Characteristic	*n*	%
Self-perceived weight		
Very underweight	2	1.80
Underweight	9	8.11
About the right weight	38	34.23
Slightly overweight	41	36.94
Very overweight	21	18.92
BMI		
Underweight	7	6.30
Normal weight	48	43.20
Overweight	32	28.90
Obese	24	21.60

Nutrition label health literacy scores indicated 53.15% of the sample had adequate levels, 33.34% had a 25% likelihood of limited health literacy and 13.51% had a 50% or greater likelihood of limited health literacy. This distribution of scores was more diverse than Study 1. Self-reported nutrition label use was moderate (*M* = 2.74, *SD* = 1.01, range 1-5). There were moderate nutrition label attitude ratings (*M* = 17.96, *SD* = 3.10, range = 9-25) and moderate self-reported nutrition label behaviour ratings (*M* = 8.17, *SD* = 2.47, range 3-14). Participants' self-reported number of nutrients they typically looked for on the nutrition label ranged from 0-17 (*M* = 5.65, *SD* = 3.71). The participant sample showed higher motivations for eating foods based on *liking a*nd *habit* and lower motivations for *weight control* (Table 6.2).

Table 6.2

Motivations for Food Choice Participant Characteristics

Food choice motivator	*M*	*SD*
Liking	6.25	0.70
Habits	5.30	0.96
Convenience	5.05	1.22
Price	4.48	1.40
Health	4.14	1.34
Weight control	3.13	1.31

6.3.2 Hypothesis 1: Food Choice Task – Performance Analyses

The means in Table 6.3 indicated higher percentage accuracy, higher confidence ratings for accurate trials and most under-confidence for the 'nutrient-specific' condition. The means showed higher accuracy and more under-confidence for the 'easy' condition and higher confidence in the 'moderate' condition. The means showed lower accuracy and more over-confidence in 'purchase' and 'hard' conditions. Based on the combined 'question type' and 'label difficulty' conditions, the means indicated the highest accuracy in the 'nutrient-specific easy' condition and the lowest accuracy and most over-confidence in the 'purchase hard' condition. These means replicated those reported in Study 1. There were changes in the percentage confidence ratings compared to Study 1; the means were higher in the 'nutrient-specific moderate' condition and lowest in the 'health-related hard' condition. Similar means were observed across 'purchase' and 'health-related' conditions for all levels of 'label difficulty' for percentage confidence ratings.

Table 6.3

The Means and Standard Deviations for the Food Choice Task Performance Measures for Each Condition

Label Type	Purchase		Health-related		Nutrient-specific		Total	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
	Percentage accuracy (%) (*N* = 111)							
Easy	55.14	23.23	70.27	25.56	79.28	23.03	68.23	17.45
Moderate	54.59	21.73	65.05	25.08	78.20	24.20	65.95	16.21
Hard	49.01	21.02	55.32	23.19	70.27	22.54	58.20	14.04
Total	52.91	13.93	63.54	18.33	75.92	19.20		
	Percentage confidence for accurate trials (%) (*N* = 86)							
Easy	60.96	21.80	59.81	22.95	71.13	24.34	63.97	20.62
Moderate	59.54	22.15	60.36	22.84	73.00	25.03	64.30	21.03
Hard	60.59	21.90	59.25	21.65	69.23	26.90	63.02	20.72
Total	60.36	20.97	59.80	21.60	71.12	24.84		
	Confidence bias scores (*N* = 107)							
Easy	.05	.31	-.12	.31	-.10	.24	-.06	.23
Moderate	.05	.31	-.07	.31	-.07	.27	-.03	.24
Hard	.10	.31	.02	.32	-.04	.27	.03	.24
Total	.07	.26	-.05	.27	-.07	.22		

6.3.2.1 Percentage Accuracy Replication Analysis. A 3 ('question type') by 3 ('label difficulty') rmANOVA was conducted on percentage accuracy (N = 111). There was a significant main effect of 'question type' on accuracy, $F_{(1.79, 196.39)} = 70.34$, p <.001, $\eta^2 = .17$. Table 6.4 shows accuracy was significantly higher in 'health-related' and 'nutrient-specific' conditions compared to the 'purchase' condition. Furthermore, accuracy was significantly higher in the 'nutrient-specific' condition compared to 'health related' condition. These outcomes replicated the findings from Study 1.

There was a significant main effect of 'label difficulty' on percentage accuracy, $F_{(1.88, 206.37)} = 21.59$, p <.001, $\eta^2 = .04$. Table 6.4 shows accuracy was significantly higher for 'easy' and 'moderate' conditions compared to the 'hard' condition. There was no significant difference in accuracy between 'easy' and 'moderate' conditions. The significantly higher accuracy in 'easy' compared to 'hard' conditions replicated Study 1 findings. There was non-significant interaction between 'question type' and 'label difficulty' on percentage accuracy ($F_{(4, 440)} = 1.71$, $p = .147$, $\eta^2 = .01$). This finding did not replicate Study 1's outcome.

Table 6.4

Bonferroni Post Hoc Pairwise Comparisons for the Significant Main Effects of 'Question Type' and 'Label Difficulty' for Percentage Accuracy

Comparisons	*M* Diff (%)	95% CI		*p*
		LL	*UL*	
Health-related vs. purchase	10.63	5.91	15.34	<.001
Nutrient-specific vs. purchase	23.00	17.62	28.39	<.001
Nutrient specific vs. health-related	12.37	8.42	16.32	<.001
Easy vs. moderate	2.28	-1.14	5.70	.322
Easy vs. hard	10.03	5.74	14.32	<.001
Moderate vs. hard	7.75	3.84	11.66	<.001

Note. Bonferroni adjustments made so alpha level to determine significance held at p <.05. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.

6.3.2.2 Percentage Confidence Ratings Replication Analysis. A 3 ('question type') by 3 ('label difficulty') rmANOVA was conducted on percentage confidence ratings for accurate trials (N = 86). There was a significant main effect of 'question type' on percentage confidence ratings, $F_{(1.48, 1.89)} = 26.15$, p <.001, $\eta^2 = .14$. Table 6.5 shows percentage confidence ratings for accurate trials were significantly higher in 'nutrient-specific' compared to 'purchase' and 'health-related' conditions. There was no significant difference in percentage confidence ratings between 'health-related' and 'purchase' conditions, replicating findings from Study 1.

Table 6.5

Bonferroni Post Hoc Pairwise Comparisons for the Significant Main Effect of 'Question Type' for Percentage Confidence Ratings for Accurate Trials

Comparisons	*M* Diff (%)	95% CI		*p*
		LL	*UL*	
Purchase vs. health-related	0.56	-2.55	3.67	1.000
Nutrient-specific vs. purchase	10.76	5.41	16.10	<.001
Nutrient specific vs. health-related	11.32	7.14	15.50	<.001

Note. Bonferroni adjustments made so alpha level to determine significance held at p <.05. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.

There was a significant interaction between ‘question type’ and ‘label difficulty’ on percentage confidence ratings for accurate trials, $F_{(3.61, 306.52)}$ = 2.48, p = .050, η^2 = .003. This did not replicate Study 1’s non-significant interaction. Table 6.6 shows significantly higher percentage confidence ratings for all ‘label difficulty’ conditions in the ‘nutrient-specific’ condition compared to ‘purchase’ and ‘health-related’ conditions. There were non-significant differences in percentage confidence ratings across all ‘label difficulty’ conditions in ‘purchase’ compared to ‘health-related’ conditions. Table 6.6 shows significantly higher percentage confidence in the ‘nutrient-specific’ condition for ‘moderate’ compared to ‘hard’ conditions. There were no further significant differences across the simple effects. There was a non-significant main effect of ‘label difficulty’ on percentage confidence ratings ($F_{(2, 170)}$ = 1.85, p = .161, η^2 = .001). This finding did not replicate the significant main effect reported in Study 1.

Table 6.6

The Simple Effects for the Interaction for Each Comparison for Percentage Confidence Ratings for Accurate Trials

Comparisons	*M* Diff (%)	95% CI *LL*	95% CI *UL*	*p*
		Easy		
Purchase vs. health-related	1.16	-2.88	5.19	1.000
Nutrient-specific vs. Purchase	10.17	4.62	15.71	<.001
Nutrient-specific vs. health-related	11.32	6.91	15.73	<.001
		Moderate		
Purchase vs. health-related	-0.81	-4.36	2.74	1.000
Nutrient-specific vs. purchase	13.46	7.88	19.03	<.001
Nutrient-specific vs. health-related	12.64	8.03	17.26	<.001
		Hard		
Purchase vs. health-related	1.34	-2.35	5.03	1.000
Nutrient-specific vs. purchase	8.64	2.33	14.96	.004
Nutrient-specific vs. health-related	9.98	4.83	15.14	<.001
		Purchase		
Easy vs. moderate	1.42	-1.13	3.97	.530
Easy vs. hard	.37	-2.60	3.34	1.000
Moderate vs. hard	-1.05	-4.37	2.28	1.000
		Health-related		
Easy vs. moderate	-.55	-3.66	2.56	1.000
Easy vs. hard	.559	-2.17	3.29	1.000
Moderate vs. hard	1.11	-1.62	3.84	.972
		Nutrient-specific		
Easy vs. moderate	-1.87	-4.04	.30	.114
Easy vs. hard	1.90	-.61	4.40	.203
Moderate vs. hard	3.77	.92	6.6	.005

Note. Bonferroni adjustments made so alpha level to determine significance held at p <.05. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.

6.3.2.3 Confidence Bias Replication Analysis. A 3 ('question type') by 3 ('label difficulty') rmANOVA was conducted on confidence bias scores (N = 107). There was a significant main effect of 'question type' on confidence bias scores, $F_{(2,212)} = 26.56$, $p < .001$, $\eta^2 = .04$. Table 6.7 shows significantly higher over-confidence scores in the 'purchase' condition compared to 'health-related' and 'nutrient-specific' conditions. This replicated the findings from Study 1. There was no significant difference in confidence bias scores for 'health-related' compared to 'nutrient-specific' conditions, which did not replicate Study 1 findings.

There was a significant main effect of 'label difficulty' on confidence bias scores, $F_{(2,212)} = 14.18$, $p < .001$, $\eta^2 = .01$. Table 6.7 shows significantly higher under-confidence in 'easy' compared to 'hard' conditions, which replicated findings from Study 1. The significant under-confidence in the 'moderate' condition compared to 'hard' condition and the non-significant difference between the 'easy' compared to the 'moderate' condition did not replicate the findings presented for Study 1. There was a non-significant interaction between 'question type' and 'label difficulty' on confidence bias scores, $F_{(4, 424)} = 1.77$, $p = .135$, $\eta^2 = .003$, which replicated the findings from Study 1.

Table 6.7

Bonferroni Post Hoc Pairwise Comparisons for the Significant Main Effects of 'Question Type' and 'Label Difficulty' for Confidence Bias Scores

Comparisons	*M* Diff (%)	95% CI		*p*
		LL	*UL*	
Purchase vs. health-related	.12	.07	.17	<.001
Purchase vs. nutrient-specific	.14	.09	.19	<.001
Health-related vs. nutrient-specific	.02	-.03	.06	1.000
Easy vs. moderate	-.02	-.06	.01	.370
Easy vs. hard	-.09	-.13	-.04	<.001
Moderate vs. hard	-.06	-.10	-.02	<.001

Note. Bonferroni adjustments made so alpha level to determine significance held at p <.05. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.

6.3.2.4 Reasons Analysis. The thought listing reasons provided after each decision made were analysed per 'question type' condition across the 45 trials (N = 4,995 trials). When a decision was not reached by a participant no reason was provided, thus these trials were not included in this analysis. The data is reported descriptively using percentages to provide insights into when participants provided nutrient-5 reasons for their food choices. Table 6.8 shows the nutrient-5 reasons were shared across the three 'question type' conditions. The percentages indicated the highest nutrient-5 reasons were in the accurate 'nutrient-specific' condition for accurate choices and highest for inaccurate choices in the ‘health-related’ condition, which reflected the findings from Study 1.

Table 6.8

Percentage of Nutrient-5 Reasons Reported Across Accurate and Inaccurate Decisions for Each Question Type

Condition	Accurate (%)		Inaccurate (%)	
	Label as a reason	Label not as a reason	Label as a reason	Label not as a reason
Purchase	22.69	32.38	10.19	34.75
Health-related	51.78	16.79	15.75	15.68
Nutrient-specific	68.72	10.68	11.12	20.60

Percentages were calculated for overall accurate and inaccurate choices per ‘question type’ to provide additional insights into nutrient-5 reasons. The percentages indicated 86.55% of accurate ‘nutrient-specific’ trials had nutrient-5 reasons (*n* = 1,264 trials), compared to 75.52% of ‘health-related’ trials (*n*= 1,058 trials) and 41.20% of ‘purchase’ trials (*n* = 881 trials). This pattern of findings replicated those reported in Study 1. The percentages indicated 53.96% of inaccurate ‘nutrient-specific’ trials had nutrient-5 reasons (*n* =328 trials), compared to 50.10% of ‘health-related’ trials (*n* = 485 trials) and ‘purchase’ trials 22.67% (*n* = 719 trials). The lowest nutrient-5 reasons in the ‘purchase’ condition replicated Study 1 findings, but the highest in the ‘nutrient-specific’ did not replicate the previous findings.

6.3.3 Hypothesis 2: Individual Differences as Predictors

The descriptive statistics for the variables used in the regression analyses were outlined earlier in Section 6.3.1. All individual differences were included as predictors of task performance.

6.3.3.1 Individual Differences as Predictors of Purchase Percentage Accuracy Task Performance. A simultaneous multiple regression was conducted to explore the predictive relationship between measured individual differences and overall 'purchase' percentage accuracy (N = 111). The overall regression model was not significant (R^2 = .08, $F_{(14,96)}$ = 0.57, p =.881). None of the individual predictors were significant (Table 6.9). Adjusted R^2 = -.06 and R^2_{Press} = - .23 statistics were not similar to the original R^2 statistic and questioned the validity of the model. The outcome of the overall regression model replicated the finding from Study 1 but did not replicate the significant individual predictor of weight control.

Table 6.9

Individual Differences as Predictors of 'Purchase' Food Choice Task Percentage Accuracy

Predictor	β	95% CI		*p*
		LL	*UL*	
Constant		-2.25	63.98	.067
Label use	.03	-4.60	5.51	.860
Label attitudes	.14	-0.41	1.69	.228
Label behaviours	-.16	-3.10	1.28	.410
Age	-.06	-0.28	0.16	.610
Sex[a]	.10	-3.18	8.96	.347
Health literacy	.002	-1.89	1.94	.982
BMI	.001	-0.49	0.49	.997
Self-perceived weight	.09	-3.06	5.78	.543
Liking	.04	-3.66	5.27	.723
Habit	01	-2.58	4.74	.560
Health	.13	-1.98	4.63	.427
Convenience	-.18	-5.28	1.20	.215
Price	.12	-1.28	3.61	.347
Weight control	.05	-2.73	3.74	.757

Note. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.

[a]0 = male, 1 = female

6.3.3.2 Individual Differences as Predictors of Health-Related Percentage Accuracy Task Performance. A simultaneous multiple regression was conducted to explore the predictive relationship between measured individual differences and overall 'health-related' percentage accuracy. The overall regression model was not significant (R^2 = .20, $F_{(14,96)}$

= 1.71, p = .066). Of the predictors, nutrition label health literacy was significant, but no other predictors were significant (Table 6.10). Adjusted R^2 = .08 and R^2_{Press} = -.09 statistics were not similar to the original R^2 statistic and questioned the validity of the model. The outcome of the overall regression model replicated the finding from Study 1, but self-reported label use was not a significant individual predictor in Study 2.

Table 6.10

Individual Differences as Predictors of 'Health-Related' Food Choice Task Percentage Accuracy

Predictor	β	95% CI		*p*
		LL	*UL*	
Constant		-20.64	60.49	.332
Label use	-.19	-9.69	2.70	.265
Label attitudes	.15	-.40	2.17	.174
Label behaviours	.05	-2.31	3.05	.784
Age	-.07	-0.35	0.19	.539
Sex[a]	.18	-0.81	14.07	.080
Health literacy	.22	0.9	4.89	.034
BMI	.12	-0.34	0.86	.395
Self-perceived weight	-.07	-6.74	4.07	.625
Liking	.11	-2.68	8.26	.313
Habits	.11	-2.36	6.61	.349
Health	-.14	-5.93	2.16	.357
Convenience	-.17	-6.51	1.43	.207
Price	.14	-1.21	4.79	.239
Weight control	.17	-1.59	6.34	.238

Note. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.

[a]0 = male, 1 = female

6.3.4 Reflexive Thematic Analysis

Four themes were developed using inductive reflexive thematic analysis to share how participants reflected on their experiences of nutrition label engagement. The themes were (a) *accessible nutrition labels can lead to informed food choices*, which explores the need for easy to understand nutrition labels to facilitate quick and informed food choices; (b) *there's more to nutrition label engagement than maintaining a balanced diet*, which focuses on how habitual engagement with nutrition labels can help with key point-of-purchase food decisions; (c) *complexities in nutrition information can lead to lack of label credibility*, which explores how experiences of inconsistency and mistrust in nutrition labels can influence engagement level; (d) *"nutrition labels are good as they are, just not all that necessary to me*", which explores the importance of freedom of choice in nutrition label engagement.

6.3.4.1 Accessible Nutrition Labels Can Lead to Informed Food Choices. This theme focuses on exploring participants' needs for easy to understand, accessible nutrition labels to facilitate quick and informed decisions about their food choices at the point-of-purchase.

Nutrition labels were described as valuable, helpful tools to guide food-related decision-making: "*I have always found them to be an essential tool in guiding my food choices*" (Vick) and: "*I was around when there were no nutritional labels so my opinion to this is any information about the food we are consuming is good information*" (Eli). These responses showed consumers awareness of nutrition labels and their use to guide dietary choices. There was confidence from participants when engaging with nutrition labels: *"I feel that I understand food labels better than most people and I often use them when out shopping*" (Kit). Participants shared a strong reliance on seeking front-of-pack nutrition labels first: *"The first label I will usually look at is the one on the front of the package, [...]. Occasionally I will also read the more detailed nutritional label at the back*" (Addison). This aligns with the goal of front-of-pack nutrition labels to empower consumers to healthier food choices with simplified and easier to understand labels at point-of-purchase.

The accessibility of colour indicators on front-of-pack nutrition labels as being '*easy to understand'* and '*locate'* were key reasons for improving engagement. Participants commented favourably on the colours used: "*I do like the coloured design of the nutrition labels.*" (Teagan). This demonstrates a perception that knowledge of the front-of-pack nutrition label is helpful for consumers to make informed food choices. Farah illustrated how consumers engaged with front-of-pack colour indicators to help make food choices: "*I look for as many green coloured labels as possible or else as few red or orange items*" and there was knowledge of the 'green' indicator being associated with 'healthier' products: "*I'll choose the healthier (greener) option*" (Lennox).

This understanding extended to the importance of considering red colour ratings: "*if I can't decide which meal to eat and one has more red, I may opt for the other one*" (Riley). These experiences highlight the interpretive nature of traffic light colours on front-of-pack nutrition labels and how they can lead to behaviour change at point-of-purchase. Furthermore, consumers can identify 'high in' foods and consider the impact that consuming them may have on their overall health: "*I think the coloured labelling on the front of packaging is good [...] to see if there are any red colours which flag up high content*" (Juniper). This highlighted that being able to easily see the impact that food products can have on achieving a balanced diet through the front-of-pack colour coding is helpful. Hayden shared how considering the nutrition labels may also affect behaviour change across future food choices: "*often it doesn't change my behaviour in the moment, but I will consider more healthy options if I have eaten some unhealthy options*".

Participants felt that having a quick overview of the healthfulness of the product was sufficient to help make an informed decision: "*I think understanding the quick glance colours on nutritional labels is all that is needed*" (Ishfaq). The term 'quick' was often used when describing engaging with front-of-pack nutrition label colours. Being able to make decisions quickly was important for participants: "*I don't think anyone wants to spend ages reading nutrition labels*" (Uia) and: "*[I] find it helpful to take time when shopping to read the labels but often am in a rush*" (Shay). The participants shared that they found front-of-pack nutrition labels less time consuming to refer to when checking the nutritional information of a prepacked product: "*it's easier to use the colours if you're in a hurry rather than looking at the specifics for each category*" (Kit) and: "*the colour coding is a simple quick reference which means you don't have to study everything and don't have to stay in the supermarket all day*" (Bailey). This demonstrated the importance of nutrition labels being accessible at point-of-purchase to improve engagement. Therefore, front-of-pack labels may be effective when competing for attention at point-of-purchase to help consumers to assess the healthfulness of the product.

The inclusion of colour coding on back-of-pack labels was highlighted to increase engagement: "*even colour coding the detailed label at the back, which would make it stand out more and catch the eye*" (Addison) and: "*they should adopt the same traffic light design for the table on the back*" (Teagan). Having nutrition labelling which is eye-catching to draw attention is important when competing with many factors at point-of-purchase. Therefore, including colour coding may be an effective way to support individuals to further engage with nutrition labels when making food choices. Furthermore, participants' shared font size can impact nutrition label engagement: "*it isn't always easy to read the labels, they are very small writing and not everyone has time to stand and read everything they are buying when shopping*" (Charlie). This aligns with consumers' need for easy-to-use labels presented on food products at the point-of-purchase to aid engagement.

This theme shared how nutrition labels that are easy to engage with are more likely to be seen as informative and used to guide food choices. The front-of-pack nutrition labels were praised for their easy-to-understand colours, with relatively quick engagement times at the point-of-purchase. Belief and confidence were shared for the ability to use front-of-pack nutrition labels to inform food choices. The motivations and reasons behind this engagement for nutrition label users are discussed in the next theme.

6.3.4.2 There's More to Nutrition Label Engagement than Maintaining a Balanced Diet. This theme shares the circumstances and motivations that participants felt nutrition labels were most helpful, leading to habitual engagement at point-of-purchase.

Some participants shared their level of engagement with nutrition labels was higher when they made food choices as the primary shopper: "*I am the main person who cooks at my house, so I feel responsible for preparing healthy meals and keeping my and my partner's diet balanced. That is why I often check the nutrition label when I go shopping*" (Mischa). This demonstrates how primary shoppers feel a responsibility of using nutrition labels to provide a balanced diet. The 'provider' instinct to engage with nutrition labels was also present when buying food products to consume with people with eating-related conditions: "*I only consider nutrition labels when the food is going to be shared with someone (e.g., looking for green sugar labels when eating with my diabetic mum)*" (Pat). This shows how habits relating to supporting the diets of others can be formed, as well as for themselves. Participants acknowledged that nutrition labels could be informative if they felt susceptible to diet-related conditions or illnesses: "*I'm aware of the links of fat and salt with things like strokes and this isn't always obvious from weight so I think nutrition labels are useful in those situations*" (Loren). This shows that prompts relating to susceptibility of diet-related conditions may increase nutrition label engagement.

Engaging with nutrition labels for participants was described as a habit: "*initially, it seemed like a chore, considering how long it took to read and understand each thing on the label. Nowadays it is often a thoughtless habit*" (Nova). This engagement with nutrition labels demonstrates their value to inform consumers when purchasing food products, particularly when purchasing for the first time with limited existing knowledge of a product: "*I only ever read the label when I buy the item for the first time*" (Yuki) and: "*I use nutrition labels mostly when buying food I have not bought before or do not buy often*" (Leslie). Complacency reduced engagement for habitual food choices: "*I tend to buy the same foodstuffs all the time, I am a creature of habit, so I don't look at nutrition labels for these products*" (Darryl), This suggests that familiarity of regular purchases may be problematic if products are reformulated but not clearly communicated to consumers or if potential dietary changes are needed to support a balanced diet.

The need to engage with nutrition labels to inform a balanced diet was shared by participants with a health-motivation: "*I use the labels to try and manage the fat and sugar content of foods sometimes when I am trying to manage my weight and eat healthier*" (Quinn). This shows how specific motivations can increase nutrition label engagement and was particularly evident for participants who were weight-training: "*when I am weight training I will also look at the protein contents*" (Bailey). These experiences suggest that when a consumer has a health-related goal they may be likely to increase engagement with nutrition labels. However, this engagement was focused on specific nutrients to help achieve specific health-related goals, which may lead to issues with other nutrients.

There was a perception that engaging with the nutrition label could help inform consumers whether a food product was value for money: "*I often look at the nutrition labels when something is much more expensive than I would usually buy, as I would want the money to be spent on something useful*" (Khai). This suggests that nutrition labels may be an indicator of the quality of the food product: "*if there are red labels present I might avoid purchasing the product or select a different one (even if it's slightly pricier)*" (Parker). This demonstrates that participants may use nutrition labels to weigh up whether the price associated with the product is reflective of its nutritional content. Participants considered the taste of the product when making food choices: "*I prefer high fat yoghurt so I would compare the amounts of fat in the nutrition labels and buy the one with the highest fat content*" (Remy). This suggests that whilst nutrition label engagement is high, some consumers may use nutrition labels in the opposite way to their intended use. This may be due to the perception shared by some participants that food products higher in certain nutrients may indicate that they are tastier: "*I would also consider taste as some low-calorie ready meals are bland and insipid. I would nearly always read the labels and understand that the tastier the meal, the more salt and sugar is usually in it*" (Blake).

This theme shared how participants may have a habitual response to engage with nutrition labels at the point-of-purchase based on their motivations and responsibilities. It explored how consumers may engage with nutrition labels to support their own balanced diet, to support others' diets and to help with competing factors at the point-of-purchase. This habit formation of engaging with nutrition labels can be meaningful to the consumer. However, there are inconsistencies within the labels which may affect the ability to form these habits that will be explored as part of the next theme.

6.3.4.3 Complexities in Nutrition Information can Lead to Lack of Label Credibility. This theme explores the impact perceived credibility and inconsistencies with existing labelling have on experiences of nutrition label engagement. This theme draws together consumer experiences of mistrust and perceived inconsistencies in the nutrition information provided by food manufacturers.

Participants shared awareness of the complexities of interpreting the front-of-pack label to support a balanced diet: “*just because something is 'green' for its fat content this doesn't necessarily mean that the product can be considered healthy as it may be high in sugar*” (Gohar). This suggests consumer understanding for needing to engage with all nutrient values to determine the healthfulness of a prepacked food product. Participants shared that when manufacturers do not include the traffic light colours as a tool to help consumers understand the nutrition information it can be more challenging to evaluate the product healthfulness: “*still to[o] many elements to have to study when there isn't a colour coding system*” (Bailey). However, there are inconsistencies in the presence of front-of-pack labels, as it is voluntary for manufacturers to display, which may further reduce the credibility of engaging with the labels.

The inconsistency in the presence of front-of-pack labels may explain the feelings shared by participants that labels can be misleading: “*I find the RYG [red, yellow, green colour indicators] a little misleading*” (Hayden) and: “*sometimes I do not believe the colour systems gives an accurate view of what is within the product*” (Cody). These perceptions may reduce engagement with nutrition labels due to the reduced perceived credibility of the complex nutrition information shared. This may be related to participants attributing this as deceitful behaviour by the food product manufacturers: "*I* *think the traffic light system is an excellent idea but then the manufacturers try and fit within the limits and beat the system, rather like car emissions*" (Toni) and: "*the manufacturer was trying to hide something*" (Yuki). This scepticism of motives behind food manufacturers sharing nutritional information with consumers demonstrates the need to challenge mistrust between the consumer and food provider.

Participants shared confusion and lack of credibility for the measurement and serving sizes: "*the two different values as in per 100 or per serving can be confusing*" (Piper) and: "*when a bag of something weighs 152g but the nutritional label gives the values for 100g and 38g as 38g is a portion size how would I know how many to eat without having a scale with me at all times?*" (Jules). They highlighted the challenges when needing to do calculations: "*many people still struggle with the maths needed to convert figures from "per 100g/ml" to levels for a full pack*" (Uri). This demonstrates the complexities of providing credible nutritional information in a clear and easy to understand way on a population level. It shows that nutrition related health literacy is important when interpreting and deciding which food products to purchase.

Furthermore, the use of terms relating to serving sizes being 'small' were shared by participants: "*the amounts per "serving" are basically meaningless as a serving is basically a subjective measure - usually ridiculously small*" (Morgan) and: "*they are ALWAYS smaller than what people consume in real life*" (Paisley), with participants expressing confusion with the serving sizes "*food nutrition labels can be confusing […] sometimes you think the whole package is one portion when in fact if you look closely at* *the label it could be 2 or 3*" (Cameron). These experiences show mistrust in manufacturers adhering to the nutrition label guidelines and indicates consumers may typically consume higher amounts of nutrients than the serving size outlined. This highlights the conflicting relationship between guidelines for food manufacturers and the information consumers feel is appropriate for nutrition labels.

This lack of trust and credibility may be explained by participants feeling that food manufacturers were consciously choosing to report nutrition information for 'small' serving sizes: "*manufacturer clearly knows that the serving size would never be used in real world usage*" (Cruz) and were responsible for the perceived unrealistic serving sizes: "*some of the sizes are ridiculously underestimated (is a portion of a bag of sweets really like 3 sweets? Who has that little in a sitting?)*" (Teagan). The motives behind food manufacturers providing nutrition information reduced perceived credibility of nutrition labels, as participants shared that food manufacturers may intentionally manipulate their serving size to make their food appear healthier: "*I think is used by companies to make their foods seem more healthy*" (Wren) and: "*its unhelpful how some companies make lower serving sizes than the average person would eat so that their nutrition numbers look better*" (Zan). The perception of trust in food manufacturers shows that potentially more transparency around serving sizes and explaining the standardisation in place for nutrition labels may help to reduce some of the issues with credibility and improve the nutrition labels effectiveness as a public health initiative.

This theme shared how current inconsistencies in, and misperceptions of, the nutrition label guidance can reduce the credibility of providing the information. It shared how a lack of trust in the motives of food companies and the complexities of providing nutritional information can be emotive and may lead to erroneous dietary choices. This reduced credibility and mistrust in nutrition labels may lead to reduced engagement, which will be explored in the next theme.

6.3.4.4 "Nutrition Labels are Good as they are, just not all that Necessary to me". Whilst participants were aware of nutrition labels, not everyone wanted to engage with them when making food choices. This theme discusses the sentiment participants shared relating to freedom of choice when choosing food products.

Nutrient intake and health were not always associated: "*calories and fat content on labels doesn't influence my choice on what I buy as I don't think they are the main contributing factors for how healthy the UK is*" (Ace). This suggests that nutrition labels are not considered important to inform health-related behaviours. Beliefs that nutrition labels are not informative for general health may reduce their effectiveness as a population-level intervention to guide consumer food choices: "*when I buy food, I usually never look at the nutrition labels, as I am able to maintain a good weight for my size without looking at them*" (Uia).

If the perceived value of knowledge gained from the nutrition label is low, this reduced engagement:

> *To be honest I very rarely look at them. Because I only eat 'ready meals' occasionally, I already know that they are not a healthy option, so the nutrition label is not go[i]ng to tell me anything I don't already know*. (Riley)

Which may lead consumers to ignore nutrition labels in preference of their own food knowledge: "*seldom give regard to the labels […] I have enough knowledge regarding food content*" (Kody). This confidence in personal food knowledge extended to capability to visually identify healthy/non-healthy food without looking at the nutrition labels: "*most of the time I think that it will be obvious how healthy or not a particular product will be, most people can tell the difference between say chocolate and porridge without a traffic light label*" (Darryl). Whilst some choices may be "obvious", reality is often far more nuanced, thus relying on visual cues may be problematic and lead to erroneous food choices.

The self-perception of 'being healthy' as a consumer may reduce engagement with nutrition labels: "*I don't often use nutrition labels when buying food because me and my husband are both relatively healthy*" (Loren). These experiences show how health beliefs can impact the level of engagement with nutrition labels. There was a perception that nutrition labels were less important if the individual was not influenced by diet-related drivers: "*helpful for some people who need to watch calories*" (Gamal). The balance of engagement with nutrition labels was also shown to be less important when the individual felt that they were already looking after other aspects of their health and felt they did not need to use food labels: "*I am not too bothered about my health when it comes to food as I don't smoke or* *really drink. Food is my vice and justify it by thinking that I'm allowed to enjoy this one thing!*" (Raven). This demonstrated that compensatory health beliefs (Knäuper et al., 2004) may play a part in the engagement with nutrition labels when making food choices, as individuals feel that if they are meeting targets in one health behaviour it can reduce the need to in another.

Consumers may reduce their engagement with nutrition labels when purchasing foods with a 'like' motivation "*sometimes I just ignore the labels if I like the food*" (Billie). This demonstrates that nutrition label engagement levels may be influenced by the prioritisation of enjoying consuming the food, particularly if the participant considers the food a 'treat': "*if it was something I really liked and ate rarely, as a treat, I wouldn't care*" (Alex). Prepacked food products are largely considered treats by many consumers and so this reduction in nutrition label engagement may have implications for their effectiveness: "*I see no harm in indulging occasionally for something that you like, as a treat, as long as you don't eat lots of unhealthy food*" (Shannon). This shows consumers had awareness and understanding of nutrition labels, but their engagement was reduced when prioritising 'liking': "*I don't really pay attention to them. I eat what I like. […] Again, I understand them fine. I just don't pay attention to them. I eat what I like, and avoid what I don't*" (Zephyr). This aligns with the nutrition label engagement models shared in Chapter 3 (Grunert & Aachmann, 2016; Grunert & Wills, 2007).

Consumers may be more dismissive of the nutrition labels where food motivations are in conflict, unless they had diet-related health conditions: "*I rarely buy processed foods (usually they are more of a treat) then I don't worry too much about what they say. I think if I had any health issues I* *would pay much more attention to them*" (Shannon). This signifies that consumers are continuing to purchase prepacked food products and that their engagement with nutrition labels is in response to diet-related conditions rather than early prevention of developing these conditions. Although aware of nutrition labels, participants questioned their necessity: "*I just don't use them […] the traffic lights are OK but I ignore those too, and have I ever picked two similar items up to compare those? No*" (Avery). This suggests that nutrition labels are not used by all consumers, which potentially reduces the population level impact of nutrition labels in improving consumer diets.

These differing nutrition label engagement levels align with them being a public health initiative to guide and inform food choices whilst empowering freedom of choice: *"I don't use them as the be all and end all of my food decisions. They help, but do not make up my mind for me*" (Nour). There was a need for balance in the nutritional information presented on food packaging with the freedom of choice: "*I am also aware of the newer traffic light labelling system […] to be frank I find it a bit irritating, it smacks of being lectured a bit.*" (Darryl), and: "*It should be clear they are a guide, and not meant to make the decision for you*" (Nour). These extracts show the balance that manufacturers and policymakers tread with population-based initiatives. There is a need for guidance, but consumers are keen to retain their freedom of choice and do not want to feel like they are being lectured: "*I don't really want my food to educate me to be honest*" (Willow). This shows that whilst the level of engagement with nutrition labels is seen as a choice rather than to help guide decisions, sometimes it can be seen as more educational or dictatorial in nature, which may reduce consumer engagement.

This theme shared how consumers valued their freedom to choose to not engage with nutrition labels when making food choices. The theme highlighted how some consumers felt nutrition label engagement was not required when they could rely on their own knowledge and the visual aesthetics of food products at point-of-purchase. It also shared how personal motivations could be prioritised and the need for balance in the nutrition label information due to some consumers questioning their necessity when making food choices.

6.3.4.5 Thematic Mapping to the COM-B Model.

It was important to explore the experiences inductively to share the nuances and complexities of nutrition label engagement experiences. Figure 6.1 shows the findings from thematic mapping of the inductive experience coding to COM-B constructs. This mapping is complemented by deductive COM-B coding of the data. The thematic mapping to the COM-B constructs was important to further strengthen the links to the theoretical framework employed in the intervention design phase.

Figure 6.1

Findings from the Inductive and Deductive Analyses Mapped on to the COM-B model.

Capability

- Physical capability: Participants emphasised the importance of easy to access nutrition labels, they experienced issues with small font size, inconsistencies in presentation and learning conditions such as dyslexia. These issues impacted physical ability to engage with the labels and need to be considered in intervention design to reduce similar barriers.

- Psychological capability: Participants varied in their level of understanding of nutrition labels, particularly for their preferred front-of-pack nutrition label. This highlighted a barrier to engagement, particularly in relation to how to use them to make healthier food choices. Serving sizes were also a cause of confusion. Knowledge and understanding of the front-of-pack nutrition label may be an avenue for future intervention.

Opportunity

- Physical opportunities: Participants shared how the front-of-pack nutrition label colours helped, especially when under time constraints. Price was considered a barrier to engagement. The intervention needs to be quick to engage with and freely accessible.

- Social opportunities: Participants shared norms and beliefs of who nutrition labels were for and that they weren't always necessary for them. There were norms shared relating to how foods are perceived as healthier based on visual appeal / marketing. There were cultural norms relating to a lack of trust in nutrition label information and resistance to a paternalistic culture. Future interventions may seek to challenge these norms, but careful consideration to phasing is required.

Motivation

- Automatic motivation: Participants with a health-goal or motivation shared nutrition label engagement was a habit. Whereas complacency or non-health motivations can reduce automatic motivations. Trying to build nutrition label engagement habits may be an avenue to explore in future interventions.

- Reflective motivation: Participants explained a hierarchy/prioritisation of nutrients when making decisions and that there can be guilt for ignoring nutrition labels. Building habits and motivation to engage with nutrition labels in interventions may help to move reflective motivations to automatic motivations, especially important for purchase-based food choices.

6.4 Discussion

This mixed-methods study explored nutrition label engagement using a refined food choice task and open-ended survey questions in UK adult consumers. It combined performance and individual differences measures and qualitative responses within a single, online study, to gain insights into the factors and experiences which influence nutrition label engagement. In sum, the quantitative findings replicated some of the findings reported in Study 1 but with some variation, particularly inconsistencies for the 'moderate' condition findings. The replication analyses overall supported the effectiveness of the food choice task as a tool to assess nutrition label engagement when applied in an online setting, which extended its application from a laboratory setting.

Furthermore, the qualitative findings shared insights into consumer experiences of nutrition label engagement, highlighting that accessible nutrition labels and nutrition label engagement can lead to informed food choices. However, consumers shared that the complexities in nutrition information can lead to mistrust and lack of credibility of nutrition labels and that there are consumers who felt that nutrition labels were not necessary for them to engage with. Taken together, the findings in this chapter added valuable insights to further contribute findings to Thesis Objective 2. It highlighted important avenues to explore in the intervention design process based on mixed-methods findings.

6.4.1 Hypothesis 1: Discussion

The findings supported the first hypothesis; that there would be differences in performance measures for accurate trials in the food choice task. These differences replicated the findings from Study 1 for participants having significantly higher accuracy and percentage confidence ratings for accurate trials for nutrient-specific decisions. Participants were less likely to provide nutrient-5 reasons for accurate purchase-based decisions compared to Study 1 but showed a similar overall pattern in reasons provided. There was an exception for the nutrient-specific reasons, where the nutrient-5 reasons were lower, this suggested differences across the two studies in cognitive processing for this condition. However, there were differences in replication for the moderate condition compared to Study 1. The inconsistency in findings for the moderate rated labels across studies 1 and 2 suggested that it may not be as effective at detecting changes in nutrition label engagement. The reduced performance for hard label decisions may show that participants felt there would be little impact on overall health if the foods were similar, compared to the wider healthier implications when compared to the easy decisions. However, as food choices are made daily, these smaller impacts are important, especially as some food choices may be similar in nutrient content, but choosing the food with less nutrients over time may help to reduce the impact on excessive body weight and non-communicable diseases (Sapio et al., 2025).

Furthermore, percentage confidence ratings for accurate trials were similar between the health-related and purchase decisions and across all ‘label difficulty’ conditions but in study 2 a significant interaction was reported. This showed significant differences within the ‘label difficulty’ ratings when consumers made ‘nutrient-specific’ decisions, indicating that confidence levels were affected based on label difficulty. However, the comparisons within each ‘question type’ showed that confidence ratings were only significantly higher for ‘moderate’ vs. ‘hard’ labels in the ‘nutrient specific’ condition. This did not support the earlier main effects and was not reflected in the confidence bias scores. This suggested that the moderate label condition may be complicating the conclusions drawn from the data. The significant main effect of under-confidence for ‘easy’ compared to ‘hard’ label types replicated Study 1. Thus, the comparisons across the measures for these two ‘label difficulty’ conditions were more stable, which was beneficial for replication purposes. Consequently, the food choice task was refined to remove the moderate condition ahead of Study 3.

6.4.2 Hypothesis 2: Discussion

When testing the second hypothesis the results indicated no overall model significance of measured individual differences in predicting accuracy for when participants made purchase-based nor health-related food choices. This replicated the findings from Study 1 and suggested that food choice task accuracy was not influenced by a combination of the measured individual differences. This suggested that when triangulating individual differences there may be variation and compensations for each measure that, when assessed in a single study, reduce the effect each difference may have on nutrition label engagement. This is important to explore as it may suggest that targeting the intervention at the broad population rather than targeting specific individual differences may be appropriate. However, like Study 1 the validity of the models were questioned due to lack of model cross-validation.

In Study 2, higher health literacy was reported as a significant individual predictor for greater accuracy for health-related decisions. This suggested that the replication of the findings in a more representative health literacy sample, achieved in Study 2, was important to gain additional insights into how it affected nutrition label engagement behaviour. Thus, nutrition label health literacy may be an aspect to consider when developing the nutrition label engagement intervention as either a target or in the materials developed so that the content is accessible across health literacy levels.

6.4.3 Research Question: Discussion

The qualitative analyses explored the research question: 'how do healthy UK adult consumers experience nutrition label engagement when making food choices?' Emphasis on front-of-pack nutrition label engagement in the experiences shared demonstrated consumer familiarity and preference for this semi-directive label. These experiences built upon findings from Todd et al. (2019) and Wahlich et al. (2012). Evaluative traffic light colours facilitate engagement (Sanjari et al., 2017) and coupled with focus on key nutrients of public health concern supported policy objectives to introduce front-of-pack labels (Gibson-Moore & Spiro, 2021; Mhurchu et al., 2017). Increased engagement with front-of-pack nutrition labels reflected the aim to appeal to the intuitive strand of the Dual Process Theory (Epstein, 1994; Kahneman, 2011). From experiences shared, the saliency of the colours and positioning of front-of-pack nutrition labels enhanced engagement as suggested in the stages of the Hierarchy of Effects Model of Quality Labelling (Grunert & Aachmann, 2016).

Perceived speed and ease of food choices using front-of-pack nutrition labels improved engagement to make food choices, as participants felt they had limited cognitive capacity and time within the shopping environment (Franken et al., 2025; Mirhoseini et al., 2025). However, some participants felt further improvements could be made to the labels and they could still be difficult to interpret, especially where colours were the same. Therefore, education on interpreting front-of-pack nutrition labels may aid consumers and reduce barriers to engagement.

In addition, there were different experiences of nutrition label engagement based on level of interest and habits. Turner et al. (2014) and Vyth et al. (2010) reported consumers with a health motivation had increased familiarity and favourable attitudes towards nutrition labels. Habits which did not focus on health lowered nutrition label engagement, but motivations and habits focused on health appealed to the deliberate strand of the Dual Process Theory (Kahneman, 2011) and more reasoned based thinking (Grunert & Aachmann, 2016). Therefore, cognitive processes can impact engagement and when drawn upon from long-term memory could impact engagement (Baddeley, 2012; Leathwood et al., 2007). These experiences reflected the cognitive ability and motivation strands of the Information Processing Framework (Kanfer & Ackerman, 1989). The quantitative findings did not yield significant results for the influence of the measured food motivations in this study. Therefore, the qualitative insights highlight how these experiences may be complex and nuanced which may not be reflected in a questionnaire. Therefore, challenging habits and beliefs on nutrition label engagement may be an important focus for the intervention so that there is a focus on labels being for everyone and to engage with them for each decision to minimise compensatory health beliefs (Knäuper et al., 2004).

The research demonstrates individual differences impact consumer trust levels in nutrition information (Campos et al., 2011). This study showed how contextual and knowledge factors impacted perceived credibility and lack of trust in nutrition labels. Previous research has highlighted this barrier to nutrition label engagement and interventions are needed to address these misperceptions to improve engagement (Mazzù et al., 2022; Seyedhamzeh et al., 2020). Serving sizes were confusing to participants and so it was a strength of the food choice task employed in the empirical study that serving size was consistent across pairings to limit potential impact of this confounder.

The COM-B model (Michie et al., 2011) aided mapping these experiences as participants shared insights across concepts of the model. The mapping highlighted avenues for interventions to target based on the inductive and deductive thematic analysis coding performed on the extracts. How findings related to the BCW intervention design process is outlined in Chapter 7. Findings suggested nutrition label intervention should account for physical capabilities, such as ensuring font size is easily legible and it is quick to engage with. Furthermore, the content of the intervention, supported by the quantitative analyses should focus on building automatic motivation for nutrition label engagement and provide improvements to psychological capability to help to facilitate this engagement. Moreover, the content should sensitively challenge misconceptions in societal norms for who nutrition labels are for and the credibility of the information provided.

6.4.4 Strengths and Limitations

A strength of the current study was the replication of some of the findings using some of the measures implemented in Study 1 but in a different population and setting. This approach was important to consider in the development of the nutrition label reengagement intervention to consider different delivery modes and broader consumer engagement. Quantitative findings added further insight into factors that influence nutrition label engagement. Whilst the sample was more representative of the UK adult population, there was a higher proportion of participants who were categorised as a normal weight using self-reported BMI measures. This potential limitation of relying on self-reported height and weight measures over objective measurements. Furthermore, there could be differences in nutrition label engagement compared to a representative sample of the BMI category distribution in the UK, as this measure can affect engagement (Borgmeier & Westenhoefer, 2009; Vyth et al., 2010).

Open-ended qualitative survey questions helped understand participant experiences of nutrition label engagement. Question phrasing was a strength of this study along with using prompts to help participants complete them by providing context to qualitative questions. Due to the health behaviour not being specific to a chronic condition or sensitive topic the concerns raised in the literature relating to this approach potentially lacking richness in the data collected compared to traditional methods was unfounded (LaDonna et al., 2018). Participants provided ample detail of analysis by sharing experiences and ideas for improving nutrition label engagement.

6.5 A Summary of the Chapter Contributions

This second empirical study reported replication quantitative analyses that confirmed the effectiveness of food choice task conditions in a more diverse UK adult consumer population and an online setting. Furthermore, the findings shared qualitative insights into consumer experiences of nutrition label engagement. The mixed-methods findings added to the findings from Study 1 to address Thesis Objective 2. In sum, the factors and experiences of consumers when engaging with nutrition labels have been explored, including the impact of individual differences. Furthermore, the food choice task has been confirmed as an appropriate instrument to assess the effectiveness of the novel intervention. The findings added further data to inform the intervention design process which is outlined in Chapter 7.

Chapter 7: Intervention Development

This chapter describes the design of the nutrition label engagement intervention implemented and evaluated within this thesis, addressing the first element of Thesis Objective 3. The chapter begins with a summary of the key findings and recommendations that informed the intervention design from the previous thesis chapters. Next an update to the outstanding steps of the theoretical framework is provided. The intervention is then introduced and justification for how each element of the intervention content, delivery and assessment timepoints are discussed. This is followed by the results and evaluation of the intervention from a pilot study conducted on eight participants to check acceptability of the intervention developed. The chapter ends with a summary of the key points relating to the development of the content, delivery and assessment timepoints of the intervention designed in the thesis.

7.1 A Summary of how the Chapter Contributions Informed the Development of the Intervention

The previous six chapters shared findings and recommendations that have contributed to the development of the intervention implemented within this thesis. A description of how each previous chapter has contributed to the development of the intervention will now be outlined. Table 7.1 provides a summary of the key findings and recommendations.

Chapter 1 outlined the current nutrition label legislation in the UK. This narrowed the scope of the intervention to target either/both the mandatory back-of-pack nutrition label and the voluntary multiple traffic light front-of-pack label. The chapter referenced credible sources where consumers can locate guidance and support on how to successfully engage with nutrition labels e.g., on the NHS website (NHS, 2022a). These credible sources were pivotal to the development of appropriate content and messaging for the intervention developed. Chapter 1 also outlined key individual differences which affect nutrition label engagement, including health literacy, BMI, age, gender, self-perceived weight and motivations for food choices. The importance of considering these individual differences when developing an intervention and its measures were outlined.

Chapter 2, a systematic review, explored the effectiveness of existing nutrition label engagement interventions in healthy adults. It provided an understanding of how researchers had approached the content, delivery and duration of this type of intervention when targeting population health. The findings from the review highlighted the need for theoretically informed interventions with robust methodological designs. It also highlighted key ‘active ingredients’ from promising interventions through BCT mapping. The BCTs mapped were: (a) goal setting (behaviour), (b) feedback on outcome(s) of behaviour, (c) instruction on how to perform the behaviour, (d) information about health consequences, (e) demonstration of the behaviour, (f) prompts/cues, (g) behavioural practice/rehearsal, (h) credible source, (i) material incentive (behaviour).

Chapter 3 provided the theoretical underpinning for the development of the intervention and described the stages of designing a behaviour change intervention using the BCW (Michie et al., 2014). Through engagement with Stage 1, the behaviour that the intervention would target was outlined as improving UK adult engagement with nutrition labels when making prepacked food choices. Step 4 of Stage 1 identified what needed to change to improve nutrition label engagement in relation to the COM-B model (Michie et al. 2011) based on the findings from Chapters 1 and 2. In addition, Stage 2 of the intervention design process relating to the identification of intervention options was completed with a focus on the intervention mapping on to ‘education’, ‘enablement’ and ‘persuasion’ intervention functions. Chapter 4 outlined the methodological approach of how the effectiveness of the intervention will be measured after implementation.

The empirical study findings reported in Chapters 5 and 6 provided support for the focus of what needed to change. These findings added support to the evaluations made in Stage 1, Step 4 of the theoretical framework (Michie et al., 2014). Study 1 highlighted that when asked to make purchase-based food choices, nutrition label engagement was lower, and consumers made less healthier food choices compared to the ‘health-related’ and ‘nutrient-specific’ conditions. This suggests that persuading consumers to improve the priority of nutrition label engagement, especially when making purchase-based food choices, may increase healthier dietary choices. Furthermore, the findings showed that consumers were looking at the labels (eye-tracking measured attention), mentioned the labels (reasons) and were confident in their health-related decisions for health-related choices but accuracy was still significantly lower than in the ‘nutrient-specific’ condition. This suggests that an intervention targeting ‘education’ on how to engage with nutrition labels when determining the healthfulness of a product may improve dietary outcomes.

Study 2 reported findings from a replication study that revised the measures and study procedure in an online environment. The findings replicated the need for education on how to successfully engage with nutrition labels when consumers made health-related choices. It also replicated the need to persuade consumers to increase nutrition label engagement when making purchase-based decisions. These findings further strengthened that these were key areas the intervention needed to target. In addition, Chapter 6 presented qualitative findings from Study 2, which explored consumers' experiences of nutrition label engagement. Four themes were presented which explored how consumers need easy, quick to use nutrition labels to help them make food choices, but that there are inconsistencies and mistrust of the nutrition information presented and whether it is credible. The experiences also highlighted the importance of freedom of choice in nutrition label engagement. The deductive mapping supported these findings and highlighted aspects of psychological capability, physical opportunity, reflective and automatic motivations for the intervention to target. These qualitative findings informed the development of the intervention, in terms of content and to consider how the delivery mode could facilitate consumer freedom of choice to engage with the intervention content.

Table 7.1

Key Contributions from the Previous Chapters which Informed the Development of the Intervention

Chapter	Key Recommendations
1: Literature review	• Outlined the legislation and credible sources of information to inform the intervention • Highlighted key individual differences to consider when assessing the effectiveness of an intervention
2: Systematic review	• Synthesised existing nutrition label interventions to provide recommendations relating to the content, duration and delivery method of the intervention • Highlighted the need for theoretically informed interventions with robust methodological designs • Ten BCTs were identified as most used within the existing interventions
3: Theoretical underpinning	• Discussed and justified the key theories used to underpin the intervention design and implementation
4: Methodological Approach	• Discussed key methodologies and justified the approach and measures taken when implementing and evaluating the intervention designed
5: Eye-tracking and think-aloud study	• Demonstrated the effectiveness of the food choice task designed to measure differences in behaviour to assess the effectiveness of an intervention • Findings supported intervention development to target purchase-based and health-related nutrition label engagement to improve dietary choices through ‘education’, ‘persuasion’ and ‘enablement’
6: Online mixed-methods study	• Replicated the quantitative findings from Chapter Five to further support the potential

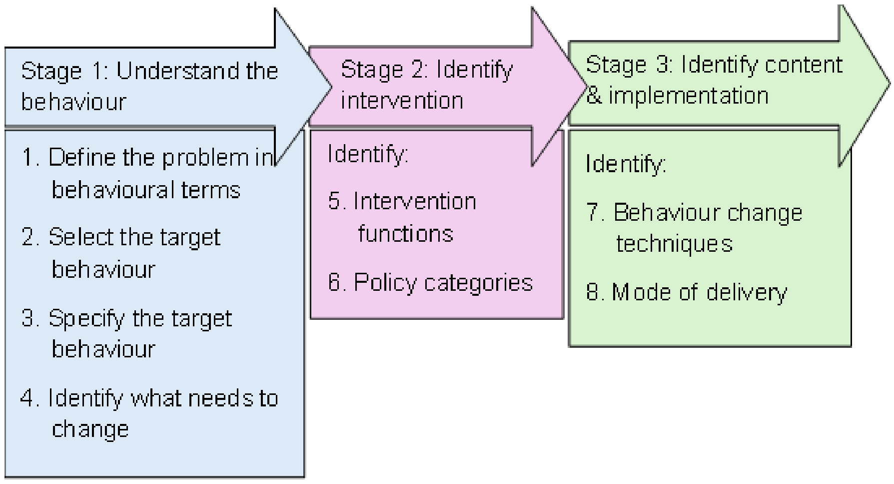
Chapter	Key Recommendations
	‘education’, ‘persuasion’ and ‘enablement’ focus for the intervention • Further refined the food choice task and measures to use in an online environment • Explored the experiences of consumer engagement with nutrition labels and discussed four themes to help inform the development of the intervention

7.2 Designing a Behaviour Change Intervention using the Behaviour Change Wheel – Updates

As outlined in Section 3.4, the guide for how to design interventions using the BCW (Michie et al., 2014) was used to develop the intervention within this thesis (Figure 7.1). This section will update the changes identified in Stage 1 Step 4 based on the findings from Studies 1 and 2. This is followed by the identification of the content and implementation approach for the intervention (Stage 3, Steps 7 and 8).

Figure 7.1

A Reminder of The Process of the Behaviour Change Wheel to Designing Interventions (Michie et al., 2014).



7.2.1 Stage 1 – Step 4: Identifying what Needs to Change

The studies reported in Chapters 5 and 6 added empirical findings to the evidence applied from the first two chapters. This resulted in a further identification of what needs to change for consumers to improve nutrition label engagement when making food choices. The empirical findings presented in Chapters 5 and 6 resulted in support for, and additional identification of what needs to change for consumers to improve nutrition label engagement when making food choices. These empirical findings have been added to the changes identified from Chapters 1 and 2 to provide an extensive and robust overview of the changes that the nutrition label engagement intervention could target (Table 7.2).

The results presented in Table 7.2 demonstrated that all aspects of the COM-B model have a need for change to improve consumer nutrition label engagement. However, the key components for the intervention focus on changes that do not require changes to the physical presentation of the nutrition labels, or the purchasing environment, as these are beyond the scope of the thesis. Therefore, whilst the format of the label and the environment are important to consider, the intervention and research presented in this thesis are focused on how to support and guide consumers to engage with nutrition labels more effectively. These changes are noted within the table as "beyond the scope of the intervention". changes that focus on an individual's ability to engage with current nutrition labels are focused on in this thesis.

Table 7.2

Identifying what needs to Change to Improve Nutrition Label Engagement Using the COM-B Model

COM-B components	What needs to happen for target behaviour to occur?	Is there a need for change?
Physical capability	Challenges with locating, reading and the format of nutrition labels	Change needed to make label format more visible on packaging but changes to label formatting are beyond the scope of the current intervention. However, the format and presentation of how the information is presented in the intervention was considered.

COM-B components	What needs to happen for target behaviour to occur?	Is there a need for change?
	Font size limits ability to engage with labels	Change needed to make labels more accessible on packaging but changes to label formatting are beyond the scope of the current intervention However, the font size of the content shared as part of the intervention is considered as part of the intervention design process.
Psychological capability	Low capability to interpret the nutrition labels for certain tasks	Change needed to improve confidence and belief in ability to engage with nutrition labels when making food choices
	Over confidence and self-reporting of label engagement.	Change needed to improve self-awareness of nutrition label engagement as well as challenge lack of engagement
Physical opportunity	Inconsistency in availability of nutrition labels	Change needed to improve consistent display of nutrition labels e.g., different brands of product, but beyond the

COM-B components	What needs to happen for target behaviour to occur?	Is there a need for change?
		scope for the current intervention
	Lack of time to engage with nutrition labels	Change needed to help consumers prioritise label engagement and reduce perceived time effort needed.
	Perceived impact on budget	Change needed to overcome potential financial barriers but beyond the scope for the current intervention
Social opportunity	Belief of who nutrition labels are for	Change needed to build awareness that nutrition labels are for all consumers purchasing and consuming prepacked food products
	Low trust in nutrition labels due to societal norms	Change needed to re-build trust in nutrition labels within society
Reflective motivation	Lack of motivation to engage with nutrition labels	Change needed as consumers do not necessarily recognise the benefits of engagement

COM-B components	What needs to happen for target behaviour to occur?	Is there a need for change?
	Low perceived importance and value of using nutrition labels	Change needed to improve beliefs held to encourage the behaviour
Automatic motivation	Competing priorities at point-of-purchase	Change needed to help consumers to establish habits

7.2.2 Stage 3 – Step 7: Identifying Behaviour Change Techniques

The BCTT (Michie et al., 2014) was introduced in Section 2.1.2. These techniques ensure that an intervention is replicable and the active ingredients are clearly described using standardised language. In Chapter 3 the ten BCTs identified from the findings presented from the systematic review (Chapter 2) were mapped to the related COM-B component and intervention functions. To assess the acceptability for these BCTs in the intervention developed, 111 consumers were asked to rate, rank and provide their opinions on the selected techniques as part of Study 2. As a reminder the ten BCTs identified in the systematic review were: (a) goal setting (behaviour), (b) feedback on outcome(s) of behaviour, (c) instruction on how to perform the behaviour, (d) information about health consequences, (e) demonstration of the behaviour, (f) prompts/cues, (g) behavioural practice/rehearsal, (h) credible source, (i) material reward (behaviour) (j) habit formation. Due to similarities between ‘instruction on how to perform the behaviour’ and ‘demonstration of the behaviour’ from a consumer perspective these were combined. Credible source was also removed from the evaluation as the need to ensure the information presented in the intervention was credible was essential both ethically and morally (Abbasi et al., 2018; Carter et al., 2011).

7.2.2.1 Behaviour Change Technique Ratings. As part of Study 2 2, 111 participants rated the seven promising BCTs. The ratings were completed once participants had finished the experimental tasks, questionnaires and qualitative experiences of nutrition label engagement. The ratings were provided in response to seven items (Figure 7.2). The items were scored on a visual analogue scale where '*0 = extremely unhelpful*' and '*100 = extremely helpful*'.

Figure 7.2

The BCT Rating Questions Asked to Participants

How helpful do you think it would be to set yourself a **goal(s)** to look at / use nutrition labels when making food choices?
How helpful do you think it would be to **receive feedback** on or record how successfully you are using nutrition labels when making food choices?
How helpful do you think it would be to receive a **demonstration and/or instruction** on how to use and understand nutrition labels when making food choices?
How helpful do you think it would be to receive **information on the health consequences** of using nutrition labels when making food choices?
How helpful do you think it would be to have **prompts or cues** to use nutrition labels when making food choices?
How helpful do you think it would be to **practise** using nutrition labels when making food choices?
How helpful do you think it would be to receive a material or **self-incentive/reward** to use nutrition labels when making food choices?

The means showed the highest acceptability rating for goal setting and the lowest for rehearsal (Table 7.3). The standard deviations demonstrated varied distribution of scores. The medians were similar across the BCTs but with a lower median for rehearsal. This was supported by the polarisation of the scores for each BCT, as each component had a minimum score of 0 and a maximum score of 100. The BCT ratings showed the variation in consumer perceptions of what may be helpful for a nutrition label engagement intervention to include. The polarisation of the ratings demonstrated the challenges of intervention design for a broad population. To provide context to these polarisations the percentage of participants who rated each BCT higher than 75% or lower than 25% were calculated. These values showed the polarisation of the ratings and the variability in how acceptable each BCT was perceived.

Table 7.3

Consumer BCT Ratings to Inform the Intervention Development

BCT	*M* (%)	*SD*	Median (%)	%(*n*) rated <25%	%(*n*) rated >75%
Goal Setting	53.99	26.78	55	17.12	24.32
Demonstration	50.23	32.35	50	31.53	28.83
Health consequences	50.14	31.48	59	30.63	26.13
Incentive	48.97	32.75	53	33.33	25.26
Feedback	46.41	29.91	50	28.83	19.82
Prompt/cues	42.23	29.86	50	35.16	15.32
Rehearsal	40.14	30.39	41	38.74	14.41

Note. Higher ranking scores indicated higher preference.

Participants had the opportunity to provide explanations for their ratings. Participant experiences echoed the sentiments previously shared in Study 2. In addition, there were new insights from the ratings in relation to nutrition label engagement experiences. These spanned across the ratings: (a) accountability and motivation can influence the level of nutrition label engagement; (b) interventions must be sensitive to and not negatively impact mental health or illicit a negative emotional response; (c) more information and support on nutrition label engagement would be helpful; and (d) nutrition labels are common sense and not difficult to engage with. Therefore, these insights were considered when implementing the BCTs within the intervention content and messaging to appeal to the broadest audience.

7.2.2.2 Behaviour Change Technique Rankings. Following the ratings of the seven BCTs, the 111 participants were asked to rank the techniques in order of preference. This step was included so participants could reflect on which options they believed would be most acceptable and preferred. This helped to capture a range of responses to build upon the ratings provided. This was important as the ratings were given on a visual analogue scale and so did not capture preference if consumers had to decide which BCTs would be most acceptable to them. Figure 7.3 outlines the instructions shown for this stage of the research.

Figure 7.3

BCT Ranking Instructions Shown to Participants

Reflecting on the suggestions, please rank, in order of preference, the ideas that you feel would most help your experience to use and understand nutrition labels when making food choices.
Please move the idea you rank the highest to the top of the order and rank each idea to the lowest ranked idea at the bottom.
You are welcome to add 'other' suggestions if needed, if these are not needed please leave them in the last place(s) of the rank order.

Setting goals

Receiving feedback

Self-monitoring success

Receiving a demonstration / instruction

Receiving information on health consequences

Having prompts / cues

Practice / training

Having an incentive / reward

Other

The rankings of the BCTs all had minimum and maximum ranges which indicated that across the participant sample each BCT had been placed in the first and last place. The values reported are without the ‘other’ suggestions included so that the rankings were focused on the BCTs provided. The rankings were based on 1 as the highest ranked concept and 7 as the lowest. Most of the means spanned moderate ranking values between 3 and 6, demonstrating the variability of preferred BCTs. The mean rankings show that ‘goal setting (behaviour)’ and ‘information about health consequences’ were the highest ranked BCTs (Table 7.4). These rankings were supported by the mode, but with ‘demonstration / instruction of the behaviour’ being the most frequently preferred BCT. Prompt/cue and practice/training received the lowest overall mean rankings from participants, suggesting that these may not be as prioritised or preferable to consumers. These findings support the individual ratings given to the BCTs.

Table 7.4

BCT Rankings to Inform Consumer Acceptability to use in an Intervention

BCT	Mean	Standard Deviation	Mode
Goal Setting	3.55	1.95	2
Health Consequences	3.55	1.98	2
Demonstration/ Instruction of behaviour	3.93	2.23	1
Incentive / Reward	4.39	2.55	7
Receiving Feedback	4.50	1.83	5
Prompt / cue	5.05	1.98	7
Practice / training	5.26	2.10	7

Note. Lower ranking scores indicated higher preference.

Participants had the opportunity to include ‘other’ suggestions. There was a sentiment from participants that focused on ‘price’ of food products and the ‘format’ of the nutrition label. These ideas reinforce the key experiences shared and analysed from the participants in Study 2 and in Section 7.2.1. Whilst outside of the BCTs, it is important to keep these in mind when designing the intervention and drawing conclusions.

In addition, some participants highlighted that the rankings would not necessarily indicate their engagement with food labels, for example: “*I dislike all of these things – they feel like having [my] diet monitored and micro-managed*” and some participants provided additional reflections on their rankings, for example: "*this ranking list is really inconsistent to the individual ratings I gave them*" and: "*top 4 are key for me*". These reflections highlight the complex cognitions, emotions and behaviours that underlie the consumers engagement with nutrition labels and the types of intervention they may be accepting of.

7.2.3 Stage 3 – Step 8: Identifying the Mode of Intervention Delivery

The systematic review (see Chapter 2) reported a variety of face-to-face and distance delivery modes for existing interventions with promising intervention outcomes. Therefore, to further establish the acceptability by the target audience of the intervention, as part of Study 2, 111 participants were asked to share their ideas on the setting for a future intervention. To make the language accessible, 'campaign' was used rather than 'intervention' in the question asked. Participants were asked: '*how do you think a campaign in this area should be delivered and why*?'. Ideas for the mode that the intervention could be delivered in were shared as prompts to help participants to consider options and encourage thoughtful responses. The responses were analysed using frequency content analysis to inform the delivery mode for the implemented intervention (Table 7.5).

Table 7.5

Consumer Preference for Intervention Delivery Mode

Delivery Mode	Frequency	Percentage (%)
Social media	72	31.44
Traditional methods (e.g., TV, articles, radio, posters)	57	24.89
Supermarket (online or instore)	52	22.71
Interactive activities / app	23	10.04
Schools	13	5.68
Do not support	8	3.49
Healthcare/community setting	4	1.75

The responses showed that participants felt social media would be the most effective delivery mode for the intervention. From the comments, this was mostly due to the perceived reach of the platform and ability to retain the freedom of choice to engage with the content. This platform has a population-level reach but requires little monetary investment compared with traditional methods, which also received a high frequency of responses. Therefore, social media-based interventions may be a cost-effective method to explore in the design stages of a public health campaign aimed at improving nutrition label engagement (Freeman et al., 2015; Sharmila et al., 2023). Whilst supermarket-led interventions were also considered as potentially effective as a strategy, this would require support by retailers, which was beyond the scope of the thesis. Participants also felt that interactive activities or an app may be an opportunity to explore. However, there are existing apps available to track diet, and these are not always easy to use at the point-of-purchase, which is the target for the present intervention. Furthermore, it has been reported that front-of-pack nutrition labels have outperformed apps when making food choices (Werle et al., 2024). The favourable responses towards interactive activities will be drawn upon to inform the messaging and tone of the content and may also be a future avenue to explore.

7.2.3.1 Considering the Duration and Follow-up Periods for the Intervention

As part of Study 2, 111 participants were asked to consider the duration that they felt a nutrition label intervention should take in the future. To make the language accessible, 'campaign' was used rather than 'intervention' in the question asked. Participants were asked: '*how long do you think a campaign should last to be effective e.g., one-time point, over a few days, over a week, over a month etc. and why?*'. Ideas for the intervention delivery duration were shared as prompts to help participants to consider options and encourage thoughtful responses. The responses were analysed using frequency content analysis to inform the delivery mode for the implemented intervention (Table 7.6).

Table 7.6

Consumer Preference for Intervention Delivery Duration

Delivery Duration	Frequency	Percentage (%)
Continuous / extended	44	15.57
Week(s) to a month	29	23.77
Periodical awareness events	19	36.07
Month(s) to a year	18	14.75
Day(s) to a week	10	8.20
One-off	2	1.64

The preference for the intervention delivery duration varied. From the content analysis it was evident that continuous/longer-term interventions were favourable to help improve awareness of them. This would be possible with a social media campaign and so aligns with the intended delivery mode. However, as the intervention in the thesis is novel and the aim is to assess the acceptability of the intervention, a shorter duration was more appropriate. This approach was with the aim, if successful, to refine and implement the intervention on a larger scale beyond the thesis. Furthermore, many of the papers included in the systematic review had a single point intervention which further supported the approach taken in the thesis. An immediate pre/post intervention was implemented to assess the immediate effectiveness of the intervention. In addition, based on the week/month duration outlined, and the follow-up periods reported in the systematic review, the follow-up was after 2-weeks. This also aligned with the guidelines for payment on Prolific which was the platform used to recruit the participants for the intervention study.

7.3 The Novel Intervention Infographic

This chapter has so far outlined the key stages and justifications involved in the intervention development. This section focuses on describing the intervention infographic, with particular attention to how the content from the previous chapters and the intervention design stages have informed the content, tone and format of the intervention designed. It also justifies the decisions behind the development of the placebo control infographic.

7.3.1 Intervention Infographic Content

The nutrition label intervention infographic is presented in Figure 7.4. As outlined earlier in this chapter, the content for the intervention infographic has been taken from existing, ‘credible sources’ that consumers can currently access to gain guidance on nutrition labelling (see Chapter 1 for full outline). This credibility was deemed as an important BCT to draw upon based on the empirical findings relating to the lack of trust in nutrition labels shared in Study 2 and previous literature (Mazzù et al., 2022; Seyedhamzeh et al., 2020). Furthermore, content relating to regulation of food labels was included on the infographic to challenge existing beliefs, and to reassure consumers that the information is there to aid their food decisions. The credible sources which informed the infographic were outlined at the bottom of the intervention infographic to state the origins of the content shared.

Figure 7.4

The Nutrition Label Intervention Infographic

The content in the red (first) section of the intervention infographic also focused on the BCTs relating to ‘information about health consequences’. Gain-framed benefits of eating a balanced diet were shared and ‘information about emotional consequences’ were highlighted in relation to how maintaining a balanced diet can make the individual ‘feel great’. Whilst information about emotional consequences was not a BCT reported in Chapter 2, the link to the positive emotion was important to help to combat negative or indifferent attitudes towards nutrition label engagement identified in the findings from Study 2. These aspects of the infographic were focused on educating and persuading the consumer to engage with nutrition labels to demonstrate that engagement is for all adults. There was also a ‘prompt’ to read the food labels as part of the title, so that the key message is readily accessible to the reader.

The orange (second) section of the intervention infographic titled ‘how do I read food labels?’ provided an ‘action plan’ of when to check the front-of-pack nutrition label and provided an ‘instruction on how to perform this behaviour’. It was decided that only information relating to the multiple traffic light front-of-pack nutrition label would be included in the intervention as this was most often referred to in the food choice tasks. This nutrition label was also highlighted as more accessible than the back-of-pack nutrition label in Study 2’s reflexive thematic analysis presented. Whilst the front-of-pack label is voluntary on prepacked products, its implementation on UK manufactured products has increased and it is also typically the first nutrition label presented when purchasing foods online via supermarket websites (Moore et al., 2018b). Thus, targeting this nutrition label was seen as most acceptable to the target audience. The “instruction of behaviour” was provided in the three steps and targeted some of the accessibility and capability concerns raised by participants when sharing their experiences of engaging with nutrition labels.

The green (third) section of the intervention titled ‘the food label reading challenge!’ aimed to draw a ‘commitment’ from consumers by using phrases such as “I will” to reinforce the desired behaviour. This section also included ‘goal setting (behaviour)’ and ‘habit formation’ concepts to encourage motivation to engage with nutrition labels. This section highlighted that the reader should now have higher ‘psychological capability’ relating to why and how to engage with nutrition labels and that this could lead to higher levels of ‘reflective motivation’ to engage with the challenge. In addition, these elements were problem-centred and motivation focused which align with the Adult Learning Theory (Knowles, 1978), which was a theory referred to by Taylor-Davis (2000) in their intervention development (Chapter 2). As the infographic is designed to be displayed on social media the key messages were devised so that they could be digested within a short space of time of less than two minutes (Kite et al., 2023). There was no material incentive for the behaviour included on the infographic. However, participants did receive payment upon study completion based on adequate engagement with all elements of the research as agreed at study sign-up.

To ensure the content was easy to understand across different health literacy abilities the content was checked for readability. This approach was recommended in a previous nutrition label engagement interventions conducted by Brunt and Schafer (1997), which was one of the papers included in the systematic review (Chapter 2). This check can reduce barriers between intervention materials and the intended audience, particularly in relation to the required literacy level needed to understand the content. Following the recommendations The Flesch Reading Ease Formula and the Flesch-Kincaid Grade were calculated for the infographic. For the current infographic, the readability checks showed that The Flesch Reading Ease Formula was 86.0% and the Flesch-Kincaid Grade was 3. These statistics indicated that the intervention content required a basic reading level of primary school age which is easy to digest for the average adult (Dunnett et al., 2025). The statistics for the current infographic were lower than the 6th grade reading level recommended in previous research (e.g., Brunt & Schafer, 1997). Therefore, this suggested that the infographic would be understood by healthy adults, irrespective of their literacy level, which was important as health literacy has been established as a potential contributing factor to consider throughout this thesis.

7.3.2 Intervention Infographic Format and Tone

To communicate the key messages on the intervention infographic the 'G.R.A.P.H.I.C.' principles devised for public health infographic design were drawn upon (Stones & Gent, 2015). 'G' stands for 'Get to know your audience' to help to understand the content and the role that the infographic will plan in behaviour change. Studies 1 and 2 presented in the thesis, along with the literature searches provided insights into the target audience. This helped to inform the tone taken in the messaging on the final infographic and was informed by the engagement in the BCW process for designing interventions (Michie et al., 2011). 'R' relates to Restricting the colour palette on the infographic to between three and five colours and that they should be sensitive to the message of the infographic. Therefore, the background to the infographic was a shade of the NHS blue to reflect the trust and origin of the content shared. The traffic light colouring scheme for each of the three sections was used as a subliminal reminder of the need to check these colours when engaging with the front-of-pack nutrition labels.

‘A’ refers to ensuring that the Alignment of the infographic is clear and consistent. There are three distinct sections to the infographic to separate the content for the consumer and allow for easy navigation to content of interest. The information presented in each of the sections of the infographic is presented in ‘threes’ and they are of a similar length in title and content to ensure visual consistency. This was important as the participants reported barriers to nutrition label engagement based on physical capability and so these experiences highlighted the need for the infographic to be easy to engage with.

The ‘P’ is ensuring that there was a focal Point and used different fonts to prioritise parts of the infographic. The intervention used rhetorical questions to engage the audience and provide a focal point. The first question related to the self-identification of the consumer as someone who consumes prepacked food products: ‘*do you eat prepacked food?*’. This was important as prepacked foods are where consumers engage with the nutrition labels.

‘H’ builds upon the prioritisation by using key Highlighting for headings. There are clear titles for each of the sections that are in larger fonts to draw attention to each section. The use of bold and larger fonts were used to draw attention to the key messages in each section, and a smaller font was used to provide additional content for the reader. This approach was taken to help reduce some of the potential negative emotions relating to feeling overwhelmed or stressed by a potential intervention.

‘I’ relates to ensuring that the Imagery used on the infographic is appropriate and reflects the message and tone of the content shared. There were relevant icons selected to accompany the key messages presented on the infographic to encourage engagement and represent the information presented. Icons were selected rather than product images to reduce copyright issues and to not detract from the key messages shared. The focal image of the front-of-pack nutrition label was used to gain attention and ensure that the reader visually knew what the infographic was focused on. The final part of the ‘G.R.A.P.H.I.C’ guidance is ‘C’ which is related to carefully choosing Charts to present. For the infographic it was decided that the use of a chart may reduce the accessibility of the key messages and potentially lead the reader to disengage if they felt it was too complex. Therefore, a chart was not included in the infographic designed.

The language used on the infographic reflected terms used by the public and the public health information available to help the readability of the information e.g., ‘food label’ rather than ‘nutrition label’ is used (NHS 2022a). Furthermore, the language aims to be clear and friendly to reduce potential emotions relating to the content being patronising or leading to negative impacts on mental health. The challenge phrases ‘get ready’, ‘get set’, ‘go’ and other call-to-action words were used throughout the infographic to encourage motivation to engage with nutrition labels and incite behaviour change.

7.3.3 Placebo Control Infographic

The elements outlined in relation to the design of the intervention infographic were replicated in the placebo control infographic (Figure 7.5). This was to ensure that any changes in the food choice task behaviours and COM-B measures as part of the implementation of the intervention were due to the content presented and not the health behaviour message. This is important as health awareness can inflate behaviour changes compared to a non-health-related placebo (Vandormael et al., 2021). The content and messaging used in the placebo control infographic mirrored the COM-B and BCT decisions made in the nutrition label intervention but focused on teeth brushing. Teeth brushing was chosen as it is related to eating behaviour, so it was an appropriate behaviour to target from a participants' perspective as it was relevant to the wider study but separate to food and nutrition label engagement behaviours. Furthermore, it is a behaviour that has been explored using the COM-B model (Goldthorpe et al., 2024) and has been targeted by BCT informed interventions (Joseph et al., 2021).

Figure 7.5

The Placebo Control Infographic

7.3.4 Pilot Intervention Evaluation

Eight participants completed the pilot phase to test the accessibility and acceptability of the intervention designed and ensure the study was working as intended. Due to the small number of participants, inferential tests were not conducted on the data. Four participants were randomly assigned to the nutrition label ‘intervention’ condition, and four participants were assigned to the ‘control’ condition. The participants completed the full experimental procedure (Section 8.2.3) and this analysis focused on the ratings shared for the intervention received (questions outlined in Section 9.3.2).

Table 7.7 shows the descriptive statistics for each of the evaluation measures by ‘condition’. The mean time spent looking at the infographics were comparable, with higher durations for the nutrition label infographic. The content and delivery ratings for the infographics were favourable, with higher scores reported in the ‘intervention’ condition. There was more range in the ‘control condition’ but still favourable. Likely to recommend was favourable for the nutrition label infographic but not for the control condition. The range of scores indicated variation between the three participants which affected the measure in the ‘control’ condition and, this item is something to consider in future implementation. The three BCTs were rated favourably for both intervention levels, with scores higher for the nutrition label infographic. Overall, the evaluation suggested favourable acceptability towards the content and message presented in the infographics.

Table 7.7

Pilot Study Evaluation Descriptive Statistics

Evaluation measure	Intervention			Control		
	M	*SD*	Range	*M*	*SD*	Range
Time spent (*ms*)	47.40	14.45	32.28-67.02	37.51	4.78	32.45-42.06
Content rating (%)	92.25	10.40	78-100	80.00	28.28	40-100
Delivery (%)	86.00	16.25	70-100	61.50	40.53	16-100
Recommend (%)	89.50	12.15	78-100	48.25	42.25	7-96
Encourage behaviour (%)	74.75	28.58	50-100	64.00	42.90	5-100
Instruction of behaviour (%)	99.75	0.50	99-100	79.25	21.05	49-95
Health consequences (%)	74.75	38.34	19-100	69.00	33.97	25-100

7.4 A Summary of the Chapter Contributions

This chapter demonstrated how key findings and recommendations from earlier chapters and input from the target audience have been used to inform the development of an intervention designed to improve nutrition label engagement in healthy UK adults. This chapter addressed the design element of Thesis Objective 3. The intervention was developed using the stages outlined by Michie et al. (2014) to aid replicability and effectiveness of the intervention delivered. The intervention was outlined and the decisions behind the content, tone and format of the infographics were justified. The pilot study demonstrated effectiveness and acceptability of the intervention designed. The findings from the novel intervention implemented are reported in Chapter 8 and evaluation of the intervention is presented in Chapter 9.

Chapter 8: The Implementation of an Intervention to Improve Nutrition Label Engagement in Healthy UK Adults: A Randomised Controlled Trial

This chapter focuses on reporting the implementation of the intervention designed in this thesis to address this element of Thesis Objective 3. The chapter begins with a brief overview of why the intervention is needed and how the intervention was designed. The methods and results from the intervention implemented are reported, including the baseline, post-intervention and follow-up analyses. The chapter concludes with a discussion of these findings, including interpretation of the findings in relation to the previous literature and how they contribute to the PhD thesis objectives.

8.1 Rationale and Aims

In the UK, nutrition labels presented on prepacked food products aim to encourage healthier dietary choices and reduce energy intake, especially from total fats and sugars (Azman & Sahak, 2014). However, research has suggested inconsistent engagement with, and understanding of, nutrition labels when consumers make food choices (Anastasiou et al., 2019; Campos et al., 2011). This inconsistency can reduce the impact of nutrition labels as a public health initiative to improve the diets of the population and contribute to reducing excessive body weight and non-communicable diseases attributed to dietary choices (Anastasiou et al., 2019; Bialkova & van Trijp, 2011; Graham et al., 2012).

The findings from the systematic review reported in Chapter 2 highlighted that many nutrition label engagement interventions were delivered in-person and potentially time-intensive, which are not feasible to deliver when targeting all healthy adults living in the UK. The approach for intervention delivery was discussed in detail in Chapter 7. In brief, there was support from the empirical research conducted in this thesis and the existing literature for an asynchronous, online intervention (Miller et al., 2018). This was on the premise that an online campaign would reach a wider audience, and that the materials of the intervention, if successful, could be replicated in other environments such as a poster displayed by food retailers, such as in supermarkets. Furthermore, the need for a theory-informed nutrition label engagement intervention was emphasised. This was considered important to ensure the intervention was supported by literature and easily replicated. The BCW (Michie et al., 2011, 2014), including the COM-B model and BCTT (Michie et al., 2013), were used to inform the development of the intervention. The engagement with each stage of the intervention design process was described in Chapters 3 and 7.

The current study aimed to investigate whether the implementation of a nutrition label intervention was effective in improving nutrition label engagement in healthy UK adults, compared to a placebo control condition. This study addressed the intervention implementation element of Thesis Objective 3, three research hypotheses for Study 3 were tested to replicate the analyses from Studies 1 and 2 and to test the effectiveness of the intervention.

> Hypothesis 1: The baseline task performance measures and measures of individual differences analyses will replicate the findings from Studies 1 and 2.

Hypothesis 2: The nutrition label engagement intervention will improve food choice task performance across timepoints compared to the control.

Hypothesis 3: The nutrition label engagement intervention will improve perceived changes in capability, opportunity, motivation and behavioural intent across timepoints compared to the control.

8.2 Method

8.2.1 Design

The study was approved by University of Staffordshire Ethics Committee in January 2025 (Appendix K). Funding was secured for the payment of participants in March 2025 from an internal funding call at University of Staffordshire from the Project Delivery Fund. These funds were released in April 2025.

8.2.1.1 Condition. 'Condition' was a between-groups independent variable with two levels. The first level was the 'intervention' condition, where participants viewed a social media infographic designed to improve nutrition label engagement. The second level was the 'control' condition, where participants viewed a social media infographic designed to improve teeth cleaning (a placebo control).

8.2.1.2 Food Choice Task - Question Type. 'Question type' was a repeated-measures independent variable related to the task demand during the food choice task. For this study there were two levels to this independent variable. The first level was 'purchase', where participants selected their food choices based on the question “*which of these products would you choose if you were looking to purchase one?*”. The second level was ‘health-related’, where participants selected their food choices based on the question “*which of these products would you choose if you were looking to select the healthier one?*”. The ‘nutrient-specific’ condition was not included in this study as the intervention focused on improving engagement with the full nutrition label rather than for singular nutrient comparisons. Section 3.2.3 provided a full explanation of this variable.

8.2.1.3 Food Choice Task – Label Difficulty. ‘Label difficulty’ was a repeated-measures independent variable related to the difficulty of each food pairing and had two levels. The first level was the ‘easy’ condition, where key nutrients were lower in one of the products and these lower values were clearly reflected in the multiple traffic light colours displayed. The second level was the ‘hard’ condition, where the key nutrient values and multiple traffic light colours were similar, making it more difficult for the participant to determine which product is healthier. The ‘moderate’ condition was not included in this study. Section 3.2.4 provided a full explanation of this variable.

8.2.1.4 Timepoint. ‘Timepoint’ was a repeated-measures independent variable related to the time when the measures were completed and had three levels. The first level was ‘baseline’, which related to the pre-intervention measures, these scores were used in the replication analyses and as co-variates in the intervention analyses. The second level was ‘post-intervention’, which related to the immediate post-test measurements completed once the participants had engaged in the intervention condition.

The third level was 'follow-up', which related to the measurements taken at a 2-week post intervention timepoint.

8.2.1.5 Food Choice Task – Performance Measures. Four dependent variables were measured as part of the food choice task. The first dependent variable was 'percentage accuracy', which related to the percentage accuracy of selecting the healthier food option from the pairings during the food choice task. The second dependent variable was 'percentage confidence rating for accurate trials', which was measured on a continuum from 0-100. The third dependent variable was 'confidence bias score', which was the difference between the average overall confidence rating and the average accuracy across the judgments (Stankov & Lee, 2014). The last dependent variable was thought listing 'reasons', which were the reasons behind each food choice the participant made. The reasons were selected from a pre-determined list informed by Study 1 and trialled in Study 2. How these measures were defined and calculated was outlined in Section 4.2.

8.2.1.6 COM-B Self-Evaluation. Perceived 'capability', 'opportunity', 'motivation' and 'behavioural intent' dependent variables were measured at each timepoint using the COM-B self-evaluation questionnaire (Michie et al., 2014). The 11 questions selected from the COM-B self-evaluation questionnaire were adapted to have a focus on nutrition labels. The full details of this scale, including the psychometric properties, were reported in Section 4.2.5.

8.2.1.7 Measures of Individual Differences. To provide context to, and replicate earlier findings for the baseline data, measures of individual differences were collected. The measures collected within this study were: (a) self-perceived weight; (b) self-reported nutrition label use; (c) BMI, calculated by self-reported height and weight; (d) nutrition label health literacy; (e) age; (f) gender; and (g) six food motivation subscales (convenience, habit, health, liking, price and weight control. The full details of the scales, including their psychometric properties where appropriate, were reported in Section 4.2.

8.2.2 Participants

The food choice task performance measures reported in Chapters 5 and 6 yielded a range of effect sizes, with many approaching or above a medium effect size. These effect sizes mirrored the effect sizes, where reported, in the systematic review papers presented in Chapter 2. Therefore, to be conservative, a medium effect size is used within the prospective power analysis for this study. From the prospective power analyses the largest conservative estimate across the research objectives indicated that 140 participants were needed to be recruited for the present study for a medium effect size and power of 0.8 (Clark-Carter, 2024). After interpolation the prospective power analysis indicated that a minimum of 124 participants needed to be recruited for the present study.

8.2.3 Materials and Procedure

8.2.3.1 Consent and Practice Phase. The study took place online via Qualtrics and was hosted on the participant recruitment site *Prolific*. Once participants signed up to participate in the research project, they accessed the Qualtrics study link within their Prolific dashboard. Upon launching the study, participants were presented with a reminder of the guidance relating to the technical requirements of the study. These requirements were outlined in the study filters during sign-up, including that the study must be completed on a device with a screen size of 14-inches or more for the stimuli to be presented correctly. Based on feedback from the pilot phase, there were three calibration checks where a calibration code was presented in different locations to ensure the stimuli would be presented correctly during the study.

After completion of the calibration checks, participants were presented with an electronic information sheet (Appendix L) and electronic consent form (Appendix M). These documents informed the participants what would be expected from them during the study and their withdrawal rights. Participants were asked to provide their electronic consent by selecting the 'agree' option on the consent form, the screen did not move on without this confirmation. After consent was obtained, participants were asked to confirm their *Prolific* unique identifier code, which was presented as embedded text in Qualtrics. This unique identifier ensured anonymity and was the code provided by participants when messaging in the platform about any technical issues, or if they wished to withdraw from the study.

Prolific stores demographic data shared by each participant for researchers to download but participants were asked to share demographic details of age, gender, weight and height, to ensure accuracy of these characteristics as they were used in the analyses. Participants then moved on to the baseline food choice task, which started the same way as the two prior studies, with a practice phase of two example stimuli. The practice phase was included to reduce the stimuli novelty effect and enable participants to familiarise themselves with the nutritional classifications. An overview of the steps of the experimental procedure was shown as a reminder before the main baseline measures were collected. The practice phase duration was approximately 3 minutes.

8.2.3.2 Baseline (Pre-Intervention) Food Choice Task Phase. In the baseline food choice tasks, there were 10 trials for each ‘question type’ condition (20 trials in total). The question changed based on the question block presented. The first block in each phase of the study was the ‘purchase’ condition, and this was followed by a short 20 second break before the ‘health-related’ condition was presented. The paired ready meals were the same for each question block, to control for ‘label difficulty’ and meal types, but the order they were presented was randomised in relation to the sequence, side of the healthier choice and the front-of-pack vs. back-of-pack image being shown first to reduce demand characteristics.

The paired ready meal stimuli were presented for a maximum of 10 seconds. During exposure time, participants read the question posed (‘purchase’ vs. ‘health-related’) to inform their food choice. Participants could switch between the front-of-pack and back-of-pack characteristics once per trial to reflect habitual behaviours, the one switch per trial was adopted after reviewing the average number of switches during the study presented in Chapter 5. Participants who were unable to reach a decision within the 10 second exposure period were asked their choice on a separate screen or participants were able to select ‘unable to reach a decision’. If a participant was unable to reach a decision the next trial began with the next food pairing choice.

Where a participant made a food choice for a trial, they were presented with a visual analogue scale from '*0 = not at all* confident' to '*100 = extremely confident*' to rate their confidence in the food choice they had just made. On the same screen, participants were asked to select from a pre-determined list of reasons regarding the reasons behind the meal choice they had just made. Participants were able to select as many reasons as they felt adequate to reflect the food decision they had made. There was also a free-entry box for participants to share any reasons they felt were not captured in the options so that these could be recorded too. Participants were asked to complete their confidence ratings and food choice reasons within 10 seconds. In total there were 20 trials in the baseline food choice task, a maximum time of 7 minutes was permitted to complete this phase of the study.

8.2.3.3 Measures of Individual Differences and Baseline COM-B Self Evaluation Phase. After the baseline food choice task, participants were asked to complete scales and questions relating to measures of individual differences in food choices and COM-B self-evaluation. This phase of the research had a maximum time of 7 minutes to complete, and timing questions were in place to ensure that participants were not searching for answers. This was to ensure that the answers provided were reflective of participants' usual behaviours and attitudes. A description of these measures, including scoring and psychometric properties was presented in Section 4.2.

The measures were presented in the same order for each participant to minimise demand characteristics: (1) participants completed randomised items from six subscales of 'The Eating Motivation Survey – Brief' (TEMS-B;

Renner et al., 2012); (2) next participants completed the self-perceived weight item "*how do you think of yourself in terms of weight?*" (Robinson et al., 2018). An option to withdraw was presented on the screen at this point due to the sensitivity of the question asked, which if selected took the participant to the debrief of the study. (3) If participants continued, they completed the self-report nutrition label use item "*how often do you use the nutrition label when making a food selection*" (Cha et al., 2014); (4) participants then completed randomised items from the COM-B self-evaluation relating to their nutrition label engagement which measured their perceived: (a) capability; (b) opportunity; (c) motivation; and (d) behaviours. Participants were also able to expand on any of their ratings using textboxes beneath each statement should they wish to. There was an attention measure randomly presented within the COM-B statements to ensure engagement across all timepoints which asked participants to: '*please select a rating of 75 for this rating*'. (5) participants then completed the Newest Vital Sign, which measured nutrition label health literacy (Rowlands et al., 2013).

8.2.3.4 Intervention Implementation Phase. Following the baseline food choice task, measures of individual difference in food choices and COM-B self-evaluation, participants completed a 30 second filler activity to reduce any carryover effects. The filler task involved participants selecting the correct brand from three force-choice options when viewing a series of cropped brand images as quickly as possible (Figure 8.1). This task was chosen as no brands were used in the food choice task, but the task had perceived relevance. The brands were not from ready meals to avoid any priming effects. Scores for the filler task were not analysed, but engagement with the task was checked to ensure it was completed.

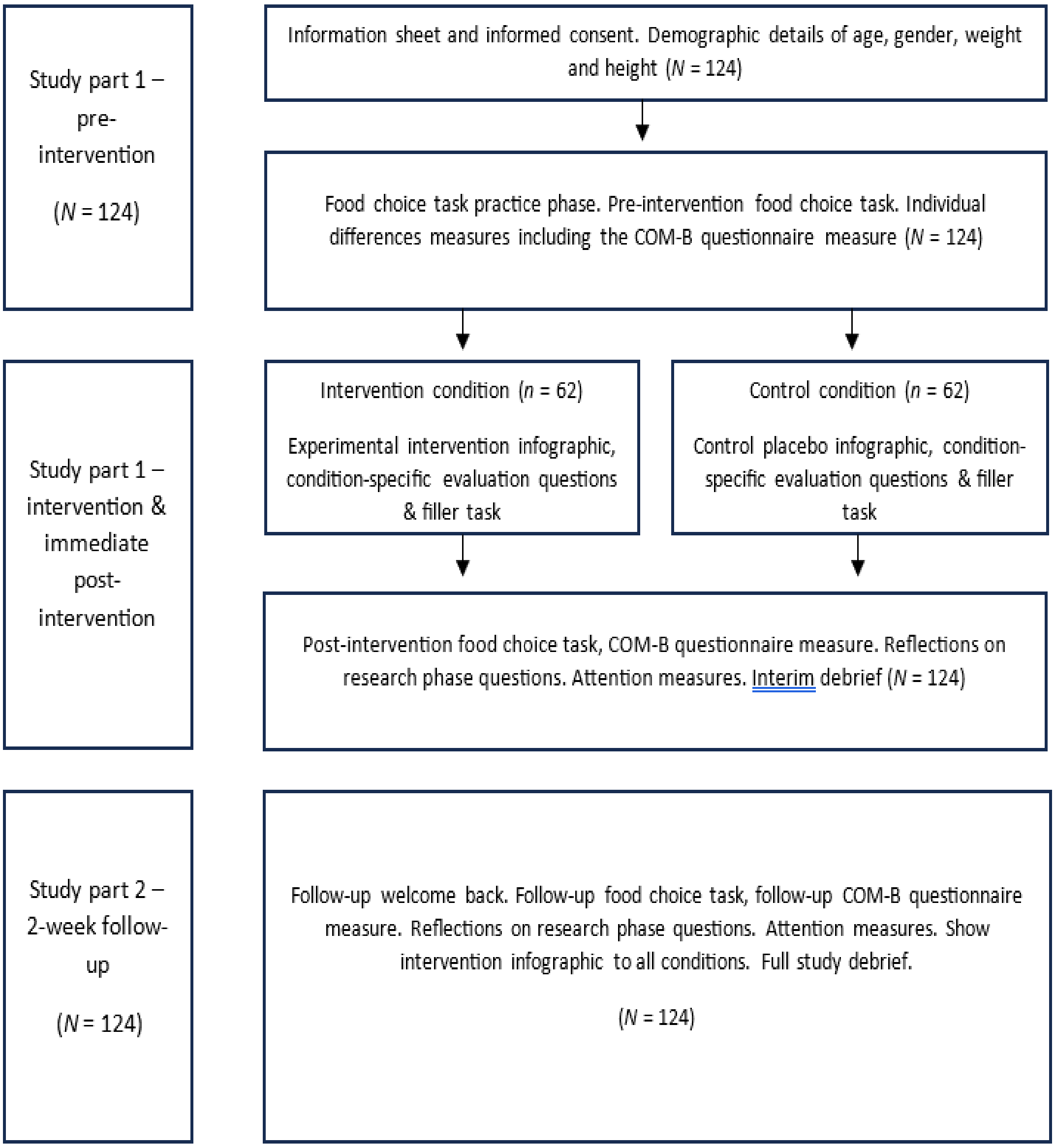
Figure 8.1

Example Stimuli for the Filler Task (Correct Response in Bold)

After completion of the filler task, participants were randomly allocated to view one of two infographics, allocated by Qualtrics at study sign-up (see Figure 8.2). Participants either viewed the 'nutrition label intervention infographic' or the 'placebo control infographic' (the content of these infographics was described in Chapter 7) for a minimum time of 30 seconds and a maximum time of 2 minutes.

Figure 8.2

Intervention Study Flowchart with Minimum Participant Numbers Needed Per Condition



Following the intervention delivery, participants were asked evaluation questions based on the infographic viewed, these findings are presented in Chapter 9. Participants were then presented with a 30 second post-intervention filler task following the same structure as the first filler task.

8.2.3.5 Post-Intervention Food Choice Task and COM-B Self Evaluation. Following the second filler task, participants were asked to complete the post-intervention food task to assess behaviour changes in food choice behaviour following the intervention. The post-intervention food choice task comprised 20 trials, ten trials in the ‘purchase’ condition followed by ten trials in the ‘health-related’ condition. The stimuli were randomised and the procedure followed the same structure as outlined in the baseline procedure. There was an optional 20-second break offered between each of the ‘question type’ conditions.

Participants were then asked to complete the post-intervention COM-B self-evaluation measure so that any changes in perceived capability, opportunity, motivation and behavioural intent could be measured. Options to withdraw were presented throughout this stage of the study. Upon completion of the post-intervention COM-B measure, participants were asked to provide any final thoughts on their participation in phase one of the research study. This was followed by the completion of two attention questions to check for answer quality: (1) to what extent they felt they paid attention during the study; and (2) to what extent they felt they completed the study to the best of their ability. These attention checks were responded to on a continuous scale from 1 (highly distracted / not to the best of my ability) to 10 (highly attentive / to the very best of my ability). All participants passed the attention checks. Participants were then presented with the study interim debrief sheet (Appendix N).

8.2.3.6 Intervention Follow-up Phase. The study link for the follow-up phase of the research was available in participants' *Prolific* dashboard two weeks after the first phase was completed. Participants were assigned in *Prolific* to the appropriate follow-up study link based on whether they were assigned to the ‘nutrition label intervention condition’ or the ‘placebo control condition’ in the first phase of the study. Participants had 5 days from when the follow-up study link was made available to complete this phase of the study. Participants received an invite message within *Prolific* once the link was available for them to complete as a reminder that the follow-up phase of the research study was available to complete and if not completed within 2 days the researcher sent a follow-up reminder.

After the follow-up study link was launched participants were thanked for returning to complete the second phase of the research study. This was followed by the display of the same study set-up technical reminders as they received in the first phase of the study and a reminder that there were timed tasks during the study which required their full attention. A withdrawal option was presented on this screen in case participants did not wish to complete the follow-up phase of the study. Participants then completed two calibration screens that ensured that the food choice task stimuli would be presented correctly. Once the calibration screens were passed the participants were asked to check that their auto-filled *Prolific* ID was correct and to amend it if required. Participants then read a “welcome to phase two of the research study” and were reminded that this phase of the research would last approximately 15 minutes.

Participants were provided with the food choice practice instructions to re-introduce them to the food choice tasks. After pressing the ‘next’ button participants then went through the same two practice trials from the first study practice phase to re-familiarise the participants with the food choice task. Participants then completed the follow-up food choice task. This comprised 20 trials, ten trials in the 'purchase' condition followed by a short optional 20 second break, then ten trials in the 'health-related' condition. The stimuli were randomised and the procedure was the same as outlined in the baseline phase of the study. Participants then completed the follow-up COM-B self-evaluation followed by the same attention checks presented at the end of phase one of the study (all participants passed these). Participants were provided with an opportunity to rate and provide their thoughts about their overall study experience, these findings are reported in Chapter 9.

The two infographics were shown side-by-side, with a brief description of how they were developed, at the end of the study. This ensured that any potential positive effects of the infographics were shared with all participants. Participants had the option to provide any thoughts on the infographics before pressing the next button to be presented with the full end of study debrief (Appendix O). The researcher reviewed submissions and approved payment within 24 hours of phase two completion. Where participants did not complete the follow-up phase of the research their payment was processed for completion of the first phase of the research after their follow-study window had closed.

8.2.4 Analysis

The baseline analyses (Hypothesis 1) focused on replicating analyses reported in Studies 1 and 2. Therefore, they employed the same approaches as outlined previously. The justification for data screening and assumption check thresholds and the stages of the analyses were outlined in Section

4.4.1. Hypotheses 2 and 3 were tested by rmAN(c)OVAs with intention-to-treat analyses conducted. Where participants were lost at follow-up (n = 7), their post-intervention scores were used. Intention-to-treat analysis was not conducted for participants who closed the study before providing consent/withdrew their data as this would be unethical. The outcome of sensitivity analyses supported the original analyses, therefore the original analyses are reported. In addition to the univariate assumption checks outlined in Section 4.4.1, multivariate checks were conducted. For these analyses the dependent variable was normally distributed whilst controlling for the covariates and the relationships between these variables at each level of the independent variables were linear. There were no multivariate outliers present across the analyses. Where there was a violation of homogeneity regression slopes the non-parametric ANCOHET is reported.

8.3 Results

8.3.1 Participant Demographics

This analysis was conducted on a total of 140 participants (intervention condition n = 70, control condition n = 70). Table 8.1 shows the mean age of the overall sample was 41.16 years (*SD* = 11.96, range = 19-75 years), with similar mean ages observed between the conditions. Self-reported label use was moderate, with higher self-reported label use observed in the ‘intervention’ condition compared to the control ‘condition’. Higher motivations for eating foods based on *liking* and *habit* and lower motivations for *weight control* were reported overall and per ‘condition’ (Table 8.1).

Table 8.1

Age, Self-Reported Label Use and Motivations for Food Choice Participant Characteristics by Condition and Overall Sample

Baseline characteristic	Intervention (n = 70)		Control (n = 70)		Full sample (N = 140)	
	M	*SD*	*M*	*SD*	*M*	*SD*
Age	40.70	11.54	41.61	12.44	41.16	11.96
Self-reported Use	3.39	1.15	2.94	1.14	3.16	1.16
Motivator						
Liking	6.09	0.66	6.17	0.68	6.13	0.67
Habit	4.99	1.07	5.23	0.93	5.11	1.01
Convenience	4.72	1.05	5.00	1.27	4.86	1.17
Price	4.17	1.28	4.33	1.25	4.25	1.26
Health	4.69	1.22	4.30	1.28	4.49	1.26
Weight control	3.95	1.52	3.54	1.32	3.75	1.43

Table 8.2 shows 37.44% of participants identified as female. BMI scores, calculated from self-reported height and weight measures, indicated 83.57% of the sample had excessive body weight (M = 31.79kg/m^2, SD = 7.94; intervention condition M = 32.37kg/m^2, SD = 8.27; control condition M = 31.21kg/m^2, SD = 7.61). The BMI weight categorisation indicated higher rates of excessive body weight than the UK average. Table 8.2 indicates participants had a relatively poor awareness of their BMI based on their self-perceived weight; 56.43% of the sample perceived their weight to be in an

overweight category. Study completion rate at follow-up was 95% (control condition = 97% completion rate; intervention condition = 92.86%).

Table 8.2

Sex, BMI, Self-Perceived Weight and Health Literacy Participant Characteristics by Condition and Overall Sample

Baseline characteristic	Intervention (*n* = 70)		Control (*n* = 70)		Full sample (*N* = 140)	
	n	%	*n*	%	*n*	%
Sex						
Female	29	41.43	23	32.86	52	37.14
Male	41	58.57	47	67.14	88	62.86
BMI						
Underweight	0	0	1	1.43	1	0.71
Normal weight	9	12.86	13	18.57	22	15.71
Overweight	24	34.29	24	34.29	48	34.29
Obese	37	52.86	32	45.71	69	49.29
Self-perceived weight						
Very underweight	0	0	0	0	0	0
Underweight	3	4.29	2	2.86	5	3.57
About the right weight	27	38.57	29	41.43	56	40.00
Slightly overweight	28	40.00	27	38.57	55	39.29
Very overweight	12	17.14	12	17.14	24	17.14
Health literacy						
50% or greater likelihood limited	21	30.00	30	42.86	51	36.43
25% likelihood limited	25	35.71	21	30.00	46	32.86
Adequate	24	34.29	19	27.14	43	30.71

8.3.1.2 Individual Differences at Baseline Based on Condition.

There is debate within the literature on whether researchers should perform significance testing on baseline differences (de Boer et al., 2015). Individual differences have been measured throughout the thesis and so it was deemed important to assess differences at baseline for each condition so that the effects could be considered as part of the analyses. Table 8.3 outlines the outcomes of independent *t* tests conducted on the individual differences for each condition at baseline. The findings indicated that self-reported label use was significantly higher in the 'intervention condition' compared to the 'control condition' at baseline. This conclusion is considered when interpreting the outcomes of the intervention analyses. There were no further significant differences for individual differences between the conditions reported at baseline.

Table 8.3

Baseline Differences in Individual Differences Measures Between the Intervention Conditions

Characteristic	Intervention condition (*n* = 70)		Control condition (*n* = 70)		*t*(140)	*p*	Cohen's *d*
	M	*SD*	*M*	*SD*			
Age	40.70	1.38	41.61	12.44	-0.45	.653	-.08
BMI	32.37	8.27	31.21	7.61	0.87	.387	.15
Convenience	4.72	1.05	5.00	1.27	-1.45	.149	-.25
Habit	4.99	1.07	5.23	0.93	-1.43	.154	-.24
Health	4.69	1.22	4.30	1.28	1.83	.070	.31
Liking	6.09	0.66	6.17	0.68	-0.67	.502	-.11
Health literacy	2.61	1.88	2.29	1.90	1.03	.304	.17
Price	4.17	1.28	4.33	1.25	-0.76	.450	-.13
Self-perceived weight	3.70	0.80	3.70	0.79	0.00	1.000	.00
Self-reported label use	3.39	1.15	2.94	1.14	2.29	.023	.39
Weight control	3.95	1.52	3.54	1.32	1.70	.091	.29

8.3.2 Hypothesis 1: Baseline Replication Performance Analyses and Individual Differences as Predictors

The means in Table 8.4 indicated similar values across 'question type' for percentage accuracy, percentage confidence ratings for accurate trials and confidence bias scores. This pattern of means did not replicate those reported in Studies 1 and 2. The means for Study 3 indicated higher accuracy, percentage confidence ratings and less over-confidence in the 'easy' compared to the 'hard' condition. This replicated the previous findings, with the exception that confidence bias scores were under-confident in the previous studies rather than less over-confident. Based on the combined 'question type' and 'label difficulty' conditions, the means indicated higher accuracy, percentage confidence ratings for accurate trials and the least under-confidence in the 'purchase' condition (Table 8.4). This finding did not replicate the direction of means reported in Studies 1 and 2.

Table 8.4

The Means and Standard Deviations for the Food Choice Task Performance Measures for Each Condition

Label Type	Purchase		Health-Related		Average	
	M (%)	*SD*	*M*n (%)	*SD*	*M* (%)	*SD*
	Percentage accuracy (%) (*N* = 140)					
Easy	66.14	23.98	64.00	25.52	65.07	20.97
Hard	53.57	22.92	53.00	23.00	53.29	17.97
Average	59.86	16.96	58.50	16.79		
	Percentage confidence for accurate trials (%) (*N* = 117)					
Easy	73.07	16.60	72.79	17.88	72.93	16.33
Hard	72.05	17.84	71.82	18.92	71.94	16.99
Average	72.56	16.09	72.31	17.81		
	Confidence bias scores (*N* = 134)					
Easy	.06	.30	.08	.32	.07	.27
Hard	.18	.28	.17	.28	.18	.23
Average	.12	.23	.13	.24		

8.3.2.1 Baseline Percentage Accuracy Analysis. A 2 ('question type') by 2 ('label difficulty') rmANOVA was conducted on percentage accuracy (*N* = 140). There was a significant main effect of 'label difficulty' on percentage accuracy, $F_{(1, 139)} = 25.78$, $p < .001$, $\eta^2 = .08$. Percentage accuracy was significantly higher in the 'easy' compared to the 'hard' condition ($p < .001$, *M* diff = 11.79, 95% CI = 7.20, 16.38). This replicated the findings reported in Studies 1 and 2. There was a non-significant main effect of 'question type' on percentage accuracy ($F_{(1, 139)} = 0.70$, $p = .404$, $\eta^2 = .001$), which did not replicate the findings reported in Studies 1 and 2. There was a non-significant interaction observed between 'question type' and 'label difficulty' on percentage accuracy ($F_{(1, 139)} = 0.22$, $p = .637$, $\eta^2 = .0003$), which replicated the findings from Study 2.

8.3.2.2 Baseline Percentage Confidence Ratings for Accurate Trials. A 2 ('question type') by 2 ('label difficulty') rmANOVA was conducted on percentage confidence ratings for accurate trials (*N* = 117). There was a non-significant main effect of 'question type' on percentage confidence ratings ($F_{(1, 116)} = 0.07$, $p = .787$, $\eta^2 = .0001$). There was a non-significant main effect of 'label difficulty' on percentage confidence ratings ($F_{(1, 116)} = 1.96$, $p = .165$, $\eta^2 = .001$). There was a non-significant interaction between 'question type' and 'label difficulty' on percentage confidence ratings for accurate trials ($F_{(1, 116)} = 0.001$, $p = .970$, $\eta^2 = .000001$). The findings replicated the non-significant findings between 'purchase' and 'health-related' conditions reported in Studies 1 and 2, but not the significantly higher confidence ratings for the 'easy' compared to 'hard' condition reported in Study 1.

8.3.2.3 Baseline Confidence Bias Scores. A 2 ('question type') by 2 ('label difficulty') rmANOVA was conducted on confidence bias scores (*N* = 134). There was a significant main effect of 'label difficulty' on confidence bias scores, $F_{(1,133)} = 18.78$, $p < .001$, $\eta^2 = .03$. There was significantly less over-confidence in the 'easy' compared to the 'hard' condition ($p < .001$, *M* diff = -.10, 95% CI = -.15, -.06). This replicated the findings reported in Studies 1 and 2. There was a non-significant main effect of 'question type' on confidence bias scores ($F_{(1,133)} = 0.21$, $p = .645$, $\eta^2 = .0002$). This finding did not replicate those reported in Studies 1 and 2. There was a non-significant interaction between 'question type' and label difficulty' on confidence bias scores ($F_{(1,133)} = 0.92$, $p = .340$, $\eta^2 = .01$). This finding did support the outcomes reported in Studies 1 and 2.

8.3.2.4 Food Choice Task Reasons. The thought listing reasons provided after each decision made were analysed per 'question type' condition across the 20 baseline trials (*N* = 2,800 trials). When a decision was not reached by a participant no reason was provided, thus these trials were not included in this analysis. The percentages for when the nutrient-5 information was listed as a reason were calculated. The data is reported descriptively to provide insights into when participants provided a nutrient-5 reason for their food choices. Table 8.5 shows the nutrient-5 reasons were shared across the three 'question type' conditions. The percentages were similar across all conditions, which did not replicate the findings from Studies 1 and 2.

Table 8.5

Percentage of Nutrient-5 Reasons Reported Across Accurate and Inaccurate Decisions for Each Question Type

Condition	Accurate (%)		Inaccurate (%)	
	Label as a reason	Label not as a reason	Label as a reason	Label not as a reason
Purchase	38.65	22.92	16.24	22.19
Health-related	38.63	21.86	15.81	23.71

Percentages were calculated for overall accurate and inaccurate choices per 'question type' to provide additional insights into nutrient-5 reasons. The percentages were similar across the conditions and did not replicate the previous empirical findings. For Study 3 the percentages indicated 63.86% of accurate 'health-related' trials had nutrient-5 reasons (*n* = 819 trials) compared to 62.77% of 'purchase' trials (*n* = 838 trials). The percentages indicated that 42.26% of inaccurate 'purchase' trials had nutrient-5 reasons (*n* = 523 trials) compared to 40.00% in the 'health-related' trials (*n* = 535 trials).

8.3.2.5 Predictors of Purchase Food Choice Task Percentage Accuracy. A simultaneous multiple regression was conducted to explore the predictive relationship between measured individual differences and overall 'purchase' percentage accuracy (N = 140). The overall regression model was significant, R^2 = .23, $F_{(12,139)}$ = 3.23, p <.001. Adjusted R^2 = .16 and R^2_{Press} = -.06 statistics were not similar to the original R^2 statistic and questioned the validity of the model. The findings from the regression model did not replicate the outcome of the regression models from the previous empirical studies. Similar to the previous two studies, the model validity was questioned. Of the predictors, health literacy, health food motivation and weight control motivations were significant individual predictors, but no other predictors were significant (Table 8.6). Weight control as a significant individual predictor replicated the finding in Study 1.

Table 8.6

Individual Differences as Predictors of Purchase Food Choice Task Percentage Accuracy

Predictor	β	95% CI		*p*
		LL	*UL*	
Constant		-6.20	66.48	.103
Label use	.18	-0.27	5.54	.075
Age	.06	-0.15	0.32	.463
Sex[a]	-.02	-6.18	4.94	.826
Health literacy	.29	1.18	4.12	<.001
BMI	-.14	-0.74	0.14	.178
Self-perceived weight	.11	-2.42	7.22	.327
Liking	.13	-0.98	7.46	.132
Habits	-.01	-3.34	3.08	.936
Health	-.29	-7.23	-0.62	.020
Convenience	.08	-1.82	4.08	.450
Price	-.16	-4.70	0.27	.081
Weight control	.33	0.99	6.82	.009

Note. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.

[a]0 = male, 1 = female

8.3.2.6 Predictors of Health-Related Food Choice Task Percentage Accuracy. A simultaneous multiple regression was conducted to explore the predictive relationship between measured individual differences and overall 'health-related' percentage accuracy (N = 140). The overall regression model was significant, R^2 = .25, $F_{(12,139)}$ = 3.49, p <.001. Adjusted R^2 = .18 and R^2_{Press} = -.01 statistics were not similar to the original R^2 statistic and questioned the validity of the model. The outcome of the model did not replicate the outcome of the regression models reported in Studies 1 and 2. Similar to the previous two studies, the model validity was questioned.

Of the predictors, self-reported label use, nutrition label health literacy, BMI, and weight control motivations were significant individual predictors, but no other predictors were significant (Table 8.7). Self-reported label use and nutrition label health literacy as significant individual predictors replicated findings from Studies 1 (self-reported label use) and 2 (nutrition label health literacy), but the overall model in these studies were non-significant. A sensitivity analysis conducted once outliers had been removed (N = 132) confirmed the significant regression model and individual predictors, except for BMI which was a non-significant predictor in the sensitivity analysis. Therefore, this finding should be interpreted with caution.

Table 8.7

Individual Differences as Predictors of Health-Related Food Choice Task Percentage Accuracy

Predictor	β	95% CI		*p*
		LL	*UL*	
Constant		-20.09	51.17	.390
Label use	.22	0.26	5.96	.033
Age	.12	-0.16	0.30	.553
Sex[a]	-.09	-8.59	2.30	.255
Health literacy	.67	0.04	2.92	.044
BMI	-.21	-0.89	-.02	.040
Self-perceived weight	.20	-0.54	8.92	.082
Liking	.04	-3.08	5.20	.614
Habits	.02	-2.79	3.50	.825
Health	-.11	-4.66	1.82	.386
Convenience	.11	-1.26	4.52	.266
Price	.06	-1.70	3.18	.548
Weight control	.31	0.80	6.52	.013

Note. CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.

[a]0 = male, 1 = female

8.3.3 Hypothesis 2: Intervention Food Choice Tasks – Performance Analyses

8.3.3.1 Percentage Accuracy Analysis. The means in Table 8.8 indicated higher accuracy scores across 'question type' and 'label difficulty' for the 'intervention' compared to the 'control' condition. Accuracy scores improved in the 'intervention' condition across the timepoints for the 'health-related' condition, with the highest accuracy scores reported at 'follow-up'. However, the accuracy scores were similar across the timepoints for the 'purchase' condition, with a slight decrease in the 'easy' condition at 'follow-up'. The means suggested that the intervention improved accuracy across the 'label difficulty' conditions in the 'health-related' condition but not in the 'purchase' condition. The 'control' condition had the same pattern of means as reported for the 'intervention' condition.

A 2 ('timepoint') by 2 ('question type') by 2 ('label difficulty') by 2 ('condition') mixed ANOVA was conducted on percentage accuracy (N = 140). Table 8.9 shows significant main effects of 'question type' and 'label difficulty' on accuracy. Accuracy was significantly higher in the 'health-related' compared to the 'purchase' condition (p <.001, M diff = 4.93, CI 95% = 2.58, 7.28). Accuracy was significantly higher in the 'easy' compared to the 'hard' condition (p <.001, M diff = 15.43, CI 95% = 11.31, 19.54). However, after adjusting for the co-variates the main effects of 'question type' and 'label difficulty' were non-significant.

Table 8.8

Descriptive Statistics for Percentage Accuracy for Each Condition

Label type	Intervention (*N* = 70)						Control (*N* = 70)						Total (*N* = 140)	
	Purchase			Health-related			Purchase			Health-related				
	M	*SD*	M_{Adj}	*M*	*SD*	M_{Adj}	*M*	*SD*	M_{Adj}	*M*	*SD*	M_{Adj}	*M*	*SD*
							Baseline							
Easy	68.29	24.67	-	64.57	25.29	-	64.00	23.24	-	63.43	25.93	-	66.43	21.87
Hard	54.86	23.27	-	54.00	25.10	-	52.29	22.66	-	52.00	20.82	-	54.43	18.39
Total	61.57	18.15	-	59.29	17.56	-	58.14	15.63	-	57.71	16.08	-		
							Post-intervention							
Easy	68.57	27.99	68.72	72.57	28.93	71.68	66.29	28.40	66.07	68.86	30.58	69.75	70.57	23.52
Hard	54.86	23.76	54.34	53.71	27.57	54.58	52.57	28.11	53.09	51.43	28.40	50.57	54.29	18.14
Total	61.71	18.49	-	63.14	18.92	-	59.43	16.84	-	60.14	18.06	-		
							Follow-up							
Easy	65.43	28.87	64.41	78.00	24.35	77.78	62.29	27.98	63.31	76.57	24.78	76.79	71.71	22.46
Hard	55.43	21.31	53.85	63.14	23.25	62.66	51.71	20.57	53.29	52.28	24.62	52.77	59.29	16.09
Total	60.43	17.32	-	70.57	18.25	-	57.00	17.88	-	64.43	15.94	-		

Table 8.9

Effects of Interest from Mixed ANOVA and ANCOVA Outcomes for Percentage Accuracy

Effect	ANOVA			ANCOVA		
	F	*p*	η^2	*F*	*p*	η^2
Timepoint	3.20	.076	.001	0.22	.641	.0001
Question type	17.22	<.001	.008	1.37	.245	.001
Label difficulty	54.97	<.001	.08	0.0003	.986	.0000001
Condition	2.86	.093	.005	2.19	.141	.003
Timepoint * question type	9.87	.002	.005	0.09	.769	.00005
Timepoint * label difficulty	0.22	.643	.00008	2.39	.124	.001
Timepoint * condition	0.92	.339	.003	0.08	.778	.00004
Question type * label difficulty	4.25	.041	.004	0.08	.773	.0001
Question type * condition	0.52	.472	.002	1.36	.246	.001
Label difficulty * condition	0.27	.607	.0004	0.26	.612	.0005
Timepoint * question type * label difficulty * condition	.63	.430	.0005	0.19	.664	.0002

Note. ANOVA *df* = 1, 138; ANCOVA *df* = 1, 125.

There was a significant interaction between ‘question type’ and ‘timepoint’ for percentage accuracy. Table 8.10 shows significantly higher accuracy in the ‘follow-up health-related’ condition compared to the ‘post-intervention health-related’ and the ‘follow-up purchase’ conditions. In addition, there was a significant interaction between ‘question type’ and ‘label difficulty’ for accuracy. Table 8.8 shows significantly higher accuracy in the ‘easy’ compared to the ‘hard’ condition for both ‘question type’ conditions.

Accuracy was also significantly higher in the ‘health-related’ compared to the ‘purchase’ condition for the ‘easy’ condition. However, after adjusting for the co-variates these interactions were non-significant. There were non-significant main effects of ‘timepoint’ and ‘condition’ on accuracy and the remaining interactions of interest were non-significant (Table 8.10).

Table 8.10

The Simple Effects for the Interaction for Each Comparison for Percentage Confidence Ratings for Accurate Trials

Comparisons	M_1 (%)	M_2 (%)	*M* Diff (%)	95% CI		*p*
				LL	*UL*	
			Purchase			
Post vs. follow-up	60.57	58.71	1.86	-1.59	5.31	.289
Easy vs hard	65.64	53.64	12.00	6.79	17.21	<.001
			Health-related			
Post vs. follow-up	61.64	67.50	-5.86	-8.96	-2.75	<.001
Easy vs. hard	74.00	55.14	18.86	13.53	24.18	<.001
			Post timepoint			
Purchase vs. health-related	60.57	61.64	-1.07	-4.55	2.41	.543
			Follow-up timepoint			
Purchase vs. health-related	58.71	67.50	-8.79	-12.06	-5.51	<.001
			Easy			
Purchase vs. health-related	65.64	74.00	-8.25	-12.32	-4.39	<.001
			Hard label			
Purchase vs. health-related	53.64	55.14	-1.50	-5.61	2.61	.472

Note. Bonferroni adjustments made so alpha level to determine significance held at p <.05. CI = confidence interval; *LL* = lower limit; *UL* = upper limit.

8.3.3.2 Percentage Confidence Ratings Analysis. The means in Table 8.11 indicated similar confidence ratings for accurate trials across 'question type' and 'label difficulty' for the 'intervention' compared to the 'control' condition. The confidence ratings in the 'intervention' condition reduced slightly across the timepoints for the 'purchase' condition and reduced at 'follow-up' for the 'health-related' condition. However, the means were similar across the task conditions. The 'control' condition had similar means, with slight increases in confidence ratings in the 'purchase' condition and slight reduction at 'follow-up'.

A 2 ('timepoint') by 2 ('question type') by 2 ('label difficulty') by 2 ('condition') mixed ANOVA was conducted on percentage confidence for accurate trials (N = 103). None of the main effects or interactions of interest were significant for percentage confidence for accurate trials (Table 8.12). These outcomes remained consistent when adjusting for baseline percentage confidence ratings for accurate trials as a covariate.

Table 8.11

Descriptive Statistics for Percentage Confidence for Accurate Trials for Each Condition

Label type	Intervention (N = 55)						Control (N = 48)						Total (N = 103)	
	Purchase			Health-related			Purchase			Health-related				
	M	SD	M_{Adj}	M	SD	M_{Adj}	M	SD	M_{Adj}	M	SD	M_{Adj}	M	SD
							Baseline							
Easy	72.36	17.40	-	71.14	18.34	-	72.07	16.30	-	72.06	16.74	-	72.05	16.09
Hard	71.78	16.86	-	70.26	19.70	-	70.44	20.25	-	70.94	18.43	-	71.19	17.30
Total	72.58	15.39	-	70.99	18.26	-	71.69	17.37	-	71.78	16.98	-		
							Post-intervention							
Easy	72.79	17.47	72.86	71.38	18.01	71.46	72.45	17.16	72.35	71.07	18.23	70.97	71.93	16.50
Hard	69.70	19.68	70.10	71.68	18.79	71.77	71.05	18.40	70.93	70.14	19.17	70.03	70.72	18.03
Total	71.38	17.20	-	71.53	17.56	-	71.75	17.16	-	70.60	17.48	-		
							Follow-up							
Easy	71.47	17.78	71.55	70.01	18.11	70.09	72.21	17.52	72.12	73.41	17.58	73.31	71.71	16.76
Hard	70.24	18.73	70.32	69.68	20.01	69.77	72.40	17.64	72.31	69.43	19.13	69.32	70.40	17.25
Total	70.85	17.07	-	69.84	17.94	-	72.31	16.95	-	71.42	17.50	-		

Table 8.12

Effects of Interest from Mixed ANOVA and ANCOVA Outcomes for Percentage Confidence for Accurate Trials

Effect	ANOVA			ANCOVA		
	F	*p*	η^2	*F*	*p*	η^2
Timepoint	0.04	.835	.0003	1.65	.202	.001
Question type	0.14	.705	.0004	0.003	.957	.000001
Label difficulty	3.56	.062	.001	2.57	.112	.001
Condition	0.04	.844	.0003	0.05	.820	.0001
Timepoint * question type	0.14	.705	.00004	2.22	.139	.001
Timepoint * label difficulty	0.02	.898	.000004	0.05	.831	.00001
Timepoint * condition	.78	.379	.001	0.81	.371	.001
Question type * label difficulty	0.003	.956	.000001	0.67	.414	.0002
Question type * condition	0.14	.705	.0001	0.14	.708	.0001
Label difficulty * condition	0.15	.698	.00005	0.16	.691	.00005
Timepoint * question type * label difficulty * condition	0.35	.557	.0001	0.35	.554	.0001

Note. ANOVA *df* = 1, 101; ANCOVA *df* = 1, 99.

8.3.3.3 Confidence Bias Analysis. The means in Table 8.13 indicated similar levels of confidence bias at ‘baseline’ and ‘post-intervention’ for both ‘conditions’, but lower over-confidence in the ‘intervention’ condition at ‘follow-up’ compared to the ‘control’ condition. At ‘post-intervention’ both conditions changed from over-confidence in the ‘purchase’ condition to ‘under-confidence’, but these scores returned close to baseline at ‘follow-up’.

The ‘intervention’ condition had less over-confidence in the ‘purchase’ compared to the ‘health-related’ condition at ‘baseline’ and ‘post-intervention’, but under-confidence in the ‘health-related’ condition at ‘follow-up’. There was a higher level of over-confidence for ‘hard’ compared to ‘easy’ conditions in both ‘conditions’. The ‘control’ condition had similar over-confidence means for ‘question type’ at baseline followed by ‘under-confidence’ for the ‘purchase’ condition at ‘post-intervention’ and less over-confidence for the ‘health-related’ compared to the ‘purchase’ condition at ‘follow-up’.

A 2 (‘timepoint’) by 2 (‘question type’) by 2 (‘label difficulty’) by 2 (‘condition’) mixed ANOVA was conducted on confidence bias (N = 140). Table 8.14 shows significant main effects of ‘timepoint’, ‘question type’ and label difficulty’ on confidence bias. After adjusting for baseline confidence bias the significant main effects outlined remained. There was significantly greater over-confidence at ‘follow-up’ compared to ‘post-intervention’ (p <.001, M diff = .15, CI 95% = .11, .20). There was significantly greater over-confidence for the ‘health-related’ condition compared to the ‘purchase’ condition (p <.001, M diff = .13, CI 95% = .09, .17). There was significantly greater over-confidence for the ‘hard’ condition compared to the ‘easy label condition’ (p <.001, M diff = .14, CI 95% = .10, .18).

Table 8.13

Descriptive Statistics for Confidence Bias Scores for Each Condition

Label type	Intervention (N = 68)						Control (N = 70)						Total (N = 138)	
	Purchase			Health-related			Purchase			Health-related				
	M	SD	M_{Adj}	M	SD	M_{Adj}	M	SD	M_{Adj}	M	SD	M_{Adj}	M	SD
Baseline														
Easy	.03	.31	-	.08	.29	-	.08	.28	-	.08	.32	-	.07	.27
Hard	.17	.26	-	.16	.28	-	.19	.30	-	.18	.28	-	.18	.23
Total	.10	.24	-	.12	.22	-	.13	.23	-	.13	.23	-		
Post-intervention														
Easy	-.31	.46	-.31	.00	.33	-.002	-.31	.45	-.31	.02	.36	.09	-.15	.31
Hard	-.17	.41	-.17	.16	.31	.16	-.18	.43	-.18	.17	.35	.18	.00	.28
Total	-.24	.40	-	.08	.25	-	-.25	.38	-	.09	.27	-		
Follow-up														
Easy	.04	.38	.04	-.07	.29	-.07	.09	.37	.02	-.03	.34	-.03	.01	.30
Hard	.14	.29	.14	.06	.25	.06	.18	.28	.17	.17	.29	.18	.14	.24
Total	.09	.28	-	-.01	.22	-	.14	.29	-	.07	.26	-		

Table 8.14

Effects of Interest from Mixed ANOVA and ANCOHET Outcomes for Confidence Bias Scores

Effect	ANOVA			ANCOHET		
	F	*p*	η^2	*F*	*p*	η^2
Timepoint	44.86	<.001	.04	25.04	<.001	.02
Question type	42.66	<.001	.03	16.73	<.001	.01
Label difficulty	47.73	<.001	.03	48.73	<.001	.04
Condition	1.22	.271	.003	0.27	.602	.0004
Timepoint * question type	98.02	<.001	.07	54.05	<.001	.04
Timepoint * label difficulty	0.44	.510	.0001	0.47	.497	.0001
Timepoint * condition	2.05	.154	.002	1.76	.187	.002
Question type * label difficulty	2.38	.125	.001	1.00	.320	.0005
Question type * condition	0.18	.674	.0001	.143	.706	.0001
Label difficulty * condition	0.09	.763	.0001	0.03	.858	.00003
Timepoint * question type * label difficulty * condition	0.48	.491	.06	0.20	.658	.0001

Note. df = 1, 139 for all effects.

There was a significant interaction between ‘timepoint’ and ‘question type’ (Table 8.14). After adjusting for baseline confidence bias the significant interaction remained ($F_{(1, 130)}$ = 54.05, *p* <.001, η^2 = .04). There was significantly greater over-confidence in the ‘purchase’ condition at ‘follow-up’ compared to ‘post-intervention’ (*p* <.001, *M* diff = -.35, 95% CI = -.43, -.28) and significantly reduced over-confidence in the ‘health-related’ condition at ‘follow-up’ compared to ‘post-intervention’ (*p* = .012, *M* diff = .05, 95% CI =

.01, .09). At ‘post-intervention’ there was significantly greater over-confidence for the ‘health-related’ condition compared to the ‘purchase’ condition (p <.001, M diff = .33, 95% CI = .27, .40) but at follow-up there was significantly reduced over-confidence in the ‘health-related’ condition compared to the ‘purchase’ condition (p <.001, M diff = -.07, 95% CI = -.12, -.03). The main effect of ‘condition’ and the remaining interactions of interest on confidence bias scores were non-significant (Table 8.14). These outcomes remained consistent when adjusting for baseline confidence bias as a covariate.

8.3.3.4 Reasons Analysis. The thought listing reasons provided after each decision made were analysed per ‘question type’ condition across 20 ‘baseline’ trials (N = 2,800 trials, n = 2,715 trials, N = 140 participants), 20 ‘post-intervention’ trials (N = 2,800 trials, n = 2,722 trials, N = 140 participants) and 20 ‘follow-up’ trials (N = 2,660 trials, n = 2606 trials, N = 133 participants). When a participant was unable to make a choice, no reason was provided and so these trials were not included in the analysis. The percentages of nutrient-5 reasons are calculated across each timepoint. The data is reported descriptively to provide insights into when participants provided nutrient-5 reasons for their food choices for each ‘timepoint’, ‘question type’ and ‘condition’. Table 8.15 shows nutrient-5 reasons were shared across ‘question type’ conditions per ‘condition’ and ‘timepoint’. The percentages indicated higher ‘purchase’ and ‘health-related’ nutrient-5 reasons for accurate choices in the ‘intervention’ compared to the ‘control’ condition. This pattern was also shown for nutrient-5 reasons for inaccurate choices, except for ‘health-related follow-up’ where the ‘control’ condition had a higher percentage of nutrient-5 reasons. The means indicated more nutrient-5 reasons in the ‘health-related follow-up’ conditions and the least in the ‘purchase follow-up’ conditions for accurate choices in both ‘conditions’.

Table 8.15

Percentages of Nutrient-5 Reasons Reported Across Accurate and Inaccurate Decisions for Each Question Type Per Condition and Timepoint

Condition	Intervention Condition				Control Condition			
	Accurate (%)		Inaccurate (%)		Accurate (%)		Inaccurate (%)	
	Label as a reason	Label not as a reason	Label as a reason	Label not as a reason	Label as a reason	Label not as a reason	Label as a reason	Label not as a reason
				Baseline				
Purchase	43.82	19.56	17.35	19.26	33.48	26.28	15.12	25.11
Health-related	42.86	18.90	18.15	20.09	34.46	24.78	13.49	27.27
				Post-intervention				
Purchase	47.31	15.57	17.76	19.36	35.80	25.59	12.72	25.89
Health-related	49.78	15.12	17.77	17.33	40.86	21.24	14.31	23.60
				Follow-up				
Purchase	43.87	17.92	20.91	17.30	32.49	25.60	13.32	28.59
Health-related	55.42	16.80	16.48	11.30	48.12	18.05	18.80	15.04

Percentages were calculated for overall accurate and inaccurate choices per ‘question type’ (Table 8.16). The ‘intervention’ condition reported more nutrient-5 reasons ‘post-intervention’ for accurate ‘purchase’ decisions compared to ‘baseline’, but the increase was not maintained at ‘follow-up’. The ‘intervention’ condition reported nutrient-5 reasons with sustained higher percentage at ‘post-intervention’ and ‘follow-up’ compared to ‘baseline’ for accurate ‘health-related’ decisions. The ‘control condition’ had similar levels of nutrient-5 reasons at ‘baseline’ for ‘question type’ conditions. The nutrient-5 reasons remained stable in the ‘purchase’ condition across the ‘timepoints’ for the ‘control condition’. The nutrient-5 reasons were lower than those shared in the ‘intervention condition’ at ‘baseline’. The nutrient-5 reasons increased ‘post-intervention’ and ‘follow-up’ for accurate ‘health-related’ decisions for the ‘control’ condition.

The percentages indicated similar nutrient-5 reasons in the ‘intervention’ condition at ‘baseline’ for inaccurate responses across the ‘question types’ and similar, but lower in the ‘control condition’. This pattern was maintained at ‘post-intervention’ for inaccurate ‘purchase’ decisions for the ‘conditions’. The percentages indicated that the ‘intervention’ condition nutrient-5 reasons were higher for inaccurate trials at ‘follow-up’ compared to ‘post-intervention’ in the ‘health-related’ condition. In the ‘control condition’ the nutrient-5 information remained stable for inaccurate ‘health-related’ choices at ‘post-intervention’ compared to ‘baseline’ but increased at ‘follow-up’.

Table 8.16

Percentages of Nutrient-5 Reasons Reported for Overall Accurate Trials and Overall Inaccurate Trials for Each Question Type Per Condition and Timepoint

Condition	Intervention Condition				Control Condition			
	Accurate only (%)		Inaccurate only (%)		Accurate only (%)		Inaccurate only (%)	
	Label as a reason	Label not as a reason	Label as a reason	Label not as a reason	Label as a reason	Label not as a reason	Label as a reason	Label not as a reason
				Baseline				
Purchase	69.14	30.86	47.39	52.61	56.02	43.98	37.59	62.41
Health-related	69.40	30.60	47.47	52.53	58.17	41.83	33.09	66.91
				Post-intervention				
Purchase	75.23	24.77	47.84	52.16	58.31	41.69	32.95	67.05
Health-related	76.70	23.30	50.63	49.37	65.80	34.20	37.74	62.26
				Follow-up				
Purchase	70.99	29.01	54.73	45.27	55.93	44.07	31.79	68.21
Health-related	76.74	23.26	59.32	40.68	72.73	27.27	55.56	44.44

8.3.4 Hypothesis 3: Intervention COM-B Analyses

Lower scores for perceived capability, opportunity and motivation measures and higher perceived behavioural intent indicate greater nutrition label engagement. The means in Table 8.17 indicated higher levels of nutrition label engagement in the ‘intervention’ condition compared to the ‘control’ condition for each ‘timepoint’ (*N* =140). Across both conditions, there was greater nutrition label engagement at ‘follow-up’ for perceived capability, motivation and behavioural intent, but at ‘baseline’ for perceived opportunity. Lowest nutrition label engagement was reported at ‘post-intervention’ for perceived capability, opportunity and motivation and at ‘baseline’ for perceived behavioural intent (Table 8.17).

Table 8.17

Descriptive Statistics for Self-Perceived COM-B Measures for Each Condition

Measure	Intervention Condition			Control Condition			Total	
	M (%)	*SD*	*M*$_{Adj}$ (%)	*M* (%)	*SD*	*M*$_{Adj}$ (%)	*M* (%)	*SD*
				Baseline				
Capability	34.41	26.79	-	43.04	25.24	-	38.73	26.29
Opportunity	33.32	28.40	-	37.77	25.69	-	35.54	27.08
Motivation	51.57	25.08	-	55.44	24.76	-	53.50	24.91
Behavioural intent	64.34	28.80	-	57.49	28.03	-	60.92	28.52
				Post-intervention				
Capability	35.24	31.47	39.03	45.63	31.75	41.45	40.43	31.92
Opportunity	39.70	26.85	41.52	45.03	25.32	43.21	42.36	26.14
Motivation	50.86	27.20	52.34	56.81	24.29	55.33	53.84	25.86
Behavioural intent	69.24	26.74	66.56	59.80	29.55	62.89	64.56	28.48
				Follow-up				
Capability	31.99	26.24	35.22	41.60	27.95	38.09	36.79	27.44
Opportunity	37.16	24.75	38.69	39.32	25.78	37.80	38.24	25.20
Motivation	47.87	27.37	49.01	56.81	24.32	55.67	52.57	26.18
Behavioural intent	73.31	25.60	71.16	67.83	26.65	70.31	70.57	26.18

8.3.4.1 Perceived Capability Analysis. A 2 (‘timepoint’) by 2 (‘condition’) mixed ANOVA was conducted on perceived capability (*N* = 140). There was a significant main effect of ‘condition’ on perceived capability, $F_{(1, 138)} = 4.70$, $p = .032$, $\eta^2 = .03$. Perceived capability was significantly lower in the ‘intervention’ condition compared to the ‘control’ condition ($p = .032$, *M*

Diff = -10.00, CI 95% = -19.13, -.88). This result indicated participants in the 'intervention' felt that they needed less information about nutrition labels compared to the 'control' condition. However, after adjusting for baseline perceived capability, there was a non-significant main effect of 'condition' on perceived capability ($F_{(1, 137)}$ = 0.94, p = .333, η^2 = .002). There was a non-significant main effect of 'timepoint' on perceived capability ($F_{(1, 138)}$ = 3.81, p = .053, η^2 = .004). There was a non-significant interaction between 'timepoint' and 'condition' on perceived capability ($F_{(1, 138)}$ = 0.05, p = .833, η^2 = .00004). These outcomes remained consistent when adjusting for baseline perceived capability as a covariate.

8.3.4.2 Perceived Opportunity Analysis. A 2 ('timepoint') by 2 ('condition') mixed ANOVA was conducted on perceived opportunity (N = 140). There was a significant main effect of 'timepoint' on perceived opportunity, $F_{(1, 138)}$ = 5.98, p = .016, η^2 = .01. There was significantly lower perceived opportunity at 'follow-up' compared to 'post-intervention' (p = .016, M Diff = -4.12, CI 95% = -7.45, -0.79). This finding indicated that participants felt that they needed less opportunity-related support for nutrition label engagement at 'follow-up' compared to immediate 'post-intervention'. However, after adjusting for baseline perceived opportunity, there was a non-significant main effect of 'timepoint' on perceived opportunity ($F_{(1, 136)}$ = 0.03, p = .792, η^2 = .0001). There was a non-significant main effect of 'condition' on perceived opportunity ($F_{(1, 138)}$ = 0.88, p = .351, η^2 = .005). There was a non-significant interaction between 'timepoint' and 'condition' on perceived opportunity ($F_{(1, 138)}$ = 0.89, p = .348, η^2 = .001). These outcomes remained consistent when adjusting for baseline perceived opportunity as a covariate.

8.3.4.3 Perceived Motivation Analysis. A 2 ('timepoint') by 2 ('condition') mixed ANOVA was conducted on perceived motivation (*N* = 140). There was a non-significant main effect of 'timepoint' on perceived motivation ($F_{(1, 138)} = 0.60$, $p = .439$, $\eta^2 = .001$). There was a non-significant main effect of 'condition' on perceived motivation ($F_{(1, 138)} = 3.60$, $p = .060$, $\eta^2 = .02$). There was a non-significant interaction between 'timepoint' and 'condition' on perceived motivation ($F_{(1, 138)} = 0.61$, $p = .438$, $\eta^2 = .001$). These outcomes remained consistent when adjusting for baseline perceived motivation as a covariate.

8.3.4.4 Perceived Behavioural Intent Analysis. A 2 ('timepoint') by 2 ('condition') mixed ANOVA was conducted on perceived behavioural intent (*N* = 140). There was a significant main effect of 'timepoint' on perceived behavioural intent, $F_{(1, 138)} = 16.47$, $p <.001$, $\eta^2 = .01$. There was significantly higher perceived behavioural intent at 'follow-up' compared to 'post-intervention' ($p <.001$, *M* Diff = 6.01, CI 95% = 3.08, 8.93). This finding indicated that participants felt that they were more likely to engage with nutrition labels at 'follow-up' compared to immediate 'post-intervention'. The significant main effect of 'timepoint' remained when adjusting for baseline perceived behaviour as a covariate ($F_{(1, 136)} = 24.88$, $p <.001$, $\eta^2 = .02$. There was a non-significant main effect of 'condition' on perceived behavioural intent ($F_{(1, 138)} = 2.98$, $p = .087$, $\eta^2 = .02$). There was a non-significant interaction between 'timepoint' and 'condition' on perceived behavioural intent ($F_{(1, 138)} = 1.86$, $p = .174$, $\eta^2 = .001$). These outcomes remained consistent when adjusting for baseline perceived behavioural intent as a covariate.

8.4 Discussion

8.4.1 Hypothesis 1: Discussion

The baseline findings replicated earlier empirical findings for higher levels of accuracy for 'easy' compared to 'hard' decisions. This demonstrated consistency in the food choice task at discerning accuracy based on 'label difficulty'. The findings did not support the significantly higher accuracy for 'health-related' compared to 'purchase' decisions reported in Studies 1 and 2. The baseline findings from Study 3 suggested similar accuracy levels between the two 'question types'; potentially partly explained by the significant individual differences regression analyses, which did not replicate earlier empirical findings. Hence, it was essential to account for any covariance of these predictors in Study 3's intervention analyses. The percentages of nutrient-5 reasons aligned with these findings, as the pattern did not replicate the lower percentage for purchase-based decisions reported in Studies 1 and 2. Study 3's baseline findings indicated higher nutrient-5 reasons when making accurate purchase-based decisions (62.77%) compared to Studies 1 (51.58%) and 2 (41.20%), suggesting the nutrition label was part of the decision-making process to a greater extent in Study 3.

There were no differences between 'health-related' and 'purchase' conditions in percentage confidence ratings for accurate trials, which replicated earlier empirical findings. This suggested building confidence through targeting psychological capability and reflective motivation was needed. The findings replicated non-significant differences between 'easy' and 'hard' conditions in Study 2 and replicated significantly higher over-confidence in 'hard' compared to 'easy conditions reported in the previous empirical studies. However, Study 3 baseline findings did not replicate the significant findings reported in Studies 1 and 2 for over-confidence in purchase-based compared to health-related decisions. This could be explained by the over-confidence reported across conditions in Study 3, which indicated participants were more likely to make errors and be less affected by task demands (Stankov & Lee, 2014). Consequently, over-confidence may decrease engagement with a nutrition label intervention.

8.4.2 Hypothesis 2: Discussion

The findings were mixed in statistical support for Hypothesis 2; that food choice task performance would be improved across timepoints in the intervention compared to the control condition. There were no main effects of timepoint or condition on accuracy or percentage confidence for accurate trials in the food choice task. These findings suggest food choice task performance was not dependent on a participant's condition assignment. Potentially indicating that food choice task engagement may influence nutrition label behaviours that are not contingent on receiving the intervention infographic. This finding has been reported previously (Miller et al., 2019). Therefore, the study design and timepoints for measures may need to be reviewed to further reduce demand characteristics and/or practice effects in the control group(s). This may be difficult to achieve when drawing between-group comparisons as participants may be lost to follow-up which may result in missing individual difference and performance-based data. Consequently, future researchers may consider repeated-measures designs with periods of ‘wash-out’ or not collect some measures from the control group.

There were main effects of ‘question type’ and ‘label difficulty’ on percentage accuracy which replicated earlier empirical findings as participants had greater accuracy when making health-related choices and for easier nutrition labels. This suggested the food choice task was replicable but main effects were non-significant when the individual differences measures were included as co-variates. There were no significant findings for percentage confidence ratings for accurate trials and there was a non-significant main effect of condition on confidence bias scores. These findings highlight the complexity of nutrition label engagement and its importance to consider how individual differences can impact engagement levels.

There were significant differences for confidence bias scores, which remained when co-variate baseline confidence bias scores were included in the analysis. The main effect of timepoint suggested that participants had higher levels of over-confidence at follow-up. The means suggested that confidence bias levels almost returned to baseline at follow-up. Therefore, the confidence bias levels at post-test are of interest as they suggested participants across conditions had greater levels of under-confidence. This suggested completing the food choice task in quick succession may influence participation confidence when making food choices. Participants were potentially reflecting on their motivations and capabilities of making food choices when completing the task for a second time. This may be an opportune moment for further intervention as participants may be more receptive to addressing potential barriers to nutrition label engagement (Stankov & Lee, 2014).

In addition, the significant over-confidence for health-related compared to purchase-related food choices and the significant over-confidence for easy compared to hard label types. These confidence bias scores may indicate that participants were more likely to make errors in making healthy food choices but felt confident that they were engaging with the nutrition labels appropriately. These findings suggest further interventions could help consumers reflect on nutrition label engagement, potentially participants could be shown their erroneous performance to help challenge their beliefs as part of a more complex intervention design (Miller et al., 2019).

The non-significant findings relating to condition across the performance measures indicate that there may have been influences on nutrition label engagement by completing the study that were not solely attributable to the nutrition label engagement intervention infographic. This is supported by the nutrient-5 reason percentages as these were higher for accurate choices for intervention participants, except for when the control participants made health-related choices at follow-up. This indicated that the control participants may have reflected on their engagement in the study and potentially this led to demand characteristics when they returned to complete the follow-up phase. The lower performance scores and the individual differences measures in the control group may suggest that this group of participants may have benefitted from the intervention infographic. It was a strength of the study that this was shown to the group at the end of the study. In the future, it may also be appropriate for additional measures to be collected after the infographic is shared with the control group to assess any differences in nutrition label engagement performance measures.

8.4.3 Hypothesis 3: Discussion

There was statistical support for Hypothesis 3; that receiving the nutrition label intervention improved perceived COM-B components across timepoints compared to the control condition. The significantly lower perceived capability scores in the intervention condition indicated that this group needed less information about nutrition labels compared to the control condition. This aligned with the task performance measures which were consistently higher for the intervention condition and the influence of individual difference predictors. Furthermore, the findings showed significantly lower perceived opportunity scores at follow-up compared to post-intervention across all participants. This suggested that participants felt that they had received opportunity related support by engaging in the study (not condition specific). This may account for the improvements in nutrition label engagement observed in the food choice task performance measures. However, when baseline perceived capability and opportunity scores were controlled for, main effects were non-significant. This suggests researchers should include baseline measures when conducting and reporting intervention research to draw appropriate conclusions.

The significantly higher perceived behavioural intent scores at follow-up compared to post-intervention, which remained when adjusting for baseline scores, indicated engaging with the study raised intentions to engage with nutrition labels. This indicates drawing a consumer's conscious awareness to their food choices may increase intention to engage with nutrition labels. Furthermore, incorporating health-related BCTs into the infographics may prompt broader health behaviour goals. However, this perceived behavioural intent was not reflected across performance measures. Based on confidence bias scores, participants may believe they have high capability and confidence to engage with nutrition labels, but they are making erroneous choices. Therefore, future interventions are needed to address misunderstandings in nutrition label engagement.

8.4.4 Strengths and Limitations

This study tested an intervention designed to improve nutrition label engagement that was informed by theoretical underpinnings and consumer insights. This approach was a strength to the study as the process of intervention design is transparent and replicable. The intervention was assessed using tested performance measures and analysis adjusted for baseline and co-variate measures to inform appropriate conclusions. Baseline replication analyses may indicate demand characteristics of participants from *Prolific* recruitment site, due to potential experience of multi-part studies which may have led to demand characteristics that the study was intervention-based. This may explain reported findings for this study that were not condition specific. Therefore, replication of the study using different samples and potentially the inclusion of a non-placebo control infographic may provide clearer insights from population groups who may be less rehearsed in intervention-based research.

Furthermore, consideration to study design and measure implementation may help to strengthen implementation of future interventions; for example, perceived behavioural intent may have increased across timepoints due to demand characteristics. Therefore, future studies may adapt the COM-B measure to not include mention of nutrition labels in the control condition, and it also implement COM-B measures without any intervention to determine if answering questions relating to the COM-B components impacted scores. Further examination of the COM-B self-evaluation questionnaire is needed to assess perception by the target audience. The psychometric properties for the COM-B self-evaluation questionnaire were acceptable in Study 3. However, when reviewing reasons provided by participants that accompanied the ratings there were differences in polarisation of ratings for the same underlying reason. Therefore, insights into perceptions of consumers when completing the questionnaire, providing additional guidance or tweaking the statements asked may help to improve the implementation of the scale in the future.

8.5 A Summary of the Chapter Contributions

This chapter reported the intervention implementation phase of the third empirical study. It reported further insights into the replication of findings to compare food choice task performance and the impact of individual differences at baseline to the earlier empirical studies. Furthermore, the findings from the novel intervention implemented demonstrated nutrition label engagement in the food choice task and COM-B concepts which were not specific to the intervention condition. The findings from the implemented intervention addressed part of Thesis Objective 3. The consumer evaluations of the intervention are presented in Chapter 9.

Chapter 9: Evaluation of an Intervention to Improve Nutrition Label Engagement in Healthy UK Adults

This chapter presents the consumer evaluation of the intervention delivered in this thesis. The chapter begins with an overview of the importance of collecting consumer evaluation and the approach taken in this thesis. Next, the method for the current chapter is outlined, including how quantitative and qualitative feedback was collected from participants. The results section is split into quantitative and qualitative analyses. The quantitative analyses explore the acceptability of the infographic received. The qualitative analysis explores the experiences of consumers when reflecting on the intervention delivered, using an inductive reflexive thematic approach. The chapter concludes with a discussion of the findings and the key contributions to Thesis Objective 3.

9.1 Rationale and Aims

To understand consumer experiences and perceptions of the intervention implemented it was important to explore their evaluations. It is recommended to incorporate consumer evaluation within intervention research (Michie et al., 2014). However, there is no standard approach to collecting intervention evaluation (Moore et al., 2014). In the systematic review (Chapter 2), seven of the studies did not report consumer evaluation to provide discussion of consumer acceptability of the intervention. Therefore, a strength of Study 3 was obtaining participant feedback to assess perceptions on how acceptable and feasible the intervention was to the target audience. For the studies that did include evaluation, most studies included quantitative Likert-scale or visual analogue scales (Dukeshire et al., 2014; Kreuter et al., 2002; Lindhurst et al., 2007; Miller et al., 2017, 2018, 2019; Souza et al., 2016). Taylor-Davis et al. (2000) reported qualitative process intervention evaluation at each delivery point.

To gain holistic understanding a mixed-methods approach was taken for Study 3. This approach is recommended for health-related behaviour change interventions due to the complexity of public health interventions (Palinkas et al., 2019). To help to understand consumer perception of the intervention, the APEASE criteria (Michie et al., 2014) were used. The intervention was considered *affordable* and *practical,* as web-based interventions are low-cost to and can reach a broad population audience (Miller et al., 2019). To strengthen insights into the practicality and *effectiveness* of the intervention consumer perspectives and experiences needed to be collected. This was important to help to inform changes that could be made in the future to help improve the *effectiveness and cost-effectiveness* of the intervention. The consumer evaluation collected focused on understanding the extent to which the intervention was considered appropriate after exposure.

The quantitative evaluation, the content, delivery mode and likelihood to recommend the infographics were rated on visual analogue scales to provide more diverse scores compared to Likert scales (Miller et al., 2018, 2019). In addition, the effectiveness of the BCTs and related outcomes were evaluated to understand how consumers perceived the intervention influenced behaviour. To provide depth to the consumer evaluations open-ended questions were posed for each rating and two essay style questions were asked related to understanding what the consumers liked and disliked (or thought could be improved) about the infographic. The qualitative findings provided an opportunity to explore any side-effects, safety needs or unintended consequences of the intervention from a consumer perspective. The individual differences reported for Study 3 demonstrated that the delivery of the intervention was equitable. However, insights into the consumers perceptions of equity were needed to understand how the intervention was received. The findings in this chapter contribute to the findings for Thesis Objective 3 and focused on the evaluation of the intervention that was implemented. One directional research hypothesis was tested:

> Hypothesis: Evaluation ratings will be more favourable for the intervention infographic compared to the placebo control infographic.

The qualitative evaluation focused on exploring how consumers perceived and experienced the nutrition label engagement intervention. The research question for this phase of the study was:

> Research Question: How do healthy UK adults perceive and evaluate a novel nutrition label engagement intervention?

9.2 Method

9.2.1 Design and Participants

For the quantitative analyses ‘condition’ was the independent variable with two levels: ‘*intervention*’ and *‘control*’. The dependent variables were evaluation ratings, higher scores indicated more favourable evaluations. The inductive reflexive thematic analysis was based on responses to open-ended survey questions. Section 8.2.2 outlined the participant characteristics.

9.2.2 Materials and Procedure

The intervention evaluation questions were asked immediately after the infographic exposure received. The first open-ended question asked the participants to reflect on the key message they took from the infographic: '*What do you think the main take-away message is from the infographic you've just seen? Please try to provide context in your answer*'. This question was presented on its own screen with an essay text box for participants to share their thoughts. The second screen asked participants five infographic evaluation questions related to APEASE concepts. Participants responded to two open-ended questions and rated three concepts on visual analogue scales from 0 (extremely unhelpful) to 100 (extremely helpful), higher scores indicated more favourable evaluation (Figure 9.1). Beneath each rating, participants could type context to their ratings.

Figure 9.1

APEASE Infographic Evaluation Questions

Rating questions

Content: *'How would you rate the content of the infroamtion provided on the infographic?'*	**Delivery mode:** *'How would you rate the delivery of the information provided on the infographic?'*	**Recommend:** *'How likely would you be to recommend the infographic you were shown to others?'*

Open-ended questions

Liked: *'In your opinion, what did you like about the infographic you have just seen? Please try to be as detailed as possible'*	**Disliked/improvements:** *'In your opinion, what did you dislike, or are there any suggestions you would like to share on how we could improve the infographic you have just seen? Please try to be as detailed as possible'*

The final evaluation screen asked three BCT outcome rating questions targeted in the intervention. Each rating was paired with an opportunity to share reasons/context for the rating provided. The ratings were given on visual analogue scales from 0 (extremely unlikely) to 100 (extremely likely), higher scores indicated more positive evaluations (Figure 9.2).

Figure 9.2

BCT Related Infographic Evaluation Questions

Intervention questions

- 'From the infographic presented how likely is it to **encourage** you to use food labels when making food choices'
- 'How helpful do you think the infographic was on **providing instructions** on how to use and understand food labels when making food choices?'
- 'How helpful do you think the infographic was **on providing information on the health consequences** of using food labels when making food choices?'

Control questions

- 'From the infographic presented how likely is it to **encourage** you to brush your teeth for two minutes, twice daily?'
- 'How helpful do you think the infographic was on **providing instructions** on how to brush your teeth for two minutes, twice daily?'
- 'How helpful do you think the infographic was on **providing information on the health consequences** of brushing your teeth for two minutes, twice a day?'

At the end of the post-intervention phase and the follow-up phase of the study participants' overall study experience questions were asked: '*how would you rate your experience of taking part in this phase of the research study?*' This was rated on a visual analogue from 0 (extremely unsatisfactory) to 100 (extremely satisfactory).

9.2.3 Data Analysis

The quantitative analyses were conducted using SPSS and focused on drawing 'condition' comparisons. Parametric tests of difference were reported where assumption checks were met, where assumption checks were violated the appropriate non-parametric test of difference was reported (see Section 4.4.1 for assumption thresholds). The original analyses are reported, but differences in outcomes from sensitivity analyses are reported. Inductive reflexive thematic analysis (Braun & Clarke, 2022) was conducted to explore how consumers experienced and evaluated the nutrition label engagement infographic (see Section 4.4.2 for details on approach taken).

9.3 Results

9.3.1 Quantitative Evaluations of the Nutrition Label Intervention

The findings from the six intervention rating evaluations shared by participants in relation to the APEASE and BCTs and the overall study experience ratings were analysed. The overall experience ratings were similar and positive across 'conditions', with higher means reported at follow-up (Table 9.1). Table 9.2 shows marginally higher means for the 'control' compared to the 'intervention' condition across APEASE and BCT ratings.

Table 9.1

Study Experience Ratings Descriptive Statistics for Condition and Timepoint

Condition	Phase 1		Follow--up	
	M (%)	*SD*	*M* (%)	*SD*
Intervention Infographic	73.72	19.97	79.95	18.72
Control Infographic	71.73	23.22	82.16	16.85

Table 9.2

Evaluation Ratings Descriptive Statistics for the Conditions

Evaluation rating	Intervention group			Control group		
	M (%)	*SD*	Median (%)	*M* (%)	*SD*	Median (%)
Content	74.24	21.22	80.00	75.97	21.87	81.00
Delivery	71.33	23.25	74.00	78.83	20.65	80.00
Recommend	59.26	28.94	60.00	60.37	31.72	70.00
Encourage behaviour	61.94	29.13	67.50	68.70	29.74	78.00
Instruction on how to perform the behaviour	69.64	25.66	76.50	75.69	20.09	76.00
Information about health consequences	65.06	27.08	70.00	66.84	24.70	70.00

9.3.1.1 Infographic Content Rating Analysis. A Mann-Whitney U test was conducted on the content ratings for 'condition'. The outcome was non-significant (U = 2248.00, p = .400, N = 140), indicating the favourable content ratings for the infographics did not differ by 'condition'

9.3.1.2 Infographic Delivery Rating Analysis. A Welch's t-test was conducted on the delivery ratings for 'condition'. Delivery ratings were significantly higher in the 'control' compared to the 'intervention' condition, $t_{(136.10)} = -2.02$, $p = .046$, $d = .34$, two-tailed test, indicating more favourable ratings in the 'control' condition.

9.3.1.3 Likely to Recommend Rating Analysis. An independent samples t-test was conducted on likely to recommend ratings for 'condition'. There was a non-significant difference in the likely to recommend ratings for the 'intervention' compared to the 'control' condition ($t_{(138)} = -0.22$, $p = .828$, $d = .04$, two-tailed test).

9.3.1.4 Encourage Behaviour Rating Analysis. An independent samples t-test was conducted on the encourage behaviour ratings for 'condition'. There was a non-significant difference in the encourage behaviour ratings for the 'intervention' compared to the 'control' condition ($t_{(138)} = -1.36$, $p = .177$, $d = .23$, two-tailed test).

9.3.1.5 Instruction on how to Perform the Behaviour Rating Analysis. A Welch's t-test was conducted on the instruction of how to perform the behaviour ratings for 'condition'. There was no significant difference in the instruction on how to perform the behaviour ratings for the 'intervention' compared to the 'control' condition ($t_{(130.48)} = -1.55$, $p = .123$, d =

.26, two-tailed test). However, when the outliers were removed, there was a significant difference, with significantly higher ratings in the ‘control’ compared to the ‘intervention’ condition, $t_{(117.32)}$ = -2.22, p = .028, d = .38, two-tailed test. This conclusion indicated that the outliers had an impact on the conclusions drawn and that the findings should be interpreted with caution.

9.3.1.6 Information about Health Consequences Rating Analysis. An independent samples *t*-test was conducted on the information about health consequences ratings for ‘condition’. There was a non-significant difference in the information about health consequences for the ‘intervention’ compared to the ‘control’ condition ($t_{138)}$ = -0.41, p = .684, d = .07, two-tailed test).

9.3.2 Qualitative Evaluation of the Nutrition Label Intervention

The responses to the open-ended question asking participants what the key message they took from the nutrition label engagement infographic focused on ‘nutrition label’ and ‘food choices’. This demonstrated the general topic of the infographic was easily discernible and reflected immediately after exposure. Furthermore, participants shared action words “*check*” and “*read*” nutrition labels, relating to their reflections of the key message from the infographic. This terminology may help to encourage these behaviours and instil action when making food choices.

Three themes were developed using inductive reflexive thematic analysis to discuss the evaluations participants shared across the open-ended APEASE and BCT survey questions for the nutrition label engagement intervention infographic they received. The themes were (a) *easy to digest content aids intervention acceptability*, which discusses the accessibility of the intervention content and the acceptability of the level of explanation provided; (b) *associative colours and bitesize formats aid readability*, which focuses on how the visual aesthetic of the intervention infographic can influence attention and engagement; and (c) *message relevance can encourage behaviour change*, which explores how the relevance of the behaviour change message can impact engagement with the intervention and change future behaviours.

9.3.2.1 "*Easy to Digest*" Content Aids Intervention Acceptability. This theme focuses on the accessibility of the content shared in the intervention and the acceptability of the level of explanation provided.

The content shared in the intervention infographic was considered: "*relevant to the topic*" (P030) and that: "*all necessary information is included*" (P084), which are important factors to encourage engagement with the content shared. It was acknowledged that the intervention was an: "*accessible 'entry-level' infographic to provide an overview of the food labelling system*" (P032) and participants liked that: "*you didn't need prior knowledge*" (P074) to engage with the content. Participants shared that the infographic: "*provided just the right level of detail for the majority of the audiences*" (P071) and was accessible: "*for any person to understand*" (P016). This evaluation suggests that the intervention infographic was acceptable to the intended consumer audience. The content presented on the infographic was described as: "*informative*" (P102) and "*very insightful*" (P037) suggesting the content was well received by the consumers. This acceptability was further highlighted by participants sharing that they felt that: "*there was nothing that I disliked about it. I can't see any way that it could be improved upon*" (P037) and: "*I do not have much specifics on how to improve the infographic because I think it was done quite well*" (P080).

Participants shared that they liked the level of explanation provided in the infographic: "*I really liked how it explained key things to look out for on a label*" (P080) and: "*I like the detailed explanation of what to read in a label and the benefit associated with reading label*" (P081). The level of explanation was linked to the simplicity of the intervention in the evaluations: "*I like the simplicity to it, it provides basic information with simple methods people can implement to leading more healthy lives*" (P129). This balanced approach in the level of explanation can help consumers to engage with the content, as it does not impact their sense of autonomy in decision making: "*I liked that it wasn't targeting which specific areas of the food label we should be most concerned about […]. It was mostly unbiased and gave me the strength to make the right decisions alone*" (P134). It is important to help consumers to feel empowered to make nutrition label informed choices, and the evaluations shared suggest that the designed intervention achieved this.

The intervention infographic was described by participants as: "*easy to digest (pardon the pun)*" (P032). This demonstrates the effectiveness of the intervention to share the content in an accessible way to engage consumers and motivate them to read the information provided. The ease of digesting the key information was attributed to a variety of factors within the participant evaluations, including the perception that the content of the intervention was concise and quick to engage with: "*it kept the main points* *clear and concise*" (P088), "*it covers what needs to be covered instantly, there's no clutter in the way*" (P052) and "*didn't take long to read and understand*" (P022). Participants finding the intervention easy to digest was important, especially in relation to time as this is a barrier to nutrition label engagement. This realisation may help to break down the perceived lack of time barrier to nutrition label engagement: "*it makes you realise that the labels are actually quite simple to read*" (P110). This suggests that the intervention encouraged behaviour change.

There were also some evaluation points to consider, as the intervention is further developed, in relation to the content. The simplicity of the intervention was evaluated as sometimes needing additional context and explanation to further encourage nutrition label engagement: "*while it is simple, by the definition it's slightly lacking in detail*" (P135) and it's: "*too oversimplified and for someone with no background knowledge it might lead them to make unhealthy choices*" (P074). These experiences show how it can be challenging to balance the varying needs of consumers for complex health behaviour changes such as nutrition label engagement. There was also awareness of the complexities in using nutrition labels when making food choices: "*there's much more complexity to nutrition*" (P129), "*not enough context about why just looking at macronutrients doesn't guarantee a healthy diet, but good key info*" (P074) and: "*the info graphic is useful but lacks context - as in, what are the recommended calorie, salt, fat servings per day*" (P050). These evaluations further demonstrate the fine balance of how to present information that is received at a level of explanation that is perceived as suitable for a broad audience. These variations in the level of explanation needed may be due to consumers varying in existing nutrition label engagement, along with individual differences such as health literacy and food motivations (see Chapter 1) and would be interesting considerations in future intervention design.

This theme highlights the balance that intervention designers need to consider when deciding the level of explanation provided on infographics, particularly for complex behaviours such as food choices whereby nutrition labels are one aspect to the behaviour. It is important for consumers to receive interventions that are easy to digest in terms of their content, but also in terms of their format and design, which will be discussed in the next theme.

9.3.2.2 Associative Colours and A Bitesize Format Aids Readability. This theme explores the importance of the visual aesthetic of the intervention to aid readability. It focuses on formatting and design concepts of the intervention.

The visual aesthetics of the intervention infographic were described as "*eye catching*" (P122) and "*visually engaging*" (P060), which is important to gain initial attention to the intervention. Participants shared favourable evaluations for the layout of the information presented in the intervention: "*I liked the fact it was a short one pager broken down into bitesize boxes"* (P131). This approach was reflected on by participants as providing a: "*clear and positive flow through the message it was conveying"* (P030) and "*the information 'flowed' downwards very well*" (P122). This suggests that the designed format had a natural flow to maintain consumer interest across the different intervention sections.

Furthermore, the information being: "*dissected into sections that makes you understand the information in a step-by-step basis*" (P140), showed that the intervention layout was effective at maintaining engagement to encourage the behaviour in a logical and acceptable way for the intended audience. This was evaluated as enhanced due to there being: "*three different sections, each with their own colour made it an easy read*" (P077), with participants liking: "*the use of colour to demonstrate each step*" (P078). These evaluations highlighted that the intervention presented the content using effective visual aids, which were acceptable to a broad audience. Furthermore, this combined approach was considered: "*appealing because of the colours and layout which draws your eye*" (P030) and that: "*the colours used do make it stand out but at the same time not make the content hard to read or too messy*" (P025). Therefore, how the intervention infographic was formatted was important to maintain attention but it was also important to have a balance.

The use of the traffic light colours was evaluated favourably by participants. The use of these colours builds an association to the encouraged behaviour change of engaging with nutrition labels and specifically the front-of-pack multiple traffic light label: "*the similarities in colour to the food label system*" (P105) and: "*the way they implemented the green, amber and red into the poster also helped separate the information and instill the idea of using the colour coding into people*" (P088). This suggests that the design choice to implement traffic light colours to act as a prompt to consumers was successful. Furthermore, participants considered the colours to relate to the steps associated with the target behaviour: "*it uses the traffic light theme - STOP - pay attention, Amber - read the info, Green go and do better*" (P032). This evaluation showed that the colours helped participants to remember the information presented in the intervention infographic, which suggested it was an effective design.

The use of imagery on the infographic was evaluated favourably by participants: "*well laid out, good use of graphics*" (P098) and the visual aesthetic relating to the volume of text included in the intervention was considered acceptable: "*didn't look like too much information to put me off*" (P133). This suggested there was an acceptable balance in how the content was presented. There were evaluations that shared that the font typeface could have been easier to read: "*it was a bit hard to read for me personally at points*" (P036) and: "*wasn't a huge fan of the design and typeface*" (P076). Therefore, as the intervention is refined it may be helpful to seek additional feedback on how it appears on different platforms and devices to help to ensure that the content is accessible to the target audience.

This theme explored how the format and design of the intervention can influence initial and maintained attention to the content. It also shared how the use of colours can be associated with the intended target behaviour. This leads into the next theme which explores how the message can also influence consumer engagement with and motivations for engaging with the target behaviour after receiving the intervention.

9.3.2.3 Message Relevance can Encourage Behaviour Change.

This theme focuses on the evaluations of the acceptability and relevance of the behaviour change message shared in the intervention.

Participants shared the intervention encouraged the desired behaviour change due to the feeling that the messaging: “*was not patronising*” (P098) or: “*nannying*” (P077) and: “*conveys the information […] in a non-preachy manner*” (P127). These experiences highlight the delicate balance of delivering an acceptable message for a public health intervention so that the information is not received as patronising by the intended audience. This was evaluated favourably in the implemented intervention. Furthermore, participants championed that the infographic was written using non-technical terminology: “*written in 'plain English'*” (P050), “*very helpful to explain it in simple terms*” (P030) and: “*everything is very clear and non-technical*” (P005). This evaluation relating to the accessibility of the message through the use of non-technical language suggested that the intervention was effective and acceptable.

This accessible messaging approach encouraged engagement: “*without any sense of scaremongering*” (P030) and built motivation to engage with nutrition labels when these engagement levels were currently low: “*as I never really think a lot about these on products I will from now as it worried me*” (P016). This demonstrated the intervention could be an effective tool to help consumers to reflect on their current levels of nutrition label engagement. It also encouraged participants to build on from their existing nutrition label engagement: “*I think I would generally look at them anyway, but this for sure makes me want to do it even more so*” (P080). This suggests that the message helped consumers to consider how to improve their future nutrition label engagement levels. Participants praised the: "*the challenge framing, which makes it motivating*" (P062), which may be instrumental in encouraging behaviour change and this self-reflection.

Furthermore, the relevance of the messaging to the audience showed how public health interventions need to be carefully designed to encourage behaviour change. Motivation to engage with the target behaviour was influenced by who the consumer believed the message was for: "*It's not really helpful to me, but I see how it could be helpful to others*" (P005). Therefore, whilst the intervention was acceptable, the message could be further developed to improve the relevance to the target audience. This highlights the challenge of providing a relevant message for a population level intervention for a behaviour that is often perceived as 'common knowledge': "*some knowledge about the traffic light system on packaging is pretty common knowledge*" (P056) and that consumers perceive that most people engage in the behaviour: "*most people already know about food labels and probably check them*" (P134). This also related to the level of knowledge participants perceive themselves to hold: "*didn't really tell me anything I didn't already know*" (P025) and others: "*pretty sure most of my circle is familiar with this information*" (P032). Hence, challenging these perceptions to build message relevance and motivation to engage in the target behaviour is vital to further strengthen the effectiveness of a nutrition label engagement intervention.

The messaging relating to the regulation of the nutrition labels was evaluated positively by participants: "*the information is regulated so you can* *trust what it says*" (P031). This evaluation is important to challenge the barriers relating to trusting the nutrition label information. Participants shared that there were further opportunities within the infographic to further build the credibility and relevance of the message: "*maybe the explanation of the traffic light vs serving suggestions could be expanded on. But I am splitting hairs*" (P077) and: "*it's misleading […] 'serving sizes' make it a nonsense*" (P053). This suggested that pre-existing attitudes, such as the lack of trust in nutrition labels, can be a focus when engaging with interventions designed in this area. Therefore, it is important to consider existing knowledge and attitudes during intervention design to ensure the message is framed appropriately for the intended audience.

This theme showed how the relevance of an intervention message to an individual is important to ensure engagement to encourage the target behaviour change. It also highlighted the potential challenges of designing accepted, relevant intervention messages for population-level interventions, where the needs and perceived relevance of the message can vary considerably across individuals.

9.4 Discussion

This chapter analysed participant intervention evaluations. The inclusion of mixed-methods evaluation methods to evaluate the implemented intervention is novel within the topic area (Palinkas et al., 2019), with none of the studies reviewed in Chapter 2 incorporating a mixed-methods evaluation approach. Taken together, the findings in this chapter addressed the evaluation component of Thesis Objective 3. It highlighted the favourable acceptance towards the infographic and explored perceptions of the intervention which may help to inform future development.

9.4.1 Hypothesis: Discussion

The findings demonstrated the infographics were mostly matched in terms of APEASE ratings, with similar levels of favourableness. However, the rating was significantly higher for the control infographics delivery mode. This may be due to the complexity of nutrition label engagement compared to teeth brushing as a health behaviour. It may also indicate that intervention participants wished to have the information communicated to them in an alternative format. This may suggest that further research is needed into the practicality of the delivery mode to consider alternative ways of communicating the information.

There were no significant differences between the conditions in the original analyses for the BCTs rated (encourage the behaviour, instruction on how to perform the behaviour, information about health consequences). However, the control infographic received significantly higher ratings for 'how to perform the behaviour' when outliers were removed. This may indicate that a singular physical health behaviour, such as toothbrushing, is a less complex behaviour for public health messaging. However, caution is needed when interpreting the result as it was impacted by outliers.

9.4.2 Research Question: Discussion

Three themes were developed using inductive reflexive thematic analysis. These themes provided deeper insights into consumers evaluation of the intervention infographic. Participants shared evaluations on the accessibility and acceptability of the intervention delivered with emphasis that easy to digest content aided acceptability. The reflections from participants on the realisation that nutrition labels are easy to understand suggested that the infographic encouraged behaviour change. In addition, participants shared how the visual aesthetic of an infographic influenced levels of attention and engagement. This suggested that the infographic format was acceptable to the target audience.

Participants attributed the colours used in the infographic to the traffic light colours on the nutrition labels. This indicated that the format of the infographic helped to prompt nutrition label engagement and further feedback on layout and formatting from consumers further strengthened these conclusions. The participants found the infographic message effective and acceptable to encourage nutrition label engagement and self-reflection of their current practice. However, evaluations shared demonstrated the challenges of designing acceptable, relevant intervention messages for population-level interventions where the needs and perceived relevance of the message can vary considerably across individuals.

9.4.3 Strengths and Limitations

The strengths and limitations for the intervention implementation were presented in Chapter 8. For the evaluation phase, this is the first study focused on nutrition label engagement interventions, that rated APEASE and BCT (Michie et al., 2013) perceptions from consumers along with insights from their overall study experience. Furthermore, the inductive reflexive thematic analysis shared insights into the accessibility and acceptance of the intervention. The mixed-methods approach provided holistic evaluative insights into how the intervention was received. The open-ended survey responses yielded detailed responses. This approach was a strength as it allowed for all participants to share their evaluation on the intervention they received, rather than an invited subsample being invited to interviews. However, it needs to be acknowledged that the evaluation was collected immediately after intervention exposure. Therefore, future research may consider including intervention evaluation measures across timepoints to gain further insights into potential side-effects, unintended consequences of the intervention and equity of the intervention after exposure.

9.5 A Summary of the Chapter Contributions

This chapter presented mixed-methods insights into the perceptions and evaluations from participants who received the novel intervention, to contribute findings to Thesis Objective 3. It demonstrated a favourable level of acceptability and accessibility for the intervention infographic as a low-cost, population-level intervention. The qualitative findings highlighted key strengths of the nutrition label engagement infographic from consumer evaluations and explored ideas for future development.

Chapter 10: General Discussion

This chapter provides a general discussion of the work presented in the thesis, the original contributions to knowledge and the implications of this knowledge on future work. The chapter starts by demonstrating how the findings presented across the thesis chapters addressed the Thesis Aim and Thesis Objectives and draws together the original contributions to knowledge. Next, the strengths and weaknesses of the work presented are discussed in relation to the participant samples, measures and analyses. This is followed by theoretical, policy and practice implications and suggested areas for future research. The chapter ends with the researchers' reflections on the thesis research conducted and a conclusion to draw the thesis to a close.

10.1 Addressing the Thesis Aim and Thesis Objectives

The thesis aimed to design, implement and evaluate an intervention to encourage improved UK adult consumer nutrition label engagement. The main aim was addressed through three Thesis Objectives, which will now be discussed before summarising the original contribution to knowledge to address the overall Thesis Aim.

10.1.1 Thesis Objective 1: To Systematically Review and Evaluate the Effectiveness of Existing Single-Component Nutrition Label Engagement Interventions Targeting Healthy Adults

The first Thesis Objective was addressed by the systematic review conducted and reported in Chapter 2. The systematic review synthesised and evaluated the findings from 15 unique single-component nutrition label engagement interventions targeting healthy adults. The findings indicated that twelve of the interventions were categorised as “quite/very promising” at improving consumer nutrition label engagement and promise for 10 BCTs (Michie et al., 2013), which contributed to the effectiveness of the interventions implemented. The findings highlighted key considerations to inform the development of future nutrition label engagement interventions targeting healthy adults. These findings included the acceptability and effectiveness of the intervention format, delivery mode, measures and timepoints. This systematic review was the first to synthesise single-component nutrition label engagement interventions for healthy adult samples and map intervention BCTs and added findings to complement existing systematic reviews conducted by Moore et al. (2018a) and Schruff-Lim et al. (2023). In addition, incorporating theoretical underpinnings to code the intervention components improved the replicability of promising BCTs and highlighted the need to incorporate theory into research design, implementation and evaluation in the future (Lewis et al., 2021; Michie et al., 2013).

10.1.2 Thesis Objective 2: To Explore the Factors and Experiences which Influence Nutrition Label Engagement in UK Adult Consumers and Test a Novel Instrument to Assess Engagement

Chapter 1 provided insights into the factors identified in previous research which have influenced nutrition label engagement. These insights were built upon using a triangulated measures approach, justified in Chapter 4. Thesis Objective 2 was addressed by Studies 1 and 2 (Chapters 5 and 6). Study 1 and the quantitative replication phase of Study 2 investigated the factors which influenced nutrition label engagement in a novel food choice task. These studies employed a novel food choice task with objective and subjective measures to assess levels of nutrition label engagement. The findings from these studies highlighted that consumers were aware of the presence of nutrition labels and were able to seek out the label when making food choice comparisons. However, the studies showed that when consumers made purchase-based food choices, they had lower nutrition label engagement and made less healthy choices. Furthermore, participants were less likely to select healthier choices across all question types for hard rated labels which suggest that larger differences in nutritional value presented for easy pairings may influence food choices more than smaller differences.

The findings also showed how consumers experienced challenges with selecting the healthier option between paired prepacked products when specifically asked to, compared to making singular-nutrient comparison choices i.e. choosing a product with less fat content. These insights suggested that consumers experience barriers to nutrition label engagement depending on the task demands and motivations they hold. This approach of exploring the factors which influence nutrition label engagement using objective measures and measures of individual differences within a single study was novel and provided in-depth insights into consumer nutrition label engagement.

In addition, Study 2 explored the experiences of consumers when reflecting on their nutrition label engagement levels. The findings showed how consumers felt that there was more to nutrition label engagement than choosing a balanced diet and that accessible labels were important to inform food choice. The experiences shared by consumers also demonstrated a lack of trust and perceived credibility of the nutrition labels and the perception that they were not for them. This provided an original contribution to knowledge as there were limited qualitative studies exploring healthy adult nutrition label engagement and none in the UK since the implementation of the front-of-pack nutrition labels.

10.1.3 Thesis Objective 3: To Design, Implement and Evaluate a Novel Intervention Aimed at Improving UK Consumer Nutrition Label Engagement

Chapter 7 summarised the key findings from earlier chapters and mapped them across to the BCW process for intervention design (Michie et al., 2014). The use of a guiding theory to underpin the intervention development was novel and helped to justify and outline the decisions taken. The intervention developed was implemented in Study 3 (Chapter 8) and evaluated (Chapter 9). The integration of consumer feedback on the intervention design process was a strength of the approach taken as these insights helped to shape the final infographic. The intervention implemented in this thesis is the first single-component nutrition label engagement intervention delivered to healthy UK adult consumers. The intervention delivered was positively evaluated by consumers and was acceptable to this target audience. However, the intervention did not have the desired effect of improving nutrition label engagement in healthy UK adults when baseline measures were accounted for. This was partly explained by the lack of replication in baseline measures in Study 3 compared to Studies 1 and 2. It was also partly explained by the improvements in nutrition label engagement across the timepoints, that were not limited to the intervention group. This finding suggested that asking consumers about their nutrition label engagement may improve their engagement levels.

10.1.4 Original Contributions to Answer the Thesis Aim

The research conducted within this thesis answered the Thesis Aim by designing, implementing and evaluating a novel intervention to improve nutrition label engagement in UK adults. The design stage was addressed by Thesis Objectives 1, 2 and 3. The implementation and evaluation stages were addressed by Thesis Objective 3. As part of the design stage, a systematic review provided new insights into single-component nutrition label engagement interventions to build upon previous literature. Furthermore, a novel food choice task was developed as an instrument to assess the effectiveness of the novel intervention and was tested in the target population before the intervention was implemented. The food choice task replications were vital to gain insights into consumer behaviour and ensure that the food choice task and measures were effective at measuring nutrition label engagement.

The intervention design process was underpinned by existing theory to aid replicability and ensure that the intervention was informed by a strong understanding of consumer nutrition label engagement. The mixed-methods insights from consumers on their nutrition label engagement provided a foundation for the content, delivery mode and measures implemented. The novel intervention designed and implemented was effective in reaching the intended audience and led to behaviour changes, but it was also evident that asking consumers to engage in activities related to food choice and nutrition label engagement improved outcomes irrespective of intervention exposure. Overall, the work presented provides a robust and novel instrument and intervention which can inform future research in the field.

10.2 Strengths and Weaknesses

10.2.1 Participants

A key strength of the research studies presented in the thesis was the focus on nutrition label engagement in UK adults with no self-reported diet-related conditions and clear eligibility criteria. This approach was informed by previous literature, which often did not specify clear eligibility criteria (Miller et al., 2019; Mnerie et al., 2015; Souza et al., 2016). In addition, the development of the intervention was informed from UK adult consumer nutrition label engagement, and the intervention was implemented within this target audience. This ensured comparable levels of exposure and familiarity with the UK nutrition labels within the target audience, which had been a limitation in previous research (Graham et al., 2015). Whilst this was a strength of the current research, it is also important to note that the papers included within the review (Chapter 2) were disproportionately from Western countries. As the UK is a Western country this was acceptable for the research presented, but there was also a reliance on fluency in English which may limit the eligibility of consumer groups living in multi-cultural UK from participating. Therefore, the extent of the findings and whether they apply to different cultural and geographical contexts within the UK are limited.

The research reported within the thesis was conducted across several years which may have impacted the levels of familiarity with the UK nutrition labels. The multiple traffic front-of-pack nutrition label was relatively new when the research began but by Study 3 had been implemented for several years. This may have impacted the experiences and engagement levels of consumers, as the labels have been implemented more consistently in recent years and may have impacted the findings reported in Study 3. Therefore, future replication may assess whether nutrition label engagement has changed or whether there was a sample effect. The replications across the studies addressed sample limitations to improve the application of the quantitative findings across samples of the UK population. However, there are still millions more people and so larger scale intervention studies would be beneficial in the future (Gordiienko-Mytrofanova et al., 2018). Furthermore, recruiting census informed samples that are reflective of the UK population may be a possible future avenue for researchers to explore to garner more representative samples (Nicolini & Valle, 2011), such as on the UK categorisations for BMI and health literacy or focus on subsamples of these groups.

The setting of replication should also be considered, as this may impact motivations and attention paid during the data collection phase. The incentives offered to participants evolved from credits/no incentive in Study 1 to participant payment in Studies 2 and 3 due to using an online recruitment platform. Consequently, the incentives may have influenced participant behaviour when engaging with the tasks as there may have been different motivations for participating (Douglas et al., 2023). Strategies were employed to reduce the impact of sampling biases, such as the deception used around the focus of the research and ensuring the incentives were not lucrative. This was somewhat successful, as the samples varied, such as the broad age ranges across the studies demonstrated that recruitment was consistent across the different study designs (Turner et al., 2021). However, future research should be mindful of sampling biases and aim to minimise them based on the financial and time resources available.

Whilst label difficulty replication of task performance was supported from a laboratory study (Study 1) online studies (Studies 2 and 3) the baseline findings from Study 3 did not replicate the earlier findings related to question type. The lack of replication may be due to the participant sample, or it may also indicate changes in the broader context of individuals living in the UK. For example, the research studies were conducted prior to, during and post the COVID-19 pandemic. During the pandemic research suggested that consumers prepared more foods at home, bought foods online and ready meal purchases increased (Grunert et al., 2023). These changes may have impacted consumer awareness of and engagement with nutrition labels.

Furthermore, the growth of mistrust in government and public health messaging post-pandemic has increased and thus consumers may be less receptive to health-related interventions (Illari et al., 2023; Rose et al., 2025). There has also been a rise in social media influencers and manufacturers talking about food consumption and ultra-processed foods on social media, which may have increased exposure to consumer-led interventions (Alwafi et al., 2022; Hunt, 2020). Therefore, these contextual factors should be considered and future replication and exploration into consumer trust and nutrition label engagement since messaging around ultra-processed food and the impact of excessive body weight on the likelihood of contracting COVID-19 have lessened (Gough et al., 2025; Sawadogo et al., 2022).

10.2.2 Methodological Approach

The mixed-methods approach across and within the studies to address the Thesis Aim and objectives is a strength of the work conducted (Migiro & Magangi, 2011). The triangulation of findings to address Thesis Objective 2 and the implementation of measures and evaluation to address Thesis Objective 3 were robust approaches to study design. As reported earlier, nutrition label engagement is challenging to measure, which may explain the variation of findings reported in the literature based on the outcome measures reported. This was demonstrated in the empirical studies conducted in the thesis, e.g., visual attention did not always equate to choosing the healthier choice. This may also be the case for the relationship between individual differences and food choice, as within the empirical studies the regression models individual differences were not always significant predictors of healthier food choices and the model validity was questioned. Whilst not reported within the thesis, further exploration of the individual differences failed to replicate effects for self-reported nutrition label use too and the removal of individual differences did not impact the regression analysis outcomes. This further supported that a triangulation of measures should be implemented to gain holistic insights into nutrition label engagement.

The measures for individual difference may need to be considered in future studies. BMI is a widely accepted measure of excessive body weight, but it has been criticised for its inability to distinguish between fat and lean mass, and for not distinguishing between sex, ethnicity, or age groups in its guidelines; these limitations can lead to misclassification (Buss, 2014; Ortega et al., 2016). Therefore, these limitations need to be considered in the conclusions drawn. Furthermore, the Newest Vital Sign (Rowlands et al., 2013) and nutrition labels in the UK require an individual to competently read and interpret English. This may be a future avenue of research to consider how health literacy, when not fluent in English, may be a barrier to UK nutrition label engagement. In the present studies these tasks were timed to ensure participants were actively engaged and for the online studies, not searching for the answers in a separate web-browser so that the responses accurately reflected their health literacy. Timed tasks are not always acceptable to participants and so this may be a limitation as consumers may have disengaged if they found the tasks too challenging with the time limits.

The food choice task developed was informed by the literature related to nutrition label engagement. This strength was built upon by the refinement of the instrument and measures across the empirical studies. However, whilst the task asked participants to make food choices, it was not point-of-purchase real-life behaviour. Therefore, the choices made excluded pressures that may impact food choices when in a shopping environment and future research may wish to replicate the task with physical products in a shopping environment. It should also be noted that the stimuli were limited to ready meals, which whilst a strength for this research as the products require nutrition label engagement, there are a range of other food types that the stimuli could be extended to. Therefore, further development of the task to emulate these conditions on a population-level would further improve the validity and reliability of the results and conclusions drawn. The focus on ready meals in the current studies controlled for the potential confounding variable of serving size, which can be problematic for consumer nutrition label engagement as highlighted in Study 2 and may have impacted the conclusions which could be drawn and so this should also be considered in future research (Moore, 2019; Van der Horst et al., 2019).

Finally, a strength of the development of the intervention designed in the thesis was the application of the BCW to intervention design (Michie et al., 2014). This framework has been developed for health behaviour change interventions. The mapping of BCTs and characterising the intervention by BCTs were strengths of the research to aid understanding into the effectiveness and application of the BCTs. However, it is possible that the systematic review may not have coded for some BCTs due to the study descriptions presented in the articles reviewed. However, the systematic way that the intervention was developed, with consumer input is a strength of the design as it ensured the BCTs were considered by the target audience to inform the design and implementation of the intervention.

10.2.3 Analysis

The replication analyses conducted within this thesis were important to address the replication crisis within psychology research (Simmons et al., 2011). The findings reported demonstrated the variability in findings and how taking a holistic approach to measuring nutrition label engagement can provide deeper insights into the complexities of the behaviour. The approach to refine the tasks based on successful replication was important to build trust in the findings, however, this should be balanced with the unsuccessful replications which can reduce trust and credibility from consumers (Hendriks et al., 2020). A strength to the intervention implementation was the follow-up timepoint after the immediate post-intervention measures. This timepoint indicated the potential impact of the nutrition label engagement intervention when consumers were not asked about their label engagement prior to task performance. Therefore, future studies may consider longer follow-up periods and the implementation of the measures around the intervention delivered to further explore differences in nutrition label engagement. A strength of the analyses conducted is the reporting of significance and effect sizes for each study. This approach was recommended from the systematic review conducted and will enable future researchers to assess the effectiveness of the research reported in future reviews and meta-analyses.

10.3 Theoretical, Policy and Practice Implications

10.3.1 Theoretical Implications

The food choice task implemented across the studies reported in the thesis was underpinned by principles of nutrition label theories (Chapter 3). This strong application was supported by the eye-tracking findings reported from Study 1, which demonstrated differences in attention to the labels based on the ‘question type’ posed. The behaviours exhibited reflected the models on nutrition label engagement by Grunert and Aachmann (2016) and Grunert and Wills (2007) as the exposure, perception and paths to decision-making were evident across the study measures. This approach helped the replication of the findings for the task performance measures. Therefore, it is recommended that future research continues to draw from relevant theory when designing and implementing food choice tasks to yield appropriate insights into nutrition label engagement.

The development of the intervention outlined in Chapter 7 demonstrated how the BCW intervention design process informed each stage of the design. Furthermore, the use of BCTs informed by the findings of the systematic review (Chapter 2) and empirical findings, in particular consumer perceptions (Chapter 7) demonstrated acceptability of the intervention designed and implemented. These were also commented upon as part of the intervention evaluation (Chapter 9). Whilst task performance measures and COM-B measures were not consistently significantly different in the findings from Study 3, the use of appropriate theory ensures that future development and replication of the intervention design process can be performed as the steps were outlined transparently. The concepts focused on were based on the findings from the literature and empirical findings and so future replications and development of the pilot intervention reported in the thesis would further identify areas that could be further addressed in the future.

10.3.2 Policy Implications

Across the three empirical studies reported in the thesis participants showed awareness of nutrition labels. This demonstrated that consumers had awareness of where to locate the labels and could successfully engage with them to make healthier choices, particularly when making singular nutrient comparisons (e.g., in the nutrient-specific conditions). However, consumers highlighted the need for consistency in front-of-pack nutrition label presentation on all prepacked food products and the need for more specific interventions related to serving size and trust of the information presented. Furthermore, there may be scope to further review the effectiveness of the nutrition label as the UK navigates policy post-Brexit. This will need input from food regulators, manufacturers and consumers to ensure the appropriateness of any redesign (Graham et al., 2016). Additionally, improving perceived relevance of nutrition labels across the population may improve everyday nutrition label engagement (e.g., in the 'purchase' condition). Furthermore, the guidance on the NHS website may need updating to reflect the importance of this type of nutrition label engagement, future research may expand on the current guidance to assess the effectiveness as an intervention. This may help to improve the effectiveness of the labels as a population health communication tool.

10.3.3 Practice Implications

To support the need for varying nutrition label information from consumers, it may be helpful to display interventions in a variety of places e.g., social media, in-store and in apps. The NHS app, which has a specific app for each of the four UK nations, has been developed to be a place where individuals can manage their healthcare and is currently being refined (Reidy et al., 2025). The NHS app and similar apps in the other UK nations may be an ideal platform to tailor and push messaging relating to public health initiatives and also include interventions to help educate and inform decision making. In these apps, nutrition label content and push campaigns could be to increase nutrition label engagement in consumers. This would be beneficial to consumers who may not typically seek out nutrition label information and help challenge beliefs on engagement. This would help to develop knowledge (capability), build trust and time (opportunity) and set goals and challenge beliefs (motivation) in one place for consumers. This may be an important development to support consumers to recognise and use food labels to help with dietary choices without the reliance on an app to provide and/or interpret nutrition label information (Miller et al., 2018).

The intervention developed has the potential to reach a wide audience as a stand-alone tool or could be used to supplement other food choice skill campaigns (Miller et al., 2018). It is low-cost and scalable to run as an intervention targeting healthy UK adult consumers (Miller et al., 2019). Future infographics may include a QR code to encourage further engagement in resources beyond the intervention delivered for interested consumers and also may increase the number of exposures to replicate public health campaigns (Niederdeppe et al., 2025). Therefore, replication of the intervention with refinements made to improve potential outcomes may be an avenue for future research to explore.

10.4 Future Directions

The research presented in the thesis used a robust approach to the design, implement and evaluate an intervention to encourage improved UK adult nutrition label engagement. Therefore, it provides a strong foundation for researchers to build from. The approach to incorporating a range of measures, methods and individual differences within single-study designs is recommended for future research to provide holistic insights into nutrition label engagement. Future research may consider including the NHS logo and endorsements in the visual design of the intervention to strengthen perceived credibility in the information presented. Furthermore, gamification interventions may be an avenue to explore for nutrition label engagement so that consumers can engage with the intervention to their desired level. This may help to improve the acceptability of the delivery mode of the information due to nutrition label engagement being a complex health behaviour.

Future research should also consider how to further build ecological validity into the research, for example, research could record shopping receipts (Harrington et al., 2019) and change serving sizes of the food stimuli used to further assess the effectiveness of interventions. In addition, the acceptability of the intervention in a range of subpopulations is needed to be sensitive to a range of individuals before a public health campaign is implemented. For example, there is a lack of research on the impact and engagement of nutrition labels on individuals with eating disorders, dyslexia and individuals with colour blindness. In addition, the implementation of the measures during the intervention phase may need revision to reduce mention of nutrition labels in the control group prior to the task implementation. Alternatively, researchers could request for additional health-related individual differences to be recorded as part of recruitment sites like *Prolific* so that these questions are not included in the individual studies which may prime or influence nutrition label engagement.

10.5 Researcher's Reflections

Reflexivity is a standard practice in qualitative research and should be incorporated into social science research, including quantitative and mixed-methods studies (Usher, 2023). Therefore, the researcher's reflections are outlined both for the empirical studies and the overall PhD process. The following paragraphs are written in first person to explore and summarise the researcher's prospective and retrospective reflections.

I have been interested in health psychology since completing my BSc (Hons) Psychology degree and studying a health psychology module focused in my final year. I followed this interest by completing my MSc Health Psychology, part-time, where I learned about how to apply health psychology theories and models. It was during my MSc research that my passion for exploring nutrition label engagement began. This research focused on investigating the UK nutrition label format and its impact on consumer food choices. From the research I realised that consumers were aware of nutrition labels and could engage with them, but that sometimes they didn't want to or felt that the labels were not for them. It was interesting that some of the participants in Study 3 in this thesis commented on colour-coding the back-of-pack label as this was the basis for my MSc thesis (it did positively impact nutrition label engagement!).

As I had existing knowledge of the topic area and research, the first few months of the PhD focused on working on the ethics for Study 1 and the ethics disclaimer for the systematic review. From subsequent top-up searches I learned that using technology, such as Rayyan for the systematic review searches, to help keep track of progress was important to navigate a part-time PhD. I had originally written the systematic review chapter on findings from 120 single and multi-component nutrition label engagement interventions, but upon reflection with my supervision team this scope and story in the thesis felt too broad for the intervention designed. Hence only the papers which focused on nutrition label engagement and not combined with cooking skills, etc. were written in Chapter 2. This process helped me to realise that the final thesis was a refined story of the PhD journey rather than all of it to help strengthen the narrative throughout the chapters. I enjoyed the process of data collection for study 1. I had used eye tracking for my MSc dissertation and liked being back in the laboratory and interacting with participants. It was great to hear their stories and interest in nutrition labels after they had completed the study, which was also a driver for the qualitative approach taken for study 2. Conducting mixed-methods studies has been an insightful experience to gain skills in quantitative and qualitative methodologies and I have enjoyed collecting and analysing these different types of data. The findings from Study 3 challenged my initial hypotheses and helped me to take a step back from my research to consider wider contextual impacts on data collection and nutrition label engagement.

I have found the writing of the thesis a challenging and rewarding process. I have refined and reworked the write-up with support from my supervisors to try my best to share the findings from my empirical studies in a narrative that flows through the thesis. This has been challenging at times and in the future I may not include quite so many measures and elements to single studies to help to refine the key findings and conclusions that can be drawn. The PhD process has helped me to develop as a researcher in relation to conducting and disseminating my research with greater clarity. The overall PhD journey has helped me to appreciate the challenges of research, especially for a complex health behaviour, and the need to remain agile as a researcher. It has also helped me to learn that sometimes Gantt chart progress does not always go to plan and progress can be different than anticipated, but that this does not reflect my passion or motivation for my research studies.

10.6 General Conclusion

The aim of the thesis was to design, implement and evaluate an intervention to encourage improved UK consumer nutrition label engagement. The systematic review conducted in this thesis identified few single-component nutrition label engagement interventions and none that were implemented with healthy UK consumers. The intervention promise scores and BCT mapping informed the development of the intervention designed. The empirical findings presented within the thesis identified factors and experiences which influenced nutrition label engagement in healthy UK adults to inform the development of the intervention. The intervention approach was feasible for a public health campaign and consumer evaluation showed that the intervention received was acceptable and rated positively. Therefore, the research presented in this thesis provides an important contribution to the literature in developing a replicable task and positively received nutrition label engagement intervention for UK adult consumers.

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Appendices

Appendix A

BCTT Overview Table (Michie et al., 2013)

Page	Grouping and BCTs
1	**1. Goals and planning**
	1.1. Goal setting (behavior) 1.2. Problem-solving 1.3. Goal setting (outcome) 1.4. Action planning 1.5. Review behavior goal(s) 1.6. Discrepancy between current behavior and goal 1.7. Review outcome goal(s) 1.8. Behavioral contract 1.9. Commitment
3	**2. Feedback and monitoring**
	2.1. Monitoring of behavior by others without feedback 2.2. Feedback on behaviour 2.3. Self-monitoring of behaviour 2.4. Self-monitoring of outcome(s) of behaviour 2.5. Monitoring of outcome(s) of behavior without feedback 2.6. Biofeedback 2.7. Feedback on outcome(s) of behavior
5	**3. Social support**
	3.1. Social support (unspecified) 3.2. Social support (practical) 3.3. Social support (emotional)
6	**4. Shaping knowledge**
	4.1. Instruction on how to perform the behavior 4.2. Information about Antecedents 4.3. Re-attribution 4.4. Behavioral experiments
7	**5. Natural consequences**
	5.1. Information about health consequences 5.2. Salience of consequences 5.3. Information about social and environmental consequences 5.4. Monitoring of emotional consequences 5.5. Anticipated regret 5.6. Information about emotional consequences

Page	Grouping and BCTs
8	**6. Comparison of behaviour**
	6.1. Demonstration of the behavior 6.2. Social comparison 6.3. Information about others' approval
9	**7. Associations**
	7.1. Prompts/cues 7.2. Cue signaling reward 7.3. Reduce prompts/cues 7.4. Remove access to the reward 7.5. Remove aversive stimulus 7.6. Satiation 7.7. Exposure 7.8. Associative learning
10	**8. Repetition and substitution**
	8.1. Behavioral practice/rehearsal 8.2. Behavior substitution 8.3. Habit formation 8.4. Habit reversal 8.5. Overcorrection 8.6. Generalisation of target behavior 8.7. Graded tasks
11	**9. Comparison of outcomes**
	9.1. Credible source 9.2. Pros and cons 9.3. Comparative imagining of future outcomes
12	**10. Reward and threat**
	10.1. Material incentive (behavior) 10.2. Material reward (behavior) 10.3. Non-specific reward 10.4. Social reward 10.5. Social incentive 10.6. Non-specific incentive 10.7. Self-incentive 10.8. Incentive (outcome) 10.9. Self-reward 10.10. Reward (outcome) 10.11. Future punishment
15	**11. Regulation**
	11.1. Pharmacological support 11.2. Reduce negative emotions 11.3. Conserving mental resources 11.4. Paradoxical instructions

Page	Grouping and BCTs
16	**12. Antecedents**
	12.1. Restructuring the physical environment 12.2. Restructuring the social environment 12.3. Avoidance/reducing exposure to cues for the behavior 12.4. Distraction 12.5. Adding objects to the environment 12.6. Body changes
17	**13. Identity**
	13.1. Identification of self as role model 13.2. Framing/reframing 13.3. Incompatible beliefs 13.4. Valued self-identify 13.5. Identity associated with changed behavior
18	**14. Scheduled consequences**
	14.1. Behavior cost 14.2. Punishment 14.3. Remove reward 14.4. Reward approximation 14.5. Rewarding completion 14.6. Situation-specific reward 14.7. Reward incompatible behavior 14.8. Reward alternative behavior 14.9. Reduce reward frequency 14.10. Remove punishment
19	**15. Self-belief**
	15.1. Verbal persuasion about capability 15.2. Mental rehearsal of successful performance 15.3. Focus on past success 15.4. Self-talk
19	**16. Covert learning**
	16.1. Imaginary punishment 16.2. Imaginary reward 16.3. Vicarious consequences

Appendix B

Systematic Review Ethical Disclaimer Approval

From: ethics <ethics@staffs.ac.uk>
Sent: 16 October 2018 08:55
To: HIGGINS Sarah <Sarah.Higgins@staffs.ac.uk>
Subject: RE: Review Disclaimer

Dear Sarah,

Thank you for submitting your Ethics Disclaimer for your project titled: 'An evaluation of the effectiveness of interventions to improve engagement with nutrition labels to guide healthier dietary choices.'

This is now formally recorded and will be inserted in relevant file(s). Please note should your research circumstances change and you deviate from your proposed methodology, you will have to inform us and you may need to complete a further application for ethics approval.

Many thanks
Ethics Admin

Appendix C

Study 1 Ethical Approval

Life Sciences and Education

ETHICAL APPROVAL FEEDBACK

Researcher name:	Sarah Higgins
Title of Study:	Identifying the barriers and facilitators to healthy eating when using nutrition labels
Status of approval:	Approved

Thank you for addressing the committee's comments. Your research proposal has now been approved by the Ethics Panel and you may commence the implementation phase of your study. You should note that any divergence from the approved procedures and research method will invalidate any insurance and liability cover from the University. You should, therefore, notify the Panel of any significant divergence from this approved proposal.

You should arrange to meet with your supervisor for support during the process of completing your study and writing your dissertation.

When your study is complete, please send the ethics committee an end of study report. A template can be found on the ethics BlackBoard site.

R. Naemi

Signed: Dr Roozbeh Naemi **Date: 11.01.2019**

Ethics Coordinator
School of Life Sciences and Education

Appendix D

Study 1 Information Sheet

Information Sheet

STAFFORDSHIRE UNIVERSITY

Who is doing this research?

The research will be conducted by Sarah Higgins, a PhD student at Staffordshire University.

What is the research about?

This research is interested in investigating the barriers and facilitators to food choices.

Why am I being invited to participate?

You are able to participate in this study as you match the recruitment criteria of: being over the age of 18, having normal or corrected-to-normal full colour vision, have lived in the United Kingdom for a minimum of 3 years since 2011. English is your first language and you have not been diagnosed with a neurological or eating-related condition.

What does the study involve?

You are being asked to take part in an experiment lasting approximately 45 minutes. This will involve making comparisons of foods whilst your eye movements, confidence ratings and verbalised decisions are recorded. As you will be having your eye movements recorded there is a risk that you will experience dry eyes, especially if you wear contact lenses. Therefore, you might want to take this factor into account when considering your participation. Following your engagement in the experiment you will be asked to answer some questionnaires relating to dietary choices, health literacy and food based self-efficacy. You will also be asked to provide some demographic details, including the researcher measuring and recording your height and weight. You can withdraw at any point during the experiment (please see the next section on how to withdraw).

What if I want to withdraw from the study?

Your participation is completely voluntary, and you may withdraw from the study at any stage during the course of the experiment, and up to the date on your debrief (by contacting the researcher using the details provided and quoting your participant number), without any penalty.

Will the information I give you be kept confidential?

All the details that you supply will be securely held by Staffordshire University and will be treated confidentially in accordance with the General Data Protection Regulation 2018 and the BPS Code of Ethics and Conduct 2018 for the purposes outlined above. Your data will be anonymised by using your participant number or pseudonym and will be amalgamated with the other participant's data to be analysed. If your data is mentioned individually in the write up/publication of this experiment you will only be referred to by your participation number or pseudonym. Your data will be stored on a password protected computer and the OneDrive which will only be accessible to the researcher and supervisory team. *The University will only keep your data* *until 10 years after the publication/write up of the results and will dispose of securely upon completion.*

What if I don't want to answer any particular questions?

If you do not wish to answer any of the questions that are included in the study, you are free to do so, without penalty.

What if I am upset by anything during the course of the study?

Making food choices and/or recording weight measures may cause emotional distress and anxiety. If this happens, you might like to take a break, or if you prefer, you can decide to end your participation and withdraw from the study at that point. If you decide to withdraw, the researcher will provide you with a copy of the debrief sheet. The debrief sheet contains information about sources of support you can access if there is anything you wish to talk about in confidence.

Who has given approval for this study?

Approval for this study has been granted by Staffordshire University's Ethics Committee.

Researcher Contact Details:

Sarah Higgins (researcher): Sarah.Higgins@staffs.ac.uk

Dr Heather Semper (principal supervisor): Heather.Semper@staffs.ac.uk

Appendix E

Study 1 Consent Form

CONSENT FORM

STAFFORDSHIRE UNIVERSITY

Project Title: The influence of barriers and facilitators on food choices

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Researcher's Name: Sarah Higgins

Researcher's Email Address: Sarah.Higgins@staffs.ac.uk

Participant Number:

Please read the following items carefully and write your initials in the box to indicate that you have read, understood and agreed with each item.

I am over 18 years of age and I voluntarily agree to participate in a research project conducted and explained to me by Sarah Higgins, a PhD student at Staffordshire University. ☐

I have read the information sheet and understand that this research is being conducted as part of a research project at Staffordshire University. ☐

I understand that I am being asked to participate in a study (lasting approx. 15-30 minutes) that involves making food choice decisions whilst my eye movements and verbal responses are recorded, and answering some dietary and health lifestyle questionnaires. ☐

I acknowledge that the tasks have been explained to me fully. I have been informed that I may withdraw from participating without penalty if I so wish and my data will be destroyed. I have been informed that withdrawal after 1 month will not be possible. ☐

I confirm that I meet the eligibility criteria for this research project: I have normal or corrected-to-normal vision, full colour vision. I have lived in the United Kingdom for a minimum of 3 years since 2011. English is my first language and I have not been diagnosed with a neurological or eating related condition. ☐

The researcher has offered to answer any questions concerning the research and I have been provided with contact details for the researcher. ☐

I understand I will be fully protected in accordance with the Data Protection Act of 2018, and in compliance with the British Psychological Society ethical guidelines, and that my data will be kept confidential and anonymous until they are securely destroyed. ☐

I understand that my name and any personal details will be anonymized in any report based on this study. I agree that any of the data I provide may be used in the researcher's report, for research publications and conferences. ☐

I understand that the data will be kept until 10 years after publication, and then destroyed. ☐

I am willing/I am not willing (**select as appropriate**) for the finished report to be used for teaching purposes at Staffordshire University. (Please note that it is possible to participate in the research even if you do not agree to this).

Participant's signature: ______________**Date:** ______________________

Researcher's signature: _____________**Date:** ______________________

Contact details:

Researcher, Sarah Higgins: Sarah.Higgins@staffs.ac.uk

Principal Supervisor, Dr Heather Semper: Heather.Semper@staffs.ac.uk

Appendix F

Study 1 Debrief Form

Participant Debrief

Project Title:	Investigating the barriers and facilitators to healthy eating when using UK nutrition labels.
Researcher's Name:	Sarah Higgins
Researcher's Email Address:	Sarah.Higgins@staffs.ac.uk
Participant Number:	

Thank you for taking part in this study. The aim of the current research was to assess whether the task question and product characteristics displayed can influence your attention to and engagement with nutrition labels to improve healthier dietary choices. There was also a focus on whether this influence was present when other factors, for example health literacy, were accounted for. For more detailed explanations, or if you wish to know the results of the study, please contact the researcher using the contact details below.

Your details will be kept confidential and complete anonymity will be maintained. Raw data will be kept on password-protected computers and on the OneDrive, which will only be accessible to the researcher and supervisory team. Raw data will be kept for ten years to allow for the write up/publication of this work. Your data will be amalgamated with other participants for the analyses for this project.

At the top of the page you will find your participant number. Please keep this page for your records or make note of your participant number. You can withdraw your data from the study up to one week after completing this experiment [date written], by contacting the researcher (see contact details below) and quoting your participant number. No other information is required, and you will not be asked to provide a reason.

If you have any concerns about your weight, please contact your local GP in the first instance and if you would like further information on how to make healthier food choices you may wish to view:
http://www.nhs.uk/Livewell/Goodfood/Pages/food-labelling.aspx or
http://www.nhs.uk/LiveWell/healthy-eating/Pages/Healthyeating.aspx

If you require any support for any adverse effects on your psychological wellbeing caused from your participation, please contact the University Counselling Service: call: +44 (0)1782 294976 or email: counselling@staffs.ac.uk

Thank you again for your participation.

If you have any concerns about the research, please contact:

Sarah Higgins (researcher): Sarah.Higgins@staffs.ac.uk

Dr Heather Semper (principal supervisor): Heather.Semper@staffs.ac.uk

Appendix G

Study 2 Ethical Approval Feedback

School of Health, Science and Wellbeing

ETHICAL APPROVAL FEEDBACK

Researcher name:	Sarah Higgins
Title of Study:	SU_22_318 'Exploring nutrition label engagement in healthy UK adults: A mixed methods approach'
Status of approval:	Approved

Thank you for addressing the committee's comments. Your research proposal has now been approved by the Ethics Panel and you may commence the implementation phase of your study. You should note that any divergence from the approved procedures and research method will invalidate any insurance and liability cover from the University. You should, therefore, notify the Panel of any significant divergence from this approved proposal. This approval is only valid for as long as you are registered as a student at the University.

You should arrange to meet with your supervisor for support during the process of completing your study and writing your dissertation.

When your study is complete, please send the ethics committee an end of study report. A template can be found on the ethics BlackBoard site.

Signed: JH

Date: 21.07.2023

Dr Jade Elliott

Ethics Co-ordinator
Psychology
School of Health, Science and Wellbeing

Appendix H

Study 2 Information Sheet

INFORMATION SHEET FOR PARTICIPANTS

Project Reference Number: SU_22_318.

<u>Exploring food choices in healthy UK adults.</u>

Researcher: Sarah Higgins **Principal Supervisor: Dr Louise Humphreys**

Sarah.Higgins@staffs.ac.uk **L.Humphreys@staffs.ac.uk**

<u>Invitation Paragraph</u>

I would like to invite you to participate in this research project which forms part of my PhD research at Staffordshire University. Before you decide whether you want to take part, it is important for you to understand why the research is being done and what your participation will involve. Please take time to read the following information carefully. Please email me if there is anything that is not clear or if you would like more information.

<u>What is the purpose of the study?</u>

I am conducting a study to measure and explore experiences of making food choices, particularly the reasons behind why food choices are made.

<u>Why have I been invited to take part?</u>

I am recruiting participants over 18 years of age to take part in this study. Participants should also meet the following criteria: have lived in the United

Kingdom for a minimum of three years since 2011; be able to fluently read and write in English; have full colour normal or corrected-to-normal (e.g., through wearing glasses) vision; have purchased prepacked food products e.g., ready meals/snacks and not be vegetarian or vegan; not experienced or been diagnosed at present or historically with any eating-related conditions which may impact food choices including, anorexia, bulimia, diabetes, colitis, food allergies or intolerances, managing a chronic condition through diet.

What will happen if I take part?

I am asking you to take part in a study lasting approximately 60 minutes. This will involve completing food choice tasks, where you will be asked to choose a meal from two paired ready meals based on a question posed. This phase of the research requires habitual behaviours to be measured and so your full attention will be needed as there are timers in place whilst looking at the ready meals and completing measures of why you chose a meal and your confidence in your choice. Following the food choice tasks you will be asked to share some demographic details and complete questionnaires relating to dietary behaviours, health literacy and self-perceived weight. You will also be asked to provide ratings and detailed written responses to a series of questions about your experiences of making food choices. The study will take place online.

Do I have to take part?

Participation is completely voluntary. You should only take part if you want to and choosing not to take part will not disadvantage you in anyway. Once you have read this information sheet, please feel free to ask any questions that will help you decide about taking part. If you decide to take part, I will ask you to agree to consent statements in an electronic consent form.

Incentives

By completing this study and adhering to the participation guidance outlined by the recruitment tool Prolific, you will be awarded the monetary reimbursement outlined at study sign up.

What are the possible risks of taking part?

We appreciate that making food choices and/or considering weight measures may cause emotional distress. If this happens you might like to take a break or, if you prefer, you can withdraw from the study using the withdraw buttons presented during the study. If you decide to withdraw, you will be shown a copy of the debrief, which contains information about sources of support you can access if there is anything you wish to talk about in confidence.

What are the possible benefits of taking part?

Aside from any incentives discussed above, there are no direct benefits to you as a participant.

Data handling and confidentiality

Your data will be processed in accordance with the data protection law and will comply with the General Data Protection Regulation 2016 (GDPR).

All the details that you supply will be securely held by Staffordshire University and will be treated confidentially in accordance with the Data Protection Act 2018 for the purposes outlined above. Your data will be anonymised by using participation codes and pseudonyms. If your data is mentioned individually in the write up/publication of this study you will only be referred to by your unique code given by the researcher during analysis. Your data will be stored on a password protected University OneDrive account, which will only be accessible to the researchers. Your electronic consent form will be stored separately to your data and the list of anonymised participation codes. The University will only keep your data until 10 years after the publication/write up of the results, and will dispose of securely upon completion. However, if the results of this study are published in a journal, then the anonymised data might be stored in an open access repository.

<u>Data Protection Statement</u>

The data controller for this project will be Staffordshire University. The University will process your personal data for the purpose of the research outlined above. The legal basis for processing your personal data for research purposes under data protection law is a ‘task in the public interest’. You can provide your consent for the use of your personal data in this study by completing the electronic consent form that will be provided to you.

You have the right to access information held about you. Your right of access can be exercised in accordance with the GDPR. You also have other rights including rights of correction, erasure, objection, and data portability. Questions, comments and requests about your personal data can also be sent to the Staffordshire University Data Protection Officer. If you wish to lodge a complaint with the Information Commissioner’s Office, please visit www.ico.org.uk.

<u>What if I change my mind about taking part?</u>

You are free to withdraw at any point of the study using the withdraw buttons presented during the study, without having to give a reason. Withdrawing from the study will not affect you in any way.

You can also withdraw your data from the study after you have finished participating, up until **one week after participation,** after which withdrawal of your data will no longer be possible as the data will already have been processed. To withdraw from the study, please email the researcher providing your Prolific identification code that you shared during the completion of the study.

If you choose to withdraw from the study, we will not retain any information you have provided us.

<u>What will happen to the results of the study?</u>

The results of the study will be disseminated in the final written PhD thesis. The results may also be disseminated more widely, for example at a research conference or in an article published in a research journal. The results may also be made available to future Staffordshire University students for teaching/reference purposes. Data collected will be anonymised and presented in the form of group statistics or using pseudonyms for qualitative responses so you will not be identifiable by others in the dissemination of the study.

<u>Who should I contact for further information?</u>

If you have any questions or require more information about this study, please contact either myself as the researcher or my principal supervisor using the following contact details:

Researcher: Sarah Higgins, Sarah.Higgins@staffs.ac.uk

Principal researcher: Dr Louise Humphreys, L.Humphreys@staffs.ac.uk

What if I have further questions, or if something goes wrong?

If this study has harmed you in any way, or if you wish to make a complaint about the conduct of the study, you can contact the study supervisor or the Chair of the Staffordshire University Ethics Committee for further advice and information:

Dr Tim Horne: Tim.Horne@staffs.ac.uk

Thank you for reading this information sheet and for considering taking part in this research.

Appendix I

Study 2 Consent Form

<u>**Exploring food choices in healthy UK adults.**</u>

Researcher: Sarah Higgins

Sarah.Higgins@staffs.ac.uk

Principal Supervisor: Dr Louise Humphreys

L.Humphreys@staffs.ac.uk

Please read the following consent statements and select 'agree' to each statement to provide your consent	**Agree**
I have read and understood the information sheet for this research project	☐
I am over 18 years of age and I voluntarily agree to participate in a research project conducted by Sarah Higgins, a PhD student at Staffordshire University.	☐
I understand that I am being asked to participate in a study lasting approximately 60 minutes where all of my responses will be recorded and I will be asked to: • Complete some food choice tasks, • Answer questions relating to food choices and demographic information • Provide written responses to a series of open questions on my food choices	☐
I understand that I may withdraw from participating without penalty if I so wish and my data will be destroyed. I have been informed that withdrawal after 1 week from participation will not be possible.	☐
I confirm that I meet the eligibility criteria for this research project as outlined on the information sheet:	☐

• I have lived in the United Kingdom for a minimum of 3 years since 2011 • I am able to read and write in English fluently • I have full colour normal or corrected-to-normal vision • I have purchased prepacked food products and I am not vegetarian or vegan • I have not experienced or been diagnosed with an eating-related condition which may affect my food choices	
I understand that I will be fully protected in accordance with the Data Protection Act of 2018, and in compliance with the British Psychological Society ethical guidelines, and that my data will be kept confidential and anonymous until they are securely destroyed.	☐
I consent that data collected can be used in the PhD thesis and could be used for publication in a scientific journal or could be presented in scientific forums (conferences, seminars, workshops) or can be used for teaching purposes and understand that all data will be presented anonymously.	☐
I understand that in the case that a report is published based on this study, the fully anonymised data may be made available for the use of other researchers for an indefinite period of time. Otherwise, the data will be kept until ten years after the PhD thesis has been written, and then destroyed.	☐
I hereby give consent to take part in this study	☐

Because we are not collecting your name or other identifying information, we need a way to identify your data if you wish to withdraw it after participation. Please include your prolific unique ID in the box below. If you wish to withdraw your data in the future, you must provide this code.

Appendix J

Study 2 Debrief Form

Participant Debrief

Exploring food choices, with a focus on nutrition label engagement, in healthy UK adults.

Researcher: Sarah Higgins	**Principal Supervisor: Dr Louise Humphreys**
Sarah.Higgins@staffs.ac.uk	**L.Humphreys@staffs.ac.uk**

Thank you for taking part in this study. The first aim of this study was to explore how engagement with nutrition labels can vary during food choice tasks and to explore the reasons and individual differences e.g. age, health literacy, behind these changes in engagement. In addition, the second aim of the research was to explore your experiences of engaging with nutrition labels and your suggestions of how this could be improved in the future.

Due to the researcher being interested in nutrition label engagement this information was not shared until after the study so that responses were not influenced by this focus in the food choice tasks. For more detailed explanations, or if you wish to know the results of the study, please contact the researcher using the contact details above.

Your details will be kept confidential at all times, and complete anonymity will be maintained. Raw data will be stored on the password-protected University OneDrive, which will only be accessible to the research team. In the case that a report is published based on this study, the fully anonymised data may be made available for the use of other researchers for an indefinite period of time. Otherwise, they will be kept by Staffordshire University until ten years after the article has been published, and then destroyed.

If you wish to withdraw your data you need to contact the researcher using your Prolific ID code [include the code given in Qualtrics here], before one week after participation [add auto updated date here in Qualtrics]. No other information is required, and you will not be asked to provide a reason.

If you have been affected by any of the issues raised in this study, and would like to talk to someone in confidence about it, you may wish to contact the following organisation(s): your GP, visit the NHS webpages on how to make healthier food choices using nutrition labels www.nhs.uk/Livewell/Goodfood/Pages/food-labelling.aspx or healthy eating www.nhs.uk/LiveWell/healthy-eating/Pages/Healthyeating.aspx or Mind to discuss any mental wellbeing issues raised https://www.mind.org.uk/information-support/helplines/

Thank you again for your participation.

Researcher's contact details: Sarah Higgins (Sarah.Higgins@staffs.ac.uk)

Principal supervisor's contact details: Dr Louise Humphreys (L.Humphreys@staffs.ac.uk)

Chair of Ethics Committee: Dr Tim Horne (Tim.Horne@staffs.ac.uk)

Appendix K

Study 3 Ethical Approval Feedback

School of Health, Education, Policing and Sciences

ETHICAL APPROVAL FEEDBACK

Researcher name:	Sarah Higgins
Title of Study:	*An intervention to improve nutrition label engagement in healthy UK adults: A feasibility randomised controlled trial with evaluation*
Status of approval:	Approved

Thank you for addressing the committee's comments. Your research proposal has now been approved by the Ethics Panel and you may commence the implementation phase of your study. You should note that any divergence from the approved procedures and research method will invalidate any insurance and liability cover from the University. You should, therefore, notify the Panel of any significant divergence from this approved proposal. This approval is valid only for as long as you are employed at the University.

When your study is complete, please send the ethics committee an end of study report. A template can be found on the ethics BlackBoard site.

Signed: **Date: 30.01.2025**

Sarah Rose

Dr Sarah Rose
Ethics Co-ordinator - HEPS

Appendix L

Study 3 Information Sheet

INFORMATION SHEET FOR PARTICIPANTS

Project Reference Number: SU_24_065.

<u>Exploring food-related behaviours in healthy UK adults.</u>

Researcher: Sarah Higgins **Principal Supervisor: Dr Louise Humphreys**

Sarah.Higgins@staffs.ac.uk **L.Humphreys@staffs.ac.uk**

Invitation Paragraph

I would like to invite you to participate in this research project which forms part of my (Sarah Higgins') PhD research at University of Staffordshire. Before you decide whether you want to take part, it is important for you to understand why the research is being done and what your participation will involve. Please take time to read the following information carefully. Please email me if there is anything that is not clear or if you would like more information.

What is the purpose of the study?

I am conducting a study to explore your experiences of making food choices, particularly when choosing between prepacked food products e.g., ready meals. I will be asking questions relating to your food choices and behaviours and will ask you to take part in food related tasks as part of this research.

Why have I been invited to take part?

I am recruiting participants over 18 years of age to take part in this study. You should also meet the following criteria: have lived in the United Kingdom for a minimum of three years since 2011; be able to fluently read and write in English; have full colour normal or corrected-to-normal vision (e.g., through wearing glasses or contact lenses); have purchased prepacked food products e.g., ready meals/snacks and not be vegetarian or vegan; not experienced or been diagnosed at present or historically with any eating-related conditions which may impact food choices including, anorexia, bulimia, diabetes, colitis, food allergies or intolerances and/or managing a chronic condition through diet.

What will happen if I take part?

I am asking you to take part in a two-part study lasting approximately 50 minutes in total. The second part of the study will take place 2 weeks after completion of the first part of the study. The first part of this two-part study will last approximately 35 minutes and you will be asked to complete some food choice tasks, where you will choose a meal from two paired ready meals based on the question posed. The food choice tasks have timers in place and so please do make sure that you are paying full attention during these tasks. You will also be asked to identify well-known food brands, look at a social media post relating to food-related behaviour, share some demographic details and complete questionnaires relating to dietary behaviours, health literacy and self-perceived weight. You will also be asked to reflect on your experience of the study. In the second part of this two-part study, which will last approximately 15 minutes and will take place 2-weeks after you completed part 1 of the study, you will be asked to complete some food choice tasks, complete some questionnaires relating to dietary behaviours and share any thoughts about the study you have completed. Both parts of the study will take place online.

Do I have to take part?

Participation is completely voluntary. You should only take part if you want to. Once you have read this information sheet, please feel free to ask any questions that will help you decide about taking part. If you decide to take part, I will ask you to agree to consent statements in an electronic consent form.

Incentives

By completing this study and adhering to the participation guidance outlined by the recruitment tool Prolific, you will be awarded the monetary reimbursement upon completion of the second part of the research outlined at study sign up.

What are the possible risks of taking part?

We appreciate that making food choices and/or considering weight measures may cause emotional distress. If this happens you might like to take a break or, if you prefer, you can withdraw from the study using the withdraw buttons presented during the study. If you decide to withdraw, you will be shown a copy of the debrief, which contains information about sources of support you can access if there is anything you wish to talk about in confidence.

What are the possible benefits of taking part?

Aside from any incentives discussed above, there are no direct benefits to you as a participant.

Data handling and confidentiality

Your data will be processed in accordance with the data protection law and will comply with the General Data Protection Regulation 2016 (GDPR).

All the information obtained will be securely held by University of Staffordshire and will be treated confidentially in accordance with the Data Protection Act 2018 for the purposes outlined above. Your data will be anonymised by using participation codes and pseudonyms. If your data is mentioned individually in the write up/publication of this study you will only be referred to by your unique code given by the researcher during analysis.

Your data will be stored on a password protected private University Microsoft Teams account, which will only be accessible to the researchers. Your electronic consent form will be stored separately to your data and the list of anonymised participation codes. The University will only keep your data until 10 years after the publication/write up of the results, and will dispose of securely upon completion. However, if the results of this study are published in a journal, then the anonymised data might be stored in an open access repository.

Data Protection Statement

The data controller for this project will be University of Staffordshire. The University will process your personal data for the purpose of the research outlined above. The legal basis for processing your personal data for research purposes under data protection law is a 'task in the public interest'.

You can provide your consent for the use of your personal data in this study by completing the electronic consent form that will be provided to you.

You have the right to access information held about you. Your right of access can be exercised in accordance with the GDPR. You also have other rights including rights of correction, erasure, objection, and data portability. Questions, comments and requests about your personal data can also be sent to the Staffordshire University Data Protection Officer. If you wish to lodge a complaint with the Information Commissioner's Office, please visit www.ico.org.uk.

What if I change my mind about taking part?

You are free to withdraw at any point of the study using the withdraw buttons presented during the study, without having to give a reason unless you wish to specify one.

You can also withdraw your data from the study after you have finished participating, up until **one week after participation,** after which withdrawal of your data will no longer be possible as the data will already have been processed. To withdraw from the study, please email the researcher providing your Prolific identification code that you shared during the completion of the study.

If you choose to withdraw from the study, we will not retain any information you have provided us.

What will happen to the results of the study?

The results of the study will be disseminated in the final written PhD thesis. The results may also be disseminated more widely, for example at a research conference or in an article published in a research journal. The results may also be made available to future University of Staffordshire students for teaching/reference purposes. Data collected will be anonymised and presented in the form of group statistics or using pseudonyms for qualitative responses so you will not be identifiable by others in the dissemination of the study.

Who should I contact for further information?

If you have any questions or require more information about this study, please contact either myself as the researcher or my principal supervisor using the following contact details:

Researcher: Sarah Higgins, Sarah.Higgins@staffs.ac.uk

Principal supervisor: Dr Louise Humphreys, L.Humphreys@staffs.ac.uk

What if I have further questions, or if something goes wrong?

If this study has harmed you in any way, or if you wish to make a complaint about the conduct of the study, you can contact the study supervisor or the University of Staffordshire Ethics Committee for further advice and information: Ethics Committee, Research, Innovation and Impact Services, University of Staffordshire, Cadman Building, College Road, Stoke-on-Trent, ST4 2DE, ethics@staffs.ac.uk

Thank you for reading this information sheet and for considering taking part in this research.

Appendix M

Study 3 Consent Form

CONSENT FORM

University of Staffordshire

Exploring food-related behaviours in healthy UK adults.

Researcher: Sarah Higgins

Sarah.Higgins@staffs.ac.uk

Principal Supervisor: Dr Louise Humphreys

L.Humphreys@staffs.ac.uk

Please read the following consent statements and select 'agree' to provide your consent	Agree
I have read and understood the information sheet for this research project	
I am over 18 years of age and I voluntarily agree to participate in a research project conducted by Sarah Higgins, a PhD student at University of Staffordshire.	☐
I understand that I am being asked to participate in a two-part study lasting approximately 50 minutes (part 1 lasting approximately 35 minutes and part two which will take place two weeks later lasting approximately 15 minutes) where all of my responses will be recorded and I will be asked to: • Complete food-related tasks and view an infographic • Answer questions relating to food choices and demographic information • Provide responses to a series of questions on my food-related behaviours and experiences of the study	

I understand that I may withdraw from participating without penalty if I so wish and my data will be destroyed. I have been informed that withdrawal after 1 week from participation will not be possible.	
I confirm that I meet the eligibility criteria for this research project as outlined on the information sheet: • I have lived in the United Kingdom for a minimum of 3 years since 2011 • I am able to read and write in English fluently • I have full colour normal or corrected-to-normal vision • I have purchased prepacked food products e.g., ready meals and I am not vegetarian or vegan • I have not experienced or been diagnosed with an eating-related condition which may affect my food choices	
I understand that I will be fully protected in accordance with the Data Protection Act of 2018, and in compliance with the British Psychological Society ethical guidelines, and that my data will be kept confidential and anonymous until they are securely destroyed.	
I consent that data collected can be used in the PhD thesis and could be used for publication in a scientific journal or could be presented in scientific forums (conferences, seminars, workshops) or can be used for teaching purposes and understand that all data will be presented anonymously.	
I understand that in the case that a report is published based on this study, the fully anonymised data may be made available for the use of other researchers for an indefinite period of time. Otherwise, the data will be kept until ten years after the PhD thesis has been written, and then destroyed.	
I hereby give consent to take part in this study	

Because we are not collecting your name or other identifying information, we need a way to identify your data if you wish to withdraw it after participation. Please include your prolific unique ID in the box below. If you wish to withdraw your data in the future, you must provide this code.

Appendix N

Study 3 Interim Debrief Sheet

Participant Debrief

Exploring food-related behaviours in healthy UK adults

Researcher: Sarah Higgins **Principal Supervisor: Dr Louise Humphreys**

Sarah.Higgins@staffs.ac.uk **L.Humphreys@staffs.ac.uk**

Thank you for taking part in the first part of this study. You will be invited to take part in the second part of this research study in 2 weeks time. Upon completion of the second part of the study you will be provided with a full debrief sheet and reimbursement for your time in Prolific.

Your details will be kept confidential at all times, and complete anonymity will be maintained. Raw data will be stored on the password-protected University Microsoft Teams site set up for the research project, which will only be accessible to the research team. In the case that a report is published based on this study, the fully anonymised data may be made available for the use of other researchers for an indefinite period of time. Otherwise, they will be kept by University of Staffordshire until ten years after the article has been published, and then destroyed.

If you wish to withdraw your data you need to contact the researcher using your Prolific ID code [pipe the code given in Qualtrics here], within one week of participation [pipe auto updated date here in Qualtrics]. No other information is required, and you will not be asked to provide a reason.

If you have been affected by any of the issues raised in this study, and would like to talk to someone in confidence about it, you may wish to contact the following organisation(s): your GP, and/or Mind to discuss any mental wellbeing issues raised https://www.mind.org.uk/information-support/helplines/. For specific eating disorder support you may wish to contact Beat: https://www.beateatingdisorders.org.uk/

Thank you again for your participation.

Researcher's contact details: Sarah Higgins (Sarah.Higgins@staffs.ac.uk)

Principal supervisor's contact details: Dr Louise Humphreys (L.Humphreys@staffs.ac.uk)

Ethics Committee: ethics@staffs.ac.uk

Appendix O

Study 3 End of Study Debrief Sheet

Participant Debrief

University of Staffordshire

An intervention to improve nutrition label engagement in healthy UK adults: A feasibility randomised controlled trial

Researcher: Sarah Higgins **Principal Supervisor: Dr Louise Humphreys**

Sarah.Higgins@staffs.ac.uk **L.Humphreys@staffs.ac.uk**

Thank you for taking part in this study. The study aimed to examine the effectiveness and acceptability of a new intervention designed to improve food label engagement in healthy UK adults. The study also aimed to replicate previous findings on how engagement with food labels can vary during food choice tasks based on the task question and individual differences e.g., age, health literacy.

Due to the researcher being interested in food label engagement this information was not shared until after the study so that responses were not influenced by this focus in the food choice tasks and responses shared. On the previous page you will have seen both infographics shown as part of the study, with one group of participants viewing the food label infographic and the other group viewing the toothbrushing infographic. It is predicted that the food label infographic will improve engagement with the food labels. For more detailed explanations, or if you wish to know the results of the study, please contact the researcher using the contact details above.

Your details will be kept confidential at all times, and complete anonymity will be maintained. Raw data will be stored on the password-protected University Microsoft Teams site set up for the research project, which will only be accessible to the research team. In the case that a report is published based on this study, the fully anonymised data may be made available for the use of other researchers for an indefinite period of time. Otherwise, they will be kept by University of Staffordshire until ten years after the article has been published, and then destroyed.

If you wish to withdraw your data you need to contact the researcher using your Prolific ID code [pipe the code given in Qualtrics here], within one week of participation [pipe auto updated date here in Qualtrics]. No other information is required, and you will not be asked to provide a reason.

If you have been affected by any of the issues raised in this study, and would like to talk to someone in confidence about it, you may wish to contact the following organisation(s): your GP, visit the NHS webpages on how to make healthier food choices using nutrition labels https://www.nhs.uk/Live-well/eat-well/food-guidelines-and-food-labels/how-to-read-food-labels/ or healthy living https://www.nhs.uk/live-well/ and/or Mind to discuss any mental wellbeing issues raised https://www.mind.org.uk/information-support/helplines/. For specific eating disorder support you may wish to contact Beat: https://www.beateatingdisorders.org.uk/

Thank you again for your participation.

Researcher's contact details: Sarah Higgins (Sarah.Higgins@staffs.ac.uk)

Principal supervisor's contact details: Dr Louise Humphreys

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