Applying psychology to interventions that shape dietary behaviours

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Ysgol Seicoleg Prifysgol Caerdydd

Statements

This thesis is being submitted in partial fulfilment of the requirements for the degree of PhD in Psychology

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Summary

The aim of this thesis was to explore how psychology could contribute in improving public health interventions that seek to produce healthier dietary behaviours within obesogenic food environments.

Although more intrusive than prior vending interventions, we found that a complete replacement approach to healthy vending can generate substantial health benefits, without causing catastrophic drops in profitability nor generating two potential compensatory behaviours (Chapter 2). These findings were taken to suggest that complete healthy vending could be a viable method for producing healthier behaviour at an affordable cost.

With prior work showing that health labels have mixed, limited impacts on consumer choices, we attempted to both strengthen their impacts (in Chapter 3) and improve understanding of the ways in which they function (in Chapter 4). The former produced a backfire effect, suggesting that in certain circumstances, highlighting an external agent that is intervening in consumer choice can jeopardize intervention success. The latter offered insights into the ways health labels shape consumer evaluations, and we concluded through providing reflections on the ways in which health labels can be adapted for improved effectiveness in future.

In Chapter 5 we explored the potential for health interventions to produce unintended effects in further detail. The succession of food choices is a key consideration – we found evidence to suggest that healthy choices made in intervention conditions are more likely to be followed be less healthy choices in subsequent scenarios.

The key implications of these findings for future work and practice are discussed in the General Discussion (Chapter 6), accompanied by considerations of broader issues to be addressed in any future work.

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Publications & Collaborations

Chapter 2 was adapted from the following published manuscript:

Griffiths, M. L., Powell, E., Usher, L., Boivin, J., & Bott, L. (2020). The health benefits and cost-effectiveness of complete healthy vending. *PloS one*, *15*(9), e0239483.

Chapter 3 was adapted from the following submitted manuscript:

Griffiths, M. L., Powell, E., Boivin, J., & Bott, L. (2020). Evaluating source credibility effects in health labelling using vending machines in a hospital setting.

The work submitted is the candidate's own. Melda Lois Griffiths wrote the articles referred to above. The other researchers listed assisted in developing the research designs of the studies, and with proofreading manuscripts. All published articles allow reproduction of the material under the Author Publishing Agreement.

Experiment 5.E4. in Chapter 5 documents a study carried out in collaboration with Dr Lewis Bott and two undergraduate final year project students. Project students contributed to the development of the research design, and with data collection. The core research design was conceptualised by the candidate and Dr Lewis Bott. The candidate completed the analysis and write up in Chapter 5 independently.

Chapter 1. Introduction

Overweight and obesity continue to present one of the 21st century's most significant challenges to public health within the developed and developing world (Kanazawa, 2020; WHO, 2021). Current health systems are failing in their efforts to achieve and maintain healthy weights and healthy energy balances within our populations, with no evidence of successful efforts to turn the tide and decrease overweight and obesity prevalence levels in the population of any nation to date (Jackson, Llewellyn, & Smith, 2020; Swinburn et al., 2019). Our dietary behaviours and activity levels make a key contribution to this problem. Chronic positive energy balance, where the energy consumed consistently outweighs the energy expended, results in overweight and obesity, which in turn are linked to numerous non-communicable diseases, physical disabilities and psychological issues (Jackson et al., 2020; WHO, 2021). Tobacco, alcohol and physical inactivity combined produce a smaller non-communicable disease burden than that presented by poor diets (Hyseni et al., 2017).

1.1. A complex system perspective

There is longstanding acknowledgement of the idea that the rise in overweight and obesity results from a complex system of interacting factors. For example, the Foresight report in 2007 proposed the existence of seven key subsystems within its conceptual framework 'the obesity system map', which all contribute in generating chronic positive energy balance (Butland et al., 2007). The subsystems included physiology, individual activity, physical activity environment, food consumption, food production, individual psychology, and social psychology. Within their theoretical model, each subsystem contains its own components, with these working both individually or in conjunction with others to shape the ways in which energy is made available, acquired, preserved and expended.

For example, the obesity system map highlights the role of genetic predisposition in shaping the metabolic processes that determine primary appetite control and how much energy is made available. Different people may have different ways of accessing and storing energy, in turn influencing their energy balance and body weight regulation. The role of dietary habits is highlighted within the food consumption subsystem, with the energy density, convenience, portion sizes, and palatability of food offerings being amongst the factors that all play their own unique role (Butland et al., 2007).

As the supporting evidence base and our understanding of this complex system has grown, so too has the acknowledgement of the fact that the interactions between these subsystems is pivotal in shaping body weight. It is the growth in multifactorial obesity (stemming from this interaction between physiology and environment) which currently presents one of the greatest causes for concern (Rohde, Keller, la Cour Poulsen, Blüher, Kovacs & Böttcher, 2019). Increased exposure to contributing environmental factors can increase the risk that any genetic predisposition for positive energy balance ultimately manifests as overweight or obesity. Another area of increased interest is the exploration of the ways in which environmental factors might affect epigenetic regulation (Diels, Vanden Berghe & Van Hul, 2020).

Psychological factors (both individual and social) are also thought to play a critical role, interacting with environmental level factors to determine behaviour, energy and ultimately body weight (Butland et al., 2007). Sociocultural perceptions of food may shape aspects of the environment relating to both food consumption and production e.g. in societies where healthier foods are not seen to be as tasty (e.g. Raghunathan, Naylor & Hoyer, 2006; Werle, Trendel & Ardito, 2013), producers may be less inclined to offer an array of healthy products to consumers. At an individual level, food literacy, self-esteem and stress are but some of the factors thought to contribute in shaping people's behaviours and their interactions with the food environment. For example, those experiencing greater stress may indulge more frequently, seeking out more energy-dense nutrient-poor foods within the food environment, ultimately leading to weight gain and a potential increase in demand for such food choices (Butland et al., 2007; Swinburn et al., 2019; Torres & Nowson, 2007). The interaction between individual differences and environmental factors is therefore crucial, with this being more so true as our food environments become increasingly obesogenic (Folkvord & Hermans, 2020; Swinburn et al., 2011; Uzogara, 2017).

1.2. The changing food environment and the role it plays

The food environment simultaneously dictates what food is accessible to consumers and signals what should be consumed, in turn shaping the affordability, availability and desirability of foods (Herforth & Ahmed, 2015). Changes in lifestyle habits are key to the growing levels of overweight and obesity (Werle et al., 2013). Yet many now believe that these habits have formed due to the ways in which the food environment has changed over recent decades. The sheer rapidity of the obesity epidemic's rise has led to many attributing its causal roots to wider environmental,

societal and political changes, as opposed to any transformations in genetics, psychology or physiology (see discussion in Sallis & Glanz, 2009).

Unhealthy food and the messaging that promotes its consumption has become increasingly easy to access in recent years. Palatable, energy-dense nutrient-poor foods are readily available, often at affordable prices, wherever food is sold. Concurrently, marketing strategies that cue excess consumption are also becoming increasingly pervasive and persuasive (Folkvord & Hermans, 2020; Swinburn et al., 2011). A Lancet Commission report in 2019 highlighted the role the food environment plays in interacting with the individual vulnerabilities of consumers (including biological, psychological, social and economic) to shape preferences, demand and ultimately supply for energy-dense nutrient-poor foods (Swinburn et al., 2019). As consumption-led economies that rely on building supply and demand have become more prevalent, so too have rates of overweight and obesity (Swinburn et al., 2011). Likewise, as the relationship between energy density and energy cost has inversed, the most energy dense options available within our markets have become the most affordable (Drewnowski, 2004).

Exposure to food environments that make unhealthy foods more affordable, available and desirable is positively associated with body weight. For example, in the US, the presence of food swamps in a neighbourhood is positively associated with that area's adult obesity rates (Cooksey-Stowers, Schwartz & Brownell, 2017). Food swamps are areas where energy-dense nutrient-poor fast and junk foods are more readily available. In terms of affordability, there have been several examples that demonstrate that the prevalence of overweight and obesity is higher in food environments where sugar sweetened beverages are sold for lower prices (e.g. Ferretti & Mariani, 2019; Headey & Alderman, 2019). For desirability, children's preferences for and consumption of energy-dense nutrient-poor foods and the prevalence of overweight/obesity have been shown to be positively associated with exposure to junk food advertising within the food environment (Cezar, 2008; Jolly, 2011; Lobstein & Dibb, 2005). Some mathematical simulation models have provided further support to the idea that junk food advertising plays a significant role in shaping the prevalence of childhood obesity in several countries (Goris, Petersen, Stamatakis & Veerman, 2010), and that the complete removal of such advertising could cause significant reductions in childhood obesity prevalence levels (for an example from the US, see Veerman, Van Beeck, Barendregt & Mackenback, 2009). These are but few of the multitude of examples of how the

composition of the food environment can shape the prevalence of overweight and obesity within the population.

As a result, many view that these shifts within the food environment, that increase the availability, affordability and desirability of less healthy food, have accelerated the increases in consumption that, hand in hand with decreases in activity, drive the obesity epidemic. While there is acknowledgement of the fact that individual differences contribute in determining how different people's dietary behaviours are differentially influenced within an obesogenic food environment (Stok et al., 2015), there is a general consensus that action needs to be taken beyond the individual level to generate large-scale impacts. Environmental factors interact with individual level ones, with the summation of their individual and combined effects manifesting as overweight and obesity at population level. Addressing some of the contributing environmental factors could reduce the magnitude of these effects.

It is now widely believed that significant reform is required if global rises in overweight and obesity are to be stopped or reversed (Folkvord & Hermans, 2020). In its current form, our food environment makes unhealthy choices easier choices for the consumer, enabling the excess consumption behaviours that fuel the obesity epidemic (Uzogara, 2017). Physical activity and energy expenditure are of course another key component of this equation. However, the ways in which the food environment shapes dietary behaviours and energy intake are the focus of this thesis. Here, we focus on applying our understanding of psychology to some of the methods currently being adopted in practice within the drive to produce a better food environment, which gives healthier choices the upper hand.

1.3. Changing dietary behaviours

A healthier food environment should enable people to make healthier choices. Having the opportunity and motivation to engage in a behaviour is key for behaviour change to occur (Michie, van Stralen, & West, 2011). If we wish to help people make healthier dietary choices within our food environments, making more nutritious foods more accessible, more readily available and more affordable could all contribute in producing a food environment that supports engagement in healthier dietary behaviours (Folkvord & Hermans, 2020; Swinburn et al., 2019).

It is these behaviours, and their sensitivities to environmental shifts, that are the focus of this thesis. While systemic change is needed to transform our food environment for the better, we

must ensure that the changes made are informed by psychology and well aligned to the ways in which people make their food choices, and approach their dietary behaviours. Individuals may need additional support in making healthier choices within an environment that is hell-bent on promoting the opposite. To provide this support, we must develop a greater understanding not only of the ways in which interventions can shape behaviours for the better, but also the psychological processes at play when we intervene within food choice environments.

Much can be learnt about the ways in which we can encourage and enable people to make healthier choices through exploring theories of behaviour change. Nudge theory, largely based on the preceding empirical work of Kahneman and Tversky (e.g. Tversky & Kahneman, 1973, 1974, 1985), relates to the ways in which we can use our understanding of heuristic processing to design interventions that bring about change (Thaler & Sunstein, 2008). The theory acknowledges that as people, much of the decisions we make are the result of automatic processes, as opposed to the rational and measured thought processes that might be expected. Nudging people towards certain beneficial decisions involves designing the choice environment around these automatic processes.

The nudge approach (built on the authors' earlier ideas of libertarian paternalism (see Thaler & Sunstein, 2003)) does not seek to take away freedom of choice, but shapes the choice environment in such a way that people are more likely to make the decisions that are better for themselves and society. Thaler and Sunstein (2008) describe this idea as choice architecture. The same choices are available, but they may be more or less easy to make. Some examples of how this could translate to the context of food choices would be making healthier options more salient with effective marketing, or making them more conveniently accessible (e.g. moving unhealthy options further away from the checkout increases the effort required to acquire them, in turn reducing their selection (see review of positional nudges for food choices by Bucher et al., 2016)). The choices themselves are therefore maintained, but their presentation is not. In contrast, some interventions take a more purely paternalistic approach, changing the range of choices available to consumers (e.g. restricting the sale of less healthy foods within certain choice environments).

More recently, the learnings of these theories have been applied with a practical perspective within the COM-B model, behaviour change wheel and behaviour change taxonomy of Michie and colleagues (Michie et al., 2011; Michie et al, 2013). The COM-B model highlights how behaviour is determined by an individual's capability, motivation and opportunity to engage in it. Manipulations to the food environment that seek to produce healthier behaviour should therefore

aim to improve capability, increase motivation and enable opportunities to behave in healthier ways. The behaviour change wheel outlines several intervention functions that all shape these three elements, in turn influencing behaviour (Michie et al., 2011). The behaviour change taxonomy offers detailed guidance on different interventions that serve these functions e.g. restructuring the physical environment, having credible sources communicate messages, or reducing exposure to cues for a negative behaviour (Michie et al., 2013).

A variety of these ideas have been translated into practice within existing interventions of dietary behaviour. Approaches to intervening in food choices range from subtle nudges (e.g. framing healthy food as more indulgent to boost their appeal (Turnwald et al., 2019; Turnwald, Boles, & Crum, 2017)), changing the nature of the choices made available through manipulating price (taxing less healthy options, subsidising healthier ones, or a combination of the two e.g. Appelhans et al. (2018) and French et al. (2001)), and changing the availability of healthy options (e.g. increasing the ratio of healthy foods compared to unhealthy foods (Kocken et al., 2012)), to more paternalistic approaches where the choices themselves are changed (e.g. restricting the sale of soft drinks in schools or removing all unhealthy foods from vending machines (Fletcher, Frisvold & Tefft, 2010; Taber, Chriqui, Frank & Chaloupka, 2014; Welsh Government, 2012)).

The interventions seen in practice adopt a range of methods, which all align with the notions of making the healthier choice the easier choice, and restricting the supply and demand for less healthy foods (Swinburn et al., 2019). Typically, interventions are designed to either a) ease access to or boost the appeal of healthier options (e.g. through subsidies, promotional material, increasing availability), or b) hinder access to or reduce the appeal of less healthy options (e.g. through taxes, displaying cautionary messages or reducing availability).

There are now numerous examples of policies that action such interventions within the UK. For example, the Welsh Chief Medical Officer introduced the Welsh hospital Healthy Vending directive in 2008 (Welsh Government, 2012), which introduced healthy promotional materials, and removed all unhealthy options from vending machines in Welsh hospitals. Nutrition labelling, which aids consumers in identifying healthier options, was made mandatory for most pre-packed foods in 2016 (UK Government, 2022). In 2018, the Soft Drinks Industry Levy took effect (UK Government, 2016), with producers of drinks with high levels of added sugar facing additional costs (in turn encouraging reformulation and improving the availability of healthier options, and in some cases passing additional costs onto the consumer thus making high sugar options less

attractive). More recently in 2020, the Welsh Government launched their "Healthy Weight, Healthy Wales" strategy (Welsh Government, 2020), with the goal of making healthier choices easier choices. In the same year, the UK Government detailed new restrictions to be introduced in April 2022, that prohibit unhealthy foods from being promoted in prominent locations in stores / online, and ban the application of multi-buy promotions for such products (UK Government, 2020).

There is therefore ample evidence of action being taken to produce a healthier food environment. However, our understanding of some of the most common approaches is limited. Introducing barriers to certain choices or facilitating others may generate different psychological responses in different circumstances. We have much to learn about how these interventions might work in practice, and about how harnessing knowledge from psychology could play a key role in shaping them for the better. This thesis compiles an array of evidence that contributes in filling these gaps.

1.4. Summary of thesis themes and aims

The first evidence gap that this thesis seeks to address relates to the complete replacement approach, as applied within vending machines. Applying restrictions that remove the opportunity to engage in a less desirable behaviour within a certain environment (e.g. make less healthy choices in a specific food environment) is one paternalistic approach that is detailed within the behaviour change wheel, and rooted within the COM-B theoretical model (Michie et al., 2011). Removing all unhealthy options from a vending machine and replacing them with healthy ones could be expected to produce healthier behaviour.

This approach has already been applied in practice for a number of years. Complete healthy vending is a key component of the Welsh Healthy Vending directive that was rolled out more than a decade ago (Welsh Government, 2012). Yet to date, there is a lack of empirical evidence to support its adoption. We have no way of knowing whether removing all unhealthy options will actually produce healthier behaviour, both at the machine and away from it. A paternalistic approach of this kind where the composition of the food choice environment is changed may well improve the quality of individual purchases made within it (that is, each sale will be less energy-dense), however overall dietary behaviour is not guaranteed to be improved. Individuals may compensate for the lack of opportunity to purchase energy-dense nutrient-poor foods through

seeking them out elsewhere (Fletcher et al., 2010; Taber et al., 2014), or buying additional items. These behaviours could jeopardize intervention success. Furthermore, the economic impacts of such an intervention must be evaluated if practitioners are to be convinced of its feasibility. We explore these ideas further in Chapter 2, where we aim to:

1. establish the ways in which the complete replacement approach influences the nutritional quality of purchases made at vending machines
2. explore the economic impacts of a complete replacement intervention within vending machines (including sales volume and profit)
3. determine whether a complete replacement intervention leads to the occurrence of compensatory behaviours either
    a. at the machine (with individuals purchasing a greater number of products)
    b. away from the machine (with individuals seeking out energy-dense nutrient-poor foods elsewhere)

Health labelling is the second theme explored within this thesis, with our discussions spanning across Chapters 3 and 4. With much of the food marketing landscape serving to increase the demand for unhealthy foods, there is increasing acknowledgement of the ways in which marketing messages can be used instead to signpost consumers towards healthy options and promote their selection (Folkvord & Hermans, 2020). In recent years, health labels that try to nudge consumers into making healthier choices within food environments have become increasingly commonplace in practice. They are a particularly attractive intervention option for practitioners as they are easy and cheap to embed within food environments, without changing the composition of the offering. Yet to date, there is limited evidence to indicate that health labels are an effective means of changing consumer behaviour for the better. Research to date has found that their effects are largely limited, and highly heterogeneous (Grech & Allman-Farinelli, 2015; van't Riet, 2013).

In Chapter 3, we explore ways of boosting the effectiveness of health labels through using ideas shaped by nudge theory and the behaviour change taxonomy (Michie et al., 2013; Thaler & Sunstein, 2008). Research from social psychology has highlighted how the same messages can be evaluated differently when given by different sources (e.g. Chaiken, 1980). Prior research has suggested that the more credible a source, the more persuasive their messages (Atkinson & Rosenthal, 2014). Capitalizing on this heuristic could improve the impact that health labels have

on consumer choices. In Chapter 3, we test whether embedding these nudges within a specific food environment (a vending machine) can increase the selection of healthy options and/or decrease the selection of unhealthy products, and shape the overall quality of dietary behaviour within a vending food environment. In Chapter 3, we aim to:

1. establish the ways in which health labels (with or without a credible source) impact the sales volumes of both healthy and unhealthy products within vending machines
2. determine whether health labels (with or without a credible source) impact the healthiness of individual behaviour within a vending food environment (e.g. whether individual consumers purchase a less items when health labels are present)

In Chapter 4, we continue to build our understanding of health labels and the ways in which they function to influence consumer evaluations. While their effects in prior research have been heterogeneous, their acceptance by practitioners and ease of use as nudges warrants developing further knowledge about the ways in which they can and cannot shape evaluations and ultimately choices. Signposting consumers towards healthier options and providing health information at point-of-purchase may indeed make it easier for consumers to identify healthy products (Hoefkens, Veettil, Van Huylenbroeck, Van Camp, & Verbeke, 2012). However, once their attention has been drawn, health labels may also shape the ways in which products are evaluated, and in turn, the extent to which they are selected. We explore how health labels (both direct and suggestive) might function differently dependent on product familiarity, arguing that labels are most informative and most likely to shape evaluations of product features under conditions of uncertainty. Furthermore, we explore whether the absence of a health label can communicate the healthiness of a product. In Chapter 4, we aim to:

1. establish whether health labels are more likely to shape consumer evaluations of unfamiliar products (testing evaluations of price, taste and healthiness)
2. determine whether health labels function differently dependent on the subtlety of their messaging (e.g. exploring whether subtler health messaging produces comparable effects to direct messaging)
3. explore whether the absence of a label on a product can serve an informative function within a choice environment where other health labels are present

We investigate the final theme of this thesis in Chapter 5. In our view, one limitation in the development of interventions that produce a healthier food environment is the tendency to look at the behaviours they produce in isolation. In the final empirical chapter, we consider the succession of behaviours, and how a prior choice, made in a healthier food environment, could produce less healthy behaviour further down the line.

Choices do not exist in isolation – they are interlinked and shape each other, and failing to account for this in our food environment interventions and their evaluations limits their applicability (Maki et al., 2019; Nilsson, Bergquist, & Schultz, 2017). In Chapter 5, we focus on the ways in which restricting or removing unhealthy options from food environments might shape behaviours that follow. This is touched upon in Chapter 2, as we explore the potential compensatory behaviours that arise from restricting unhealthy options within vending machines.

Prior work has highlighted how overall consumption can remain stable, or even increase when unhealthy options are removed from food environments within paternalistic interventions, as individuals compensate through seeking them out elsewhere (e.g. Fletcher et al., 2010; Taber et al., 2014). Likewise, nudging consumers to select healthy options through presenting them first within a selection has been linked to greater overall consumption levels and increased unhealthy purchasing (Flores, Reimann, Castaño, & Lopez, 2019; Wisdom, Downs, & Loewenstein, 2010). Exposure to healthy food environments, or the initial selection of healthy choices could therefore increase subsequent consumption, jeopardizing the health benefits of interventions within food environments. We test the extent to which individuals follow their initial healthy behaviours with indulgent ones in the Chapter's first two experiments.

One caveat that warrants exploration is the suggestion that these effects across successive choices are dependent on the attribution of behaviour. Some have hypothesised that attributing an initial healthy behaviour to oneself instead of an external agent could licence later indulgence (Bradley-Geist, King, Skorinko, Hebl, & McKenna, 2010). This could mean that the more overtly paternalistic an intervention, the less likely it is to produce licensing effects. However, others have argued that when healthier choices are enforced, consumers make no commitment to health and feel less compelled to make healthier choices afterwards (Finkelstein & Fishbach, 2010). We explore these ideas further in two experiments. In Chapter 5, we aim to:

1. test whether exposure to food environments with high availability of healthy options increases the potential for subsequent licensing effects to occur
2. determine whether interventions that enforce healthier choices are more or less likely to produce licensing effects

To close, in Chapter 6 we discuss the key themes that emerge from our findings, reflecting on their implications for future interventions, practice and policy action that serves to produce a healthier food environment.

Chapter 2. The health benefits and cost-effectiveness of complete healthy vending

2.1. Chapter Introduction

Vending machines are machines of convenience. Offering 24-hour access to food and drink in public spaces such as schools, hospitals and workspaces, they are many people's first choice when searching for a quick pick-me-up. It is therefore unsurprising that vending machines are predominantly stocked with quick-fix foods that are high in energy, but low in nutritional content. This has led some to describe vending machines as obesogenic food environments (Rosi et al., 2017). While the financial advantages of these 24-hour, zero-contact sales machines is undeniable, so too is their contribution to the obesity epidemic currently being evidenced across the globe (Uzogara, 2017). With vending machines so widely dispersed across all manner of settings, addressing their contribution to the composition of the food environment, and in making less healthy choices easier choices, is important for reducing obesity levels. In this study, we investigate one simple approach to making vending healthier: the complete replacement of standard products typically considered unhealthy (i.e. energy-dense nutrient-poor foods) with healthier options (i.e. products low in salt and added fat/sugar).

While such an intervention has already been introduced in practice (e.g. Welsh Healthy Vending directive discussed in Chapter 1 (Welsh Government, 2012)), existing evidence of its effectiveness is scarce. Prior research has predominantly focused on environments in which healthy and regular products are both available and consumers have the choice of which to purchase. The goal has been to find ways of increasing the proportion of healthier sales made by consumers. We divide this literature into two general approaches. The first is to make healthier choices more appealing using labelling or promotional material. Enabling healthier choices through adding information to the choice environment that eases the process of identifying healthier options is the goal of many widely-used interventions e.g. the traffic light label system in the UK (UK Government, 2022). Two vending studies have shown some success in using this approach. French et al. (2001) applied health labels and health-promoting signage to 55 vending machines over 12 months. Low-fat sales accounted for 14.3% of all sales in the no label condition, but 15.4% with labels and signs. The increase was significant across vending location. In a school-based randomised control trial, Kocken et al. (2012) increased the availability of healthier options and used hand signals to label products as being either favourable (thumbs up – 99 calories or

less), moderately unfavourable (index finger – 100-170 calories) and unfavourable (thumbs down – 171 or more calories). The intervention led to moderately unfavourable products accounting for 26.6% more of all sales, and unfavourable products accounting for 27.6% less of all sales. Sales of favourable products were unchanged, with less than 2% of all sales coming from such items.

Despite these promising findings, food choice interventions that use healthy labels and messages appear to have limited success. A review of the use of promotional materials and labels providing health information in vending machines conducted by Grech and Allman-Farinelli (2015) found that effects were either absent or minimal across the eight studies considered. Labels are easy to ignore, and some have questioned whether their effects are weak as they are not always used, or not always effective in inspiring change (Brambila-Macias et al., 2011; Mhurchu, Eyles, Jiang, & Blakely, 2018). Whether or not they are read is one question, with whether they can provide sufficient motivation for changing food choice being another (Brambila-Macias et al., 2011). Information alone may not be enough.

The second approach is to alter the relative costs of the choices, either by taxing less healthy products or by subsidising healthier ones. These measures make healthier behaviours easier, and less healthy behaviours harder. Fiscal measures of this kind are highlighted as viable behaviour change techniques within the behaviour change wheel and COM-B model (Michie et al., 2011). When framed within this model, subsidising healthier options or taxing less healthy ones can increase the motivation and opportunity to make healthier choices, and decrease these fundamental conditions of behaviour change for less healthy choices.

The existing literature demonstrates how subsidising healthier products has a robust positive impact, with greater reductions in price leading to higher proportions of healthy sales (Grech & Allman-Farinelli, 2015). For example, French et al. (2001), described above, also applied price reductions of 10%, 25% and 50% on low-fat products. They observed significant increases in sales of healthy products of 1.0%, 4.2%, and 10.1% respectively, with no loss in revenue.

Taxing unhealthy options within vending machines has been tested far less extensively but existing evidence shows similar benefits to subsidising healthy options. A 25% tax on unhealthy items was tested in a 14-month trial with data collected at two vending locations (Appelhans et al., 2018). In addition to the tax, the researchers tested a 25% discount on healthy items, a 25 second delay in the vending time of unhealthy options and a combination of time delays and pricing interventions. All interventions successfully increased the proportion of healthy choices made, yet

the most effective was the 25% price tax on unhealthy products, which increased the proportion of healthy choices made within the machine by 13.6%. Introducing financial enablers to healthy choices, and barriers to less healthy choices are therefore two viable intervention-options within vending environments where both healthy and less healthy foods are available.

Substantial health gains can therefore be made by manipulating price and other factors within mixed vending machines (Appelhans et al., 2018; French et al., 2001; Grech & Allman-Farinelli, 2015). Nonetheless, more impressive changes in health behaviour might be obtained if the opportunity to make less healthy choices is completely removed (Michie et al., 2011). In other words, removing regular products entirely and leaving only healthy products. If people have no choice but to choose healthy products at the machine, their behaviour will surely become healthier. Despite their more intrusive nature, previous literature has suggested that measures that change the composition of the choice environment hold far greater potential to produce positive change than solely adding information to these environments (Brambila-Macias et al., 2011).

That being said, prior studies adopting the complete replacement approach are few in number, and those that exist suggest some difficulties. The first is that consumers may go elsewhere to search for unhealthy products. While vending machines follow certain healthy eating restrictions, other vendors do not. If consumers are frustrated or dissatisfied with the offering in the machine, they may search for alternatives at other nearby outlets. While vending would be 100% healthy, behaviour would not necessarily be so. This problem is illustrated by studies examining the effect of removing sugared soft drinks from vending machines in schools. Taber et al. (2014) measured the association between vending access to soft drinks and consumption in 10,000 schools across the United States. They found that overall consumption of soft drinks was higher in children where school vending of soft drinks was restricted. Taber and colleagues (2014) suggested that without a whole-environment change to soft drink supply, children were able to obtain drinks elsewhere, where they overcompensated for the removal of soft drinks from the school vending machines. In the same vein, evidence from another school study shows that while soft drink consumption on school premises decreased where soft drink vending sales were restricted, overall consumption (including off premises) did not differ across groups (Fletcher et al., 2010). This highlights the need to evaluate the effectiveness of vending interventions not only based on what happens inside the machine, but also on what happens outside of it (Appelhans et al., 2018; Bos, van der Lans, van Kleef, & van Trijp, 2018; French et al., 2001).

A second concern for interventions that completely remove unhealthy products is that consumers may buy more healthy products to replace the perceived loss of satiation that occurs from not consuming unhealthy products (e.g. buying two healthy bars to replace one unhealthy bar). Healthy products are often considered to be less satiating (Suher, Raghunathan, & Hoyer, 2016), and consumers may consider that a single item purchased at a healthy vending machine could be less satiating than a single item bought from a less healthy range of products, and alter their purchasing accordingly if satiation is their key dietary goal. There is currently no evidence for this compensatory behaviour but nor are there any vending studies that have tracked the behaviour of individual consumers in real-choice scenarios. Data showing an increase in the sales of healthy products (e.g. with price reductions in French et al. (2001)) are consistent with fewer individuals making more multi-item purchases. Furthermore, the advent of credit card readers in vending machines removes some of the impediments to multi-item purchasing (e.g. less need for coinage, less time needed per transactions), and so multi-item purchases might be more frequent now than in the past. If multi-item purchasing is more common in machines that stock only healthy items, behaviour may not necessarily be healthier.

A final concern with complete healthy vending is that the loss in revenue may be unsustainable. Balancing cost and public health benefit is a common concern for health interventions (Berwick, Nolan, & Whittington, 2008; Weatherly et al., 2009). Catering departments may be reliant on vending machine revenue, and any action that would jeopardize these profits may be approached with reluctance. Previous vending studies have not observed a drop in profit during healthy vending interventions (Appelhans et al., 2018; French et al., 2001; Kocken et al., 2012). However, the interpretation and relevance of these studies with respect to complete healthy vending is complicated. First, previous studies have all used partial healthy vending. Particularly determined consumers have always had the option of choosing their regular products if they wished. As noted, if regular products are not available, consumers may switch to purchasing elsewhere or to purchasing nothing at all. Complete healthy vending would suffer a drop in revenue from these consumers whereas partial healthy vending would not. Second, some partial healthy vending interventions have included salient price discounts on healthy products (Appelhans et al., 2018; French et al., 2001; Kocken et al., 2012). The discount has the effect of increasing sales volume by creating extra demand, thereby offsetting any drop in demand for the regular product (and increasing the total number of calories consumed). In complete healthy

vending, any discount applied to healthy products would not be salient because there would be no non-discounted products with which to compare it. Discounting healthy products within complete healthy vending may not be a viable option for balancing revenue. Finally, the product range used across studies varies considerably and random effects of product range have not been included in statistical analyses. While these studies have demonstrated that their interventions are both health and cost effective within their product ranges, it is difficult to know whether effects on sales volume (or any other dependent measure) would replicate in other environments where different product ranges are available.

In summary, complete replacement of unhealthy products may have the potential for generating large health improvements. Nonetheless, it may result in problematic compensatory behaviours, and implications on revenue are unknown. This chapter reports a controlled experiment to test the health and cost implications of complete healthy vending.

2.E1.1. Complete replacement as a healthy vending intervention

Sales data were collected from vending machines located in a hospital environment. Stock was varied fortnightly between a regular (unhealthy) range and a healthy range over the course of six months. To assess healthy behaviour, the calorific content of products sold was measured, and sales were measured through analysing sales volume and cost/profit. The analysis for both used linear mixed models with time and product range as random effects. Potential compensatory behaviours were also explored. To establish whether consumers would search elsewhere for regular snacks during healthy vending periods, sales data from the nearby convenience shop were analysed, with the hypothesis that unhealthy sales would increase at the shop during healthy vending. Finally, credit card data and on-site observations were used to test the hypothesis that individuals would compensate for the lack of unhealthy options available at the machine by making more multi-item purchases during healthy vending periods than regular periods.

2.E1.2. Materials and methods

2.E1.2.1. Participants

Participants voluntarily made purchases from vending machines without being aware that they were taking part in a study. Ethical approval was granted from the NHS research ethics committee (IRAS number: 231390) and the Cardiff University School of Psychology ethics

committee. Permission was given not to collect consent from participants and to not inform them of the nature of the study.

2.E1.2.2. Study design

The independent variable was vending condition (two levels: healthy vending, unhealthy vending). Healthy and unhealthy stock was alternated across two vending locations within a large hospital site. Healthy stock was available in one vending location and, concurrently, unhealthy stock in the other. Stock type was systematically rotated across the two locations every two weeks. The study lasted for 24 weeks. Across the duration of the study, each vending machine contained healthy stock for 12 two-week periods and unhealthy stock for 12 two-week periods. Sales data from the vending machines were used to measure three dependent variables - sales volume, profit and calories sold. Discussions with the vendor around average sales indicated that the study would be sufficiently powered to identify small effects within a much shorter timeframe, however the study was carried out over 24 weeks to better account for variability across time.

2.E1.2.3. Implementation

Within the scoping phase, discussions with the Aneurin Bevan University Health Board (with representatives from their Public Health team, a dietitian and the facilities team) resulted in access being provided to their hospital premises and vending contractors for study implementation. The hospitals within the health board were scoped for suitability (with the number of vending machines being investigated, as well as foot traffic at each site). Two vending machines at the Royal Gwent hospital in Newport were selected for use in the study based on the conclusions of this a priori work.

The two vending machines were located in public areas, where staff, patients and visitors could all access the machines. One machine was located in an Accident and Emergency department (*A&E* machine), the other in a reception area (*reception* machine). The A&E machine was in an isolated location, separated from other food outlets. The reception machine was located within the main entrance for maternity patients, and on the same floor as a coffee shop and restaurant, which sold a variety of snacks and hot and cold meals (see Appendix 1 for hospital floor plan).

Vending machines were identical (Model: Necta Tango) running the Nayax vending system. The machines allowed cash and card purchases. They had 32 coils, 16 for crisps (four items in each of the four top rows) and 16 for bars/small packets (eight items in each of the bottom two

rows). Product sold, location, exact time and method of purchase (cash or card; first and last four digits recorded if card) were all recorded by the Nayax system.

Planograms (diagrams of the planned visual layout of stock) were kept constant throughout the trial (see Appendix 2). The fidelity of the compliance to this layout was monitored by supervising the first three changeover periods (when stock from each machine was swapped over) and by receiving timestamped photographic evidence of the layout from each changeover thereafter. Time estimates for each changeover period during the trial were also obtained from the vending machine providers, to ensure that these were kept consistent and could be cross-referenced with the sales data to ensure all sales were logged under the correct condition.

2.E1.2.4. Vending snacks

Snacks were selected by the vending provider (JDJ Vending Services) and the research team (including a Public Health Wales Consultant and a Public Health Wales Dietitian). All snacks were selected with the aim of maximizing profit subject to the healthy/unhealthy experimental constraints.

Healthy snacks satisfied the Welsh Hospital Healthy Vending directive constraints (Welsh Government, 2012) whereas unhealthy items did not. The government-developed constraints set strict guidelines for fat, saturated fat, sugar and salt levels for all vending products (see Appendix 3 for further details). For the healthy condition, there were 19 distinct snacks, 13 of which occupied two coils, and for the unhealthy condition, there were 23 distinct snacks, 9 of which occupied two coils. The size of the range differed across conditions because more unhealthy snacks were available from the vendor than healthy snacks. Details of the nutritional information for each individual snack can be seen in Appendix 4. The mean wholesale cost of products was comparable across healthy and unhealthy products, M_{Healthy} = 44p (SD = 5p), $M_{\text{Unhealthy}}$ = 43p (SD = 3p), and to ensure that products were equally affordable for all potential customers, all products were sold for 80p. Wholesale cost and profit margins for each product can be found in Appendix 5.

2.E1.2.5. Observational study

An observational study was completed concurrently with collection of the vending data. The goal was to obtain information about multiple purchases. Observations occurred during two time points of the study – a five-day period in the first changeover period, and a five-day period in the sixth changeover period. Observations were made Monday to Friday, from 11:30am to

17:30am, with observations occurring at each machine in alternating 1.5 hour periods. The order of observation was counterbalanced across the five days. During the observation period, data was collected on the number of items purchased by each individual consumer, and the time it took to complete their purchasing (starting from when they approached the machine, and the last time measure recorded being that noted for the collection of the last item purchased). The researcher sat in a location where the machine was in view and recorded all purchases on a mobile device. As both machines were located in areas where members of the public often sat waiting, this was regarded an appropriately covert method.

2.E1.2.6. Shop comparison

The reception vending machine was located close to a shop selling healthy and unhealthy snacks. The shop was open 8am to 4pm, seven days a week, and was approximately 25 meters from the vending machine. To establish whether healthy snacks in the vending machine led to replacement purchasing of unhealthy snacks elsewhere, data on the sales of unhealthy products at the shop were obtained for the study period. See Results for analysis.

2.E1.2.7. Statistical analyses

The data were analysed as mixed models with the lme4 package in R (Bates et al., 2022). Individual products (*items*) and time period were included as random effects. Model specification was maximal (see Barr, Levy, Scheepers, & Tily, 2013), in that all possible random effects parameters were included. *p*-values were computed with the Kenward-Roger and Satterthwaite approximations to degrees of freedom, implemented in the lmerTest package (Kuznetsova, Brockhoff, & Christensen, 2016).

2.E1.3. Results

Across the 6-month trial period, a total of 17,571 sales were made across both machines. Of these, 9959 sales were made in A&E and 7612 sales were made in the reception area. The sales data from both machines in both conditions of the experiment were used to explore the impact on the healthiness of behaviour and the cost of the intervention.

2.E1.3.1. Health behaviour

The calories sold across the healthy and unhealthy conditions of the experiment were compared. The healthy range of items had a lower mean calorie content per item than that of the unhealthy range, M = 130.50 kcals (SD = 41.46) *vs* M = 226.63 kcals (SD = 65.99). Nutritional

information for each item on sale was mapped onto sales volume data within each condition of the experiment. 923,000 kcals were purchased in the healthy condition and 2,354,000 kcals were purchased in the unhealthy condition. This equates to a 61% drop in the number of calories sold from the unhealthy condition to the healthy condition.

To assess whether the drop in calories sold was robust across time and item range, we obtained an average calorie sold score for each fortnightly time period and tested a mixed effects model with product condition (healthy, unhealthy) and machine (A&E, reception) as fixed effects, and fortnightly time period (N = 12) and item range (healthy N = 19; unhealthy N = 23) as random effects. Random intercepts and slopes were included for time period and random intercepts for items.

Significantly fewer calories were sold in the healthy product conditions of the experiment, $\beta = -2240.74$; SE = 579.23; t = -3.87; $p < 0.0001$ (see Figure 1). In addition, significantly more calories were sold in the A&E machine than the reception machine, $\beta = 742.25$; SE = 184.38; t = 4.03; $p < 0.0001$, but there was no interaction between product condition and machine, $\beta = 41.86$; SE = 208.85; t = 0.20; $p = 0.84$. In short, stocking healthy items successfully lowered the number of calories sold relative to stocking unhealthy items.

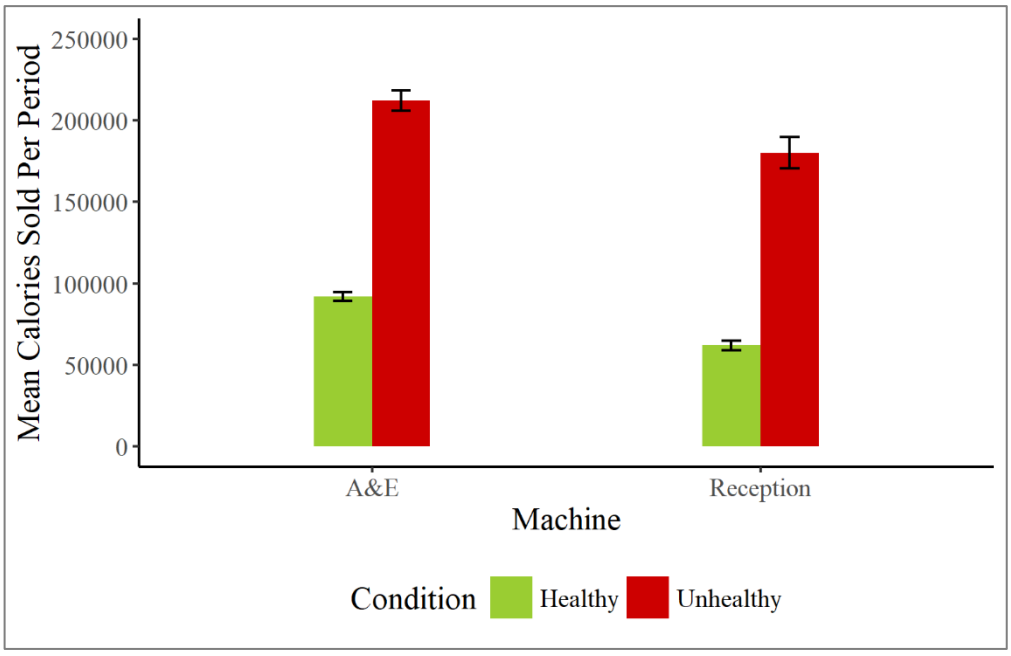


Figure 1. Mean number of calories sold within a fortnightly period for each product type, in each machine. Error bars show standard error of the mean with respect to time period.

2.E1.3.2. Sales volume

Sales were higher in the unhealthy condition than the healthy condition, with N = 10,155 unhealthy and N = 7,416 healthy sales being made across the 6 months of testing. In a similar approach to the assessment of calories, we calculated sales volume for each of the 12 time periods of the experiment and tested a mixed effects model with period and item as random effects (see Figure 2). Random intercepts and slopes were included for time period and random intercepts for items.

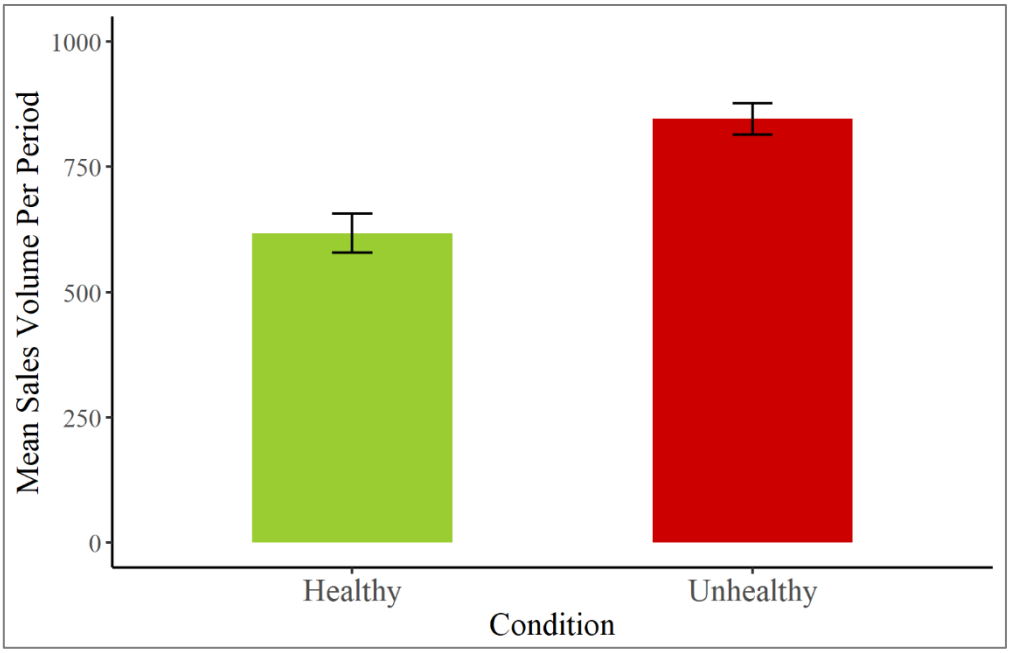


Figure 2. Mean sales volume per period within each condition. Error bars show standard error of the mean.

Surprisingly, we observed no significant effect of product condition, β = -2.13; SE = 2.82; t = 0.45; p = 0.45, nor of the interaction of machine by product condition, β = 1.52; SE = 1.10; t =1.39; p = 0.18. Sales volumes did however differ across machines, with a significantly higher number of sales being recorded in A&E compared to the reception area, β = 4.80; SE = 0.92; t = 5.25; $p < 0.0001$.

To better understand why there were no significant differences across product conditions, we examined the data in more detail. Figures 3 and 4 show the data as a function of time and machine.

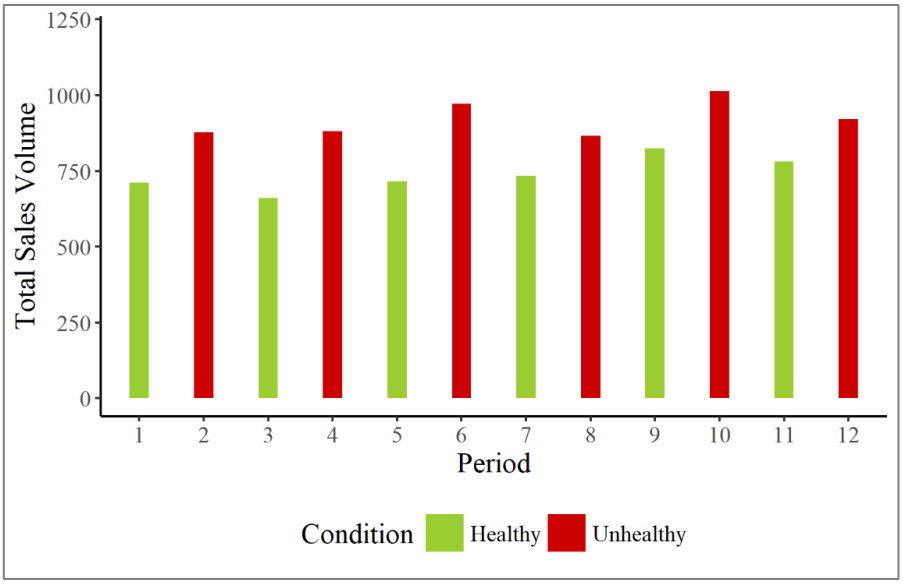


Figure 3. Total sales volume in the A&E machine during each of the 12 fortnightly periods.

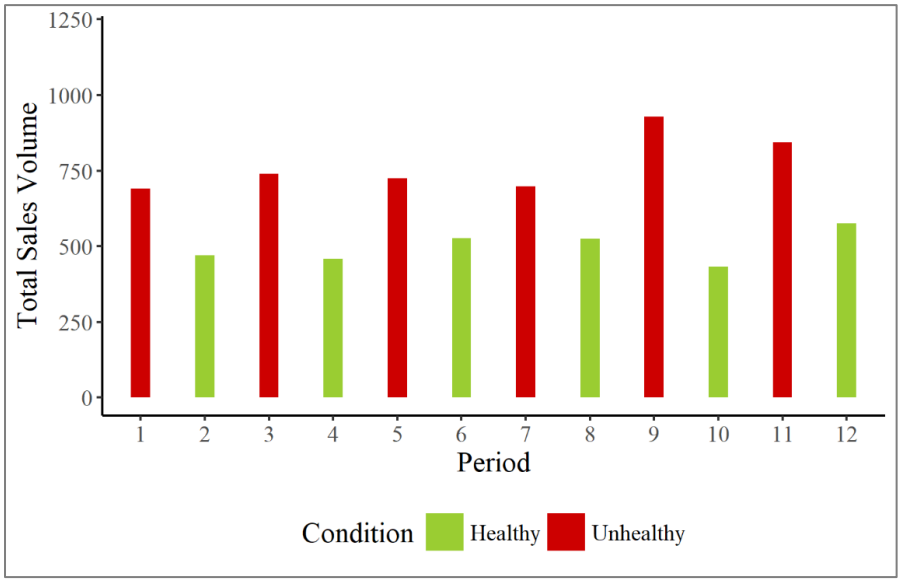


Figure 4. Total sales volume in the reception machine during each of the 12 fortnightly periods.

For both machines, there were more sales for unhealthy products than healthy products across the entire time span of the experiment. To test this, we constructed a model that included product range and machine as fixed factors and time as a random factor, but not item. This model highlighted significantly greater sales in the unhealthy product condition, $\beta = -2.13$; SE = 0.88; t

= -2.43; p = 0.02. There was no interaction of product condition by machine, β = 1.52; SE = 0.88; t = 1.73; p = 0.08.

This pattern of results (significance of product type dependent on inclusion of item as random effect) suggests that across item variability for sales volume was high. Figure 5 illustrates this graphically.

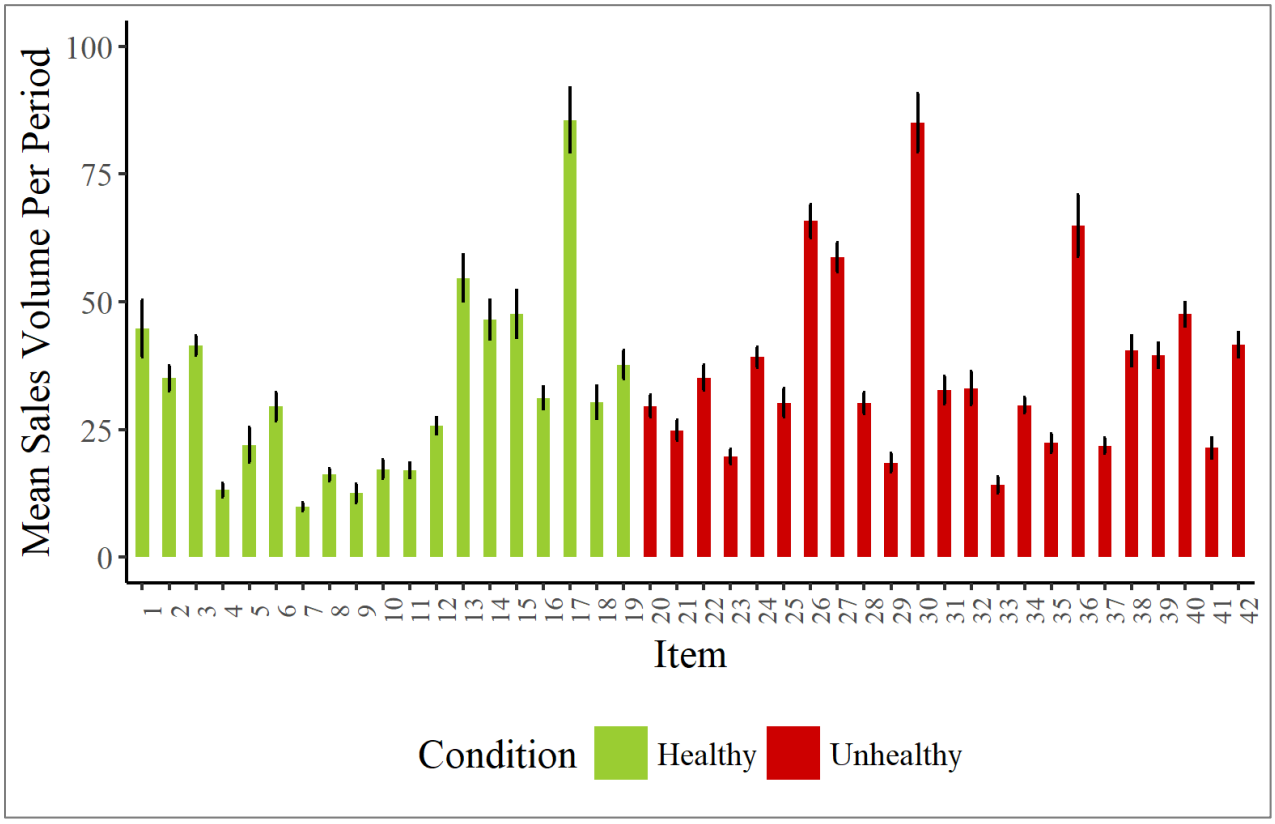


Figure 5. Mean sales volume per period for each item (grouped by condition). Each bar represents a different item (numbers for each item correspond to those in Appendix 4). Error bars show standard error of the mean.

While there were more sales on average in the unhealthy condition, both product conditions have high variability, with some products selling as much as 80 units in each group, and some as few as 10 units. The high variability ultimately prevents the model from showing significant effects

of the different product ranges on sales. This result and its meaning is considered further in the General Discussion.

2.E1.3.3. Profit

Profit was defined as the difference between cost price and sale price. All products were sold at the same price, 80p. Healthy and unhealthy ranges yielded similar profits per item, *M* = 41p (SD = 3) *vs M* = 41p (SD = 5) respectively. Thus the difference in total profit across conditions was largely determined by the number of sales in each condition. Total profit was £2657.70 in the healthy condition, and £3773.86 in the unhealthy condition.

Not surprisingly, inferential statistics for profit yielded similar conclusions to those of total sales. A mixed model with profit as the dependent measure, machine and product condition as fixed factors, and time and item as random effects revealed no significant effect of product condition, $\beta = -1.01$; SE = 1.10; t = -0.92; $p = 0.37$, but the same model without items as a random effect produced a significant result, $\beta = -1.01$; SE = 0.34; t = -2.96; $p = 0.003$. The effect of machine was significant in both analyses, (analysis including item as random effect: $\beta = 1.76$; SE = 0.33; t = 5.27; $p < 0.0001$; analysis excluding item as random effect: $\beta = 1.76$; SE = 0.34; t = 5.16; $p < 0.0001$), but there was no interaction of machine by product range in either analysis, (analysis including item as random effect: $\beta = 0.50$; SE = 0.40, t = 1.25; $p = 0.22$; analysis excluding item as random effect: $\beta = 0.50$; SE = 0.34; t = 1.46; $p = 0.14$).

2.E1.3.4. Calorie content and sales

The majority of healthy sales came from products under the 100-calorie mark (53%), with all bar one of these being crisps. None of the unhealthy products were below this 100-calorie threshold. Within both the healthy and unhealthy product ranges, there was no significant association between the calorie content of products and their total sales volumes, (Healthy range: r = - 0.29, n = 19, p = 0.23; Unhealthy range: r = - 0.14, n = 23, p = 0.53).

2.E1.3.5. Shop sales

To establish whether participants engaged in compensatory purchasing elsewhere, we examined the sales data of the convenience shop located approximately 25m from the reception vending machine. Items sold in the shop were categorized as either healthy or unhealthy, and the

total sales volumes for unhealthy items at the shop were calculated across the twelve fortnightly periods of the experiment. If people purchased unhealthy products from the shop instead of healthy products from the vending machine, sales of unhealthy products from the shop should be higher when the vending machine sold healthy products than when it sold unhealthy products.

The shop was open 8am to 4pm, seven days a week. Therefore, while this comparison allowed us to explore whether individuals sought out unhealthy snacks at the shop during healthy vending, it could only allow for doing so during the day. As the shop was closed at night, we could not capture the behaviour of those who may have sought out alternative snacks to those offered at the machine during the night.

We conducted the analysis on two sets of products, a restricted range of shop products comparable to that sold in the vending machine (N = 17; the remaining 6 were not sold by the shop), and the entire set of unhealthy products sold in the shop (N= 84). Items were coded as unhealthy/healthy based on the same Welsh vending guidelines used to categorize vending machine items (Welsh Government, 2012). We tracked sales of these unhealthy products at the shop, comparing sales during the times when the machine nearby was selling either healthy or unhealthy products.

Both analyses revealed almost identical fortnightly sales across conditions. For comparable products, healthy vending M = 842 unhealthy shop sales (SD = 91) *vs* unhealthy vending M = 843 unhealthy shop sales (SD = 118); and for all products, healthy vending M = 2757 unhealthy shop sales (SD = 202) *vs* healthy vending condition M = 2721 unhealthy shop sales (SD = 322). A mixed model with sales of the complete shop range as the dependent measure, product condition (healthy, unhealthy) as a fixed factor, and time and item as random factors (random slopes and intercepts for product range) did not show a significant effect of product condition, $\beta = 0.21$; SE = 0.85; t = 0.25; $p = 0.81$, nor did a similar model applied to the comparable product range, $\beta = -0.01$; SE = 1.96; t = -0.01; $p = 0.99$. This suggests that participants were not shifting their purchasing from the vending machine to the shop when the reception vending machine sold healthy products.

2.E1.3.6. Estimates of multi-item purchasing

We also tested whether individuals engaged in compensatory behaviours by making more multi-item purchases when approaching the machine during healthy vending compared to

unhealthy vending. Two estimates of multi-item purchasing were obtained. The first was from the observational sessions and the second from a tally of purchases made on the same credit cards.

2.E1.3.6.1. Observation

A tally was kept of the number of items bought by each individual who approached the machine during observation. Across the ten days of observation, one hundred and nine individuals were observed making single, double and triple item purchases. However, there was no significant difference in the likelihood of single item *vs* multi-item purchases across product conditions (see Figure 6), χ^2 (1) = 2.20, p = 0.14, φ = 0.14.

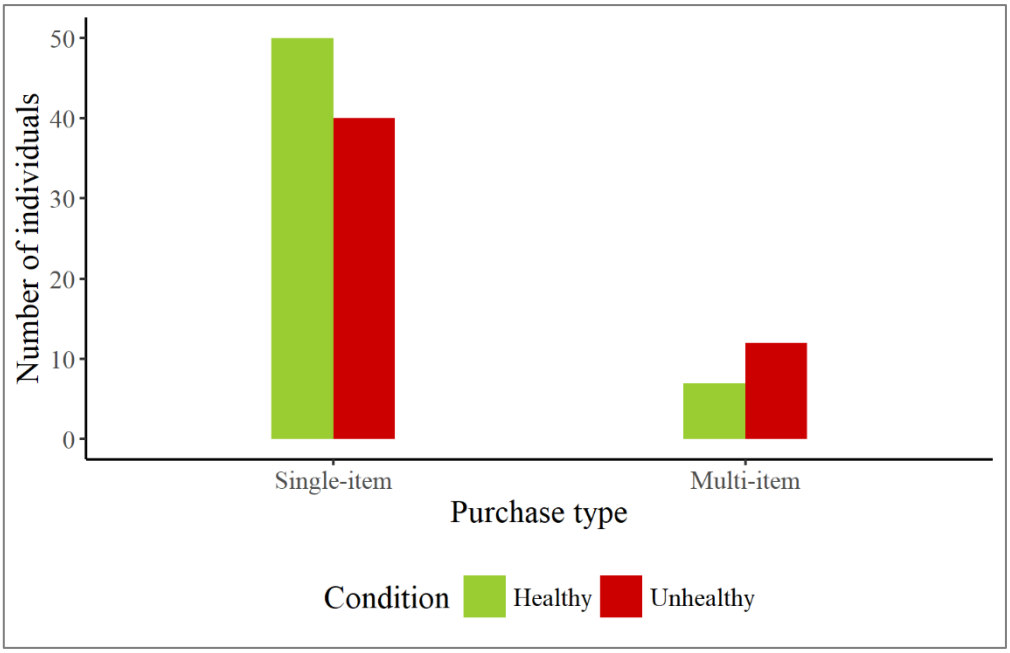


Figure 6. Number of consumers making single or multi-item purchases in healthy and unhealthy conditions during observation.

2.E1.3.6.2. Credit card analysis

The vending machine provided the first and last four digits of each credit card that made a purchase. Purchases made by cards with the same first and last four digits were treated as multiple purchases made by the same consumer.

For those that paid with a credit card, multi-item purchases (N = 792) appeared to be more common than single-item purchases (N = 709) for both the healthy and unhealthy product ranges, with this pattern more pronounced for unhealthy products (see Figure 7). However, there was no

significant difference in the likelihood of single item *vs* multi-item purchases across product conditions, based on credit card sales, χ^2 (1) = 1.41, p = 0.23, φ = 0.03.

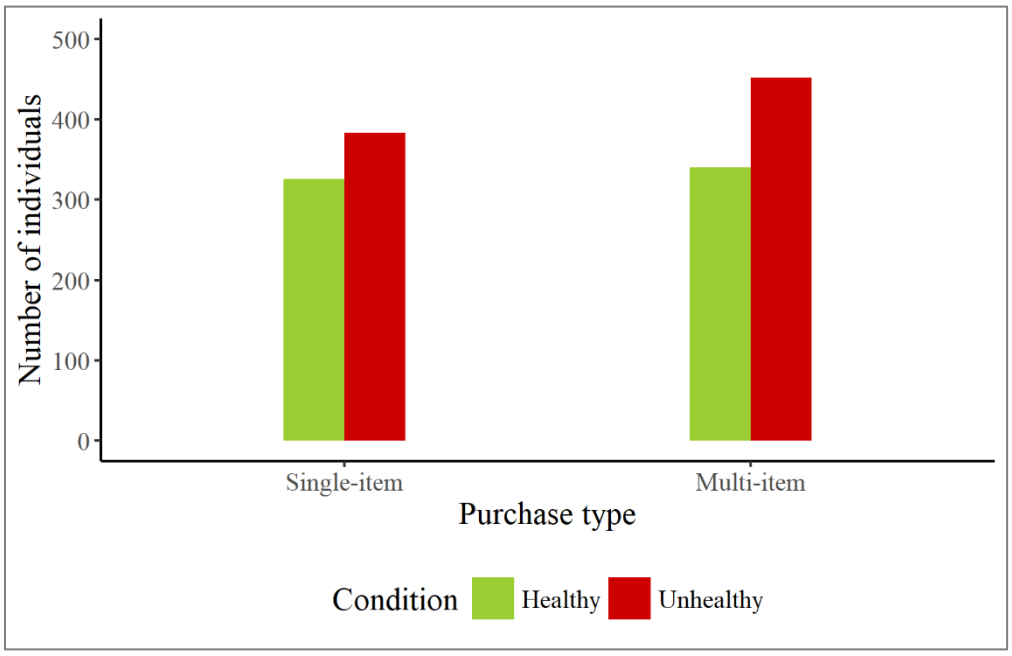


Figure 7. Number of consumers making single or multi-item purchases in healthy and unhealthy conditions with credit cards.

2.2. Chapter Discussion

The aim of this study was to test the impact on health behaviour and the cost effectiveness of replacing unhealthy products with healthy products in vending machines. For health, the data is unambiguous. Healthy vending led to 61% fewer calories being sold. Furthermore, the drop in calories sold was not associated with increased sales of unhealthy products in a nearby food outlet, nor did it result in more multi-purchase sales from individuals seeking to satiate their hunger with a healthier range. These effects were significant across time and product range. For cost, the effects were less clear. While there was a 27% drop in sales volume and a 30% drop in profit associated with healthy vending, these effects were not significant. Overall our results suggest that complete healthy vending can be introduced in hospitals to achieve healthier dietary behaviour, without incurring a catastrophic loss in sales nor introducing compensatory behaviours that offset the public health gains of healthier products.

Healthy behaviour was achieved when removing all unhealthy products from vending machines. Previous research has yielded much lower health benefit. Products under 100 kcals made up 53% of all healthy sales in the present study. In contrast, Kocken et al. (2012) were unable to increase the proportion of sales within this category above 2% in their school-based study where healthier products were made more available, more apparent (through labelling) and more affordable. By using diverse initiatives for healthy products, healthier sales, as a proportion of all sales, can be achieved: 21% with a 50% price reduction (French et al., 2001), 45% with a 75% healthy vending intervention (Kocken et al., 2012), 53.7% with a 25% tax on unhealthy products (Appelhans et al., 2018), and 78% by restricting unhealthy products to 33% of the assortment (Bos et al., 2018). In the present study, complete healthy vending, by definition, led to 100% healthy purchasing at the machine. Clearly, if the primary aim of an intervention is to increase healthy behaviour, completely replacing regular products with healthy products will have the greatest impact.

What is surprising about our intervention is that it did not lead to a dramatic loss in sales or profit. On average, sales in the healthy condition were 73% of those in the unhealthy condition (profit 70%), and this change was statistically significant only in a secondary analysis when the random effects of items were removed from the statistical model (see Implications for vendors, below). That healthy products resulted in a high proportion of sales is an important finding for those interested in maintaining consumer satisfaction and sales, and more importantly, for encouraging vendors and hospitals to supply healthier products.

In addition, there was no evidence that consumers engaged in compensatory behaviours that offset the benefits of healthy vending. We tested two of these potential behaviours. The first relates to purchasing at the individual level. Analysing averages, as has been done in previous vending research, ignores information about how behaviour manifests itself at the individual level. Average behaviour may improve after an intervention but health improvements in some groups may obscure detriments in others. In this study, we were able to monitor individual purchasing by analysing single and multi-purchase behaviour. The concern was that some groups may have stopped consuming entirely while others may have chosen to make more multi-purchases to offset the lower perceived satiation of the healthy options. Contrary to this hypothesis, however, purchasing behaviour was uniform across healthy and unhealthy vending conditions, with the vast majority of sales being single-item purchases. From a public health perspective these findings are encouraging.

Measures of the second compensatory behaviour were similarly positive. Previous research has suggested that imposing bans within certain environments can lead to replacement behaviour occurring elsewhere (Fletcher et al., 2010; Taber et al., 2014). Here, regardless of what was being sold in the reception vending machine, sales of unhealthy items at the vendor 25m away remained stable. Consumers did not seek out the closest available alternative when faced with a healthy selection of products, which in turn suggests that vending machine custom is to an extent captive custom. Consumers will buy at the machine, or if unsatisfied with what is on offer, they will not buy anything at all. Both of these outcomes have a positive health impact (compared to regular vending). However, it must be acknowledged that this comparison only captures sales at one alternative site, and only during the day. There are other compensatory behaviours that this research did not capture (e.g. whether individuals brought more snacks from home during healthy vending or whether behaviour at night differed), and other methods (e.g. interviews with consumers) may be required to gain a complete understanding of what consumers do when faced with unexpected food choices.

2.4.1. Implications for vendors

Profits and sales were first analysed by including time and product range as random factors in a mixed model. Although there was a 27% drop in sales (30% drop in profit) with the introduction of healthy products, the effect was not significant. When the random effect of product range was removed, however, the drops in sales volume (27%) and profit (30%) were significant (across time). This means that if the same products were used in the future, sales volumes/profits from healthy products would be significantly less than those from unhealthy products, but if different products were used, the pattern may not be the same. Whether organisations use a similar range of products as used in the present study depends on the similarity of the vending environment. For example, hospitals in Wales will have access to the same kinds of products as we used in our study and so are likely to experience a similar drop in profit when switching from unhealthy to healthy vending, but those in other countries will have access to a different range of products and can expect a different pattern of sales.

From a vendor's perspective the implication is that the product range is crucial in determining the size of the sales change from unhealthy to healthy vending. A selection of the healthy products in our range sold very well, with the highest selling product across both conditions

being a healthier one (see Figure 5). The healthiness of a product is therefore not necessarily a predictor of its saleability. While our product range produced losses at the machine level, exploring sales item by item can help determine which products might have potential for making healthy vending more profitable.

2.4.2. Changing consumer behaviour vs changing consumers

The change from unhealthy to healthy products could have been accompanied by two sorts of behavioural patterns. One possibility is that there was one specific type of consumer whose behaviour was changed as a consequence of the intervention – those with a preference for unhealthy products. In the healthy condition, such consumers could either be flexible and choose to purchase a healthier product instead, or if they were more inflexible and unsatisfied with the selection, refrain from making a purchase at all (accounting for the difference in sales seen across conditions). The second possibility is that purchases in each condition were made by two separate types of consumer - those that had a preference for unhealthy products, and those that had a preference for healthy products. The unhealthy products attracted only the unhealthy consumers and the healthy products only the healthy consumers. With this explanation, our findings would suggest that the unhealthy group were more numerous than the healthy group.

Categorically distinguishing between these accounts is not possible with our data. An additional, mixed condition would be required in which the entire range of healthy and unhealthy products would be available in a single machine. Comparison between healthy and mixed conditions would indicate the proportion of consumers who changed their preference over and above those who were attracted to the healthy range. However, in our view, the two consumer model is unlikely. This account would require that in the healthy condition, a large number of consumers would have approached the vending machine only to leave empty-handed when they found that no unhealthy products were available. Yet during the observation phase of the study we did not notice such behaviour (although we did not explicitly code for customers not making purchases). Furthermore, if consumers were sufficiently focussed on obtaining an unhealthy snack, they would likely have searched out an alternative outlet that would provide one. Even though the closest outlet to the reception machine was only 25m away, we observed no evidence of such compensatory behaviour.

2.4.3. Limitations and future directions

There are some limitations to the study. The first is that we tested in only a single location (a hospital). It is possible that different locations would yield different patterns of purchasing and compensatory behaviour. For example, hospitals are environments in which healthy behaviour is to be expected and some consumers might approach vending machines with the intention of purchasing healthy snacks. Consequently, the drop in sales with healthy products reported here might be smaller than in other environments in which regular products are expected. Similarly, hospitals have fewer opportunities for alternative venue purchases than other environments such as airports. Compensatory behaviour may be greater where there are more outlets closer to the vending machines. Furthermore, the product guidelines we adopted were developed specifically for hospitals (Welsh Government, 2012). Our findings may not translate to environments with alternative vending guidelines. For example, guidelines in Welsh schools are arguably more exclusionary, with most confectionary and savoury snacks banned within them (Welsh Government, 2014). The impact on sales or the prevalence of compensatory behaviours may be greater if replicating the study in a school environment. Nevertheless, our findings are still a useful reference point for what could be applied to environments that are currently free of any vending restrictions.

Another limitation is the failure to account for stock waste in our estimate of the cost of the intervention. Decreases in sales may result in increases in waste due to products passing their shelf-life without selling. Future work should measure not only how many products are sold, but how many products are not sold, for a more accurate representation of the cost of healthy vending.

Finally, we did not assess overall satisfaction levels for the product range tested. Complete replacement is an intrusive approach. High intrusiveness can put the longevity of interventions at risk, as they are more likely to cause frustration and dissatisfaction within those that are subjected to them (Bos, Van Der Lans, Van Rijnsoever, & Van Trijp, 2015). Accompanying our work with consumer surveys may have provided a greater depth of insights into the reasoning behind consumer behaviour, and the potential longer-term impacts of such an intervention.

2.4.4. Conclusions

In conclusion, this study provides evidence about the health benefits and cost effectiveness of complete healthy vending. Under healthy vending, we saw a substantial drop in calories

consumed but a surprisingly small drop in sales and no noticeable increase in compensatory behaviours. Consumers appear to purchase what is available to them, even if it is a healthy product, rather than going elsewhere. This suggests that healthy vending can serve as an effective health improvement intervention for hospitals that has few negative consequences.

Chapter 3. Evaluating source credibility effects in health labelling using vending machines in a hospital setting

3.1. Chapter Introduction

It is now most likely the case that the vast majority of the food choices we make from day to day cannot be carried out without us being exposed to some form of promotional material that attempts to influence this choice. Food advertising is thought to play a key role in making our food environments more obesogenic, cementing the link between the products that are made available and the consumer demand for them, shaping consumer preferences, and increasing consumption (Folkvord & Hermans, 2020). The need for more responsible food marketing practices is being acknowledged, with examples of governments restricting what can be marketed, to whom, and when becoming more common (such as the new restrictions introduced by the UK Government, as discussed in Chapter 1 (UK Government, 2020)). There is therefore an appetite for developing more responsible food marketing practices, and with it have come more and more examples of research that explores the ways in which the healthiness of a product can be marketed to boost healthy sales (Folkvord & Hermans, 2020).

Health labels could serve as easily, and cheaply implementable interpretational aids that help consumers evaluate the healthiness of products (Borgmeier & Westenhoefer, 2009). In turn, providing this information at the point-of-purchase can ease the identification of healthier options, and make healthier choices more frequently made ones (Hoefkens et al., 2012). Consistent with these ideas, there are examples of studies that have found positive effects of labelling, particularly when combined with other interventions that change product price or availability for example (Bialkova, Sasse, & Fenko, 2016; French et al., 2001; Kocken et al., 2012).

However, as touched upon in Chapter 2, most studies have found only small and variable effects of labelling (Grech & Allman-Farinelli, 2015; van't Riet, 2013; Wagner, Howland, & Mann, 2015). There is a need to develop our knowledge of the ways in which they function, the circumstances in which they might influence dietary behaviour change, and how these effects could be strengthened. Health advice alone may not be sufficient to motivate individuals to use health labels and opt for healthier options. In this study we test whether highlighting a trusted source of health advice alongside health information on a label facilitates its use. To foreshadow

our results, we found no beneficial effect of including a credible source. In fact, in one setting, credible source labels had the reverse effect to that intended: the label caused the campaign to "backfire" and encouraged unintended, less healthy purchasing choices. The following provides a summary of the study rationale and our approach to the experimental design.

For health labels to have an impact, they must first be read, and secondly, their messaging must provide the reader with sufficient motivation to change their behaviour (Brambila-Macias et al., 2011). For both, it may be possible to tap into psychological biases evident within decision making as part of heuristic processing strategies to increase the likelihood of a label being used and having influence. One such bias when evaluating messages is the tendency for differential evaluation of messages based on their source.

Research in social psychology has demonstrated that the source of a message can have an impact on how it is processed. For example, one study demonstrated that source likeability influences the extent to which participants' opinions change to align with that of the source (Chaiken, 1980). It has been argued that individuals are more susceptible to persuasion if a message comes from a credible source, with credible sources holding expertise, being trustworthy and being good willed (Hovland, Janis, & Kelley, 1953; Wu & Wang, 2011).

Given the potential for persuasive influence, source effects have also been discussed within the context of sales. Within the marketing literature, signaling theory postulates that consumers are reliant on cues or signals to help them evaluate products (Kirmani & Rao, 2000), however, they will only use these signals if it is cost-effective, or effort-effective for them to do so (Atkinson & Rosenthal, 2014), with factors such as the credibility and usefulness of the signal influencing this cost / benefit judgment (Boulding & Kirmani, 1993). Claims about products that come from trusted sources are more likely to be accepted (Atkinson & Rosenthal, 2014).

People often defer to a course of action recommended by someone with expertise (Cialdini, 2001) and knowing that a message comes from a trusted source works as a mental shortcut to simplify the decision making process. People have a limited capacity for mental effort (Kahneman, 2003), and have a strong preference for minimizing cognitive demand through using mental shortcuts of this kind (Kool, McGuire, Rosen, & Botvinick, 2010). Existing evidence suggests that using trusted, expert sources to endorse claims makes these claims more credible to the consumer, more likely to influence consumer evaluations and can make products appear more appealing

(Atkinson & Rosenthal, 2014; Boulding & Kirmani, 1993; Kirmani & Rao, 2000; Parkinson, 1975; Rupprecht, Fujiyoshi, McGreevy, & Tayasu, 2020).

Resultantly, a food health label associated to a clinician, as opposed to a sales person, may well have greater influence on you as a consumer. Supporting health claims on health labels with an endorsement from a credible source could therefore be an effective mental shortcut for consumers to rely upon when selecting healthier foods, which could in turn increase the proportion of healthy choices made. Likewise, it could simplify the process of identifying healthier options, making healthier choices easier choices.

That being said, there are some constraints to consider. For example, the extent to which consumers rely on mental shortcuts such as source attributes depends on their involvement with the communicated message. Where consumers are making decisions that have limited importance (and thus low involvement), exerting effort into making a thoroughly considered systematic decision may be unwarranted, and people may rely more heavily on their low-effort, quick-thinking heuristic processing strategies to come to a decision (Chaiken, 1980; Kahneman, 2003; Kool et al., 2010). It could be argued that selecting foods is a low involvement decision. On average, consumers spend 35 seconds choosing each product when shopping in supermarkets (Grunert & Wills, 2009). In these low involvement scenarios, where decisions are made quickly, people may opt to minimize the effort exerted in making these choices, and will rely more heavily on heuristics, such as source credibility, in coming to a decision. Including source information on health labels within commercial food environments may therefore influence choices for the better.

Source credibility can be an effective tool in persuading consumers. However, there is also the risk that source credibility will lead to negative effects via reactance. Theories of psychological reactance postulate that imposing rules or constraining freedoms can result in individuals reacting against them and showing increased desire for the restricted choice (Brehm, 1966). While health labels do not enforce certain choices, they suggest certain courses of action, which some may interpret as an intrusion of their personal freedom (Kleef & Dagevos, 2015). There is some evidence within the general population of reluctance to accept health claims by health promoters (Crossley, 2002), and attempts to influence diets are sometimes perceived as paternalistic violations of agency and freedom of choice by the government (Eagle, Bulmer,

Kitchen, & Hawkins, 2004). As such, emphasising high credibility sources on labels carries the risk of causing reactance effects if consumers view their presence as a threat to their free will.

There is a scarcity of direct evidence demonstrating the impact of source credibility on the effectiveness of food health labels in shaping consumer behaviour. However, available indirect evidence is consistent with higher credibility sources having the potential to generate positive effects (Dong, 2015; Feunekes, Gortemaker, Willems, Lion, & van den Kommer, 2008; Grewal, Gotlieb, & Marmorstein, 1994; Hawley et al., 2013; Rupprecht et al., 2020).

Outside the context of health, research has shown that consumer product evaluations for a VCR were more positive when a highly credible source (an electrical engineer) made product claims, compared to when the same claims were made by a low credibility car salesman (Grewal et al., 1994). More recently, evidence has emerged that demonstrates the ways in which source credibility can shape the influence of health-relevant messages. We provide three examples. Firstly, an experiment on adolescents' nutrition label use found that source credibility differentially impacted the perceived knowledge gained from a persuasive argument for the use of nutrition labels. Participants rated that they gained more knowledge from the same informative statement if it came from a dietitian, as opposed to a celebrity or a layperson, with this effect even stronger in participants that rated highly for health consciousness (Dong, 2015). A second study found that consumers from the USA, Germany, China and Thailand rated expert sources as highly trustworthy sources of health information on food product labels (Rupprecht et al., 2020). Finally, Feunekes and colleagues tested whether endorsements by international and national health organizations have an influence on evaluations of health label credibility (Feunekes et al., 2008). In an online study with over 1,600 participants across four European countries, smiley face health labels were presented with an endorsement from either the World Health Organization (WHO), the European Union (EU), European Food Manufacturers (EFM), or a national nutrition organization from the relevant country. Results showed that credibility was significantly higher in the presence of the endorsement. Furthermore, the less nutritionally-targeted EU and EFM endorsements were evaluated as less credible than those from the WHO and the respective national nutrition organizations.

While results from all of these studies suggest that there are potential benefits to using labelling that highlights highly credible sources, they are limited as their measures focused on attitude change as opposed to behaviour change. Source credibility might alter attitudes and

intentions but not behaviour. However, there is support within the literature that suggests that source credibility can translate attitude change to behaviour change. For example, having credible sources back communications is one of the behaviour change techniques recognised within the Behaviour Change Taxonomy (Michie et al., 2013). There may therefore be potential to harness this behaviour change technique to improve the effectiveness of health labels in shaping consumer choices for the better. Nevertheless, without further insights on the impact health labels with credible sources have on purchasing behaviour, it is difficult to estimate how effective they might be as an intervention and what impact they may have on healthy sales.

Exploring the influence of source credibility on the impact of messages is particularly relevant within public health. Public health campaigns are often fronted by well-known health authorities, such as the NHS, who are considered to have expert knowledge and are trusted sources of health information (e.g. Barker, Minns Lowe, & Reid, 2007). Having well-known and trusted organizations endorse information on nutrition labels increases their credibility (Feunekes et al., 2008), and associating campaigns with these authorities could improve the potential of these interventions to change behaviour for the better. However, there is a need to develop the evidence base that supports this practice.

In summary, health labels may serve as an easy and affordable method of nudging consumer behaviour but they have shown only limited effectiveness. Attributing the labelling to a trusted, highly credible source of health information might boost the effect of the label. In this study, we test source credibility directly using purchasing behaviour as the outcome measure.

3.E1.1. Can credible sources make health labels more effective?

We tested whether high source credibility improved the effectiveness of health labelling using vending machines. As shown in Chapter 2, vending machines are a useful tool for studying the effects of interventions on food choice as they offer exceptional levels of experimental control (Appelhans et al., 2018; French et al., 2001). Sales data were collected from the same two hospital vending machines described in Chapter 2 (one in A&E, the other in the reception area) over a period of three months. Unlike the study described in Chapter 2, here the machines sold healthy products (e.g. baked crisps, cereal bars) and unhealthy products (e.g. standard crisps, chocolate bars) in equal proportions. Each week, the machines were independently and randomly assigned to one of three conditions, with the outcome measure being the number of products sold.

There were two labelling conditions and a control, no label condition. In the low credibility condition, healthy products were labelled “lighter choices”. In the high credibility condition, the same label was appended with the National Health Service (NHS) logo (“NHS Lighter Choices”). In the UK, the NHS is one of the most trusted sources of health information, and its endorsement is often seen as a stamp of approval for products or treatments (Barker et al., 2007; Evans et al., 2007).

If high source credibility improves the effects of labelling, sales of healthy products should increase in the high credibility condition compared to control and low credibility conditions. Similarly, sales of unhealthy products should decrease.

3.E1.2. Methods

3.E1.2.1. Participants

Participants voluntarily made purchases from vending machines without being aware that they were taking part in a study. Ethical approval was granted from the NHS research ethics committee (IRAS number: 231390) and the Cardiff University School of Psychology Ethics Committee. Permission was given not to collect consent from participants and to not inform them of the nature of the study.

3.E1.2.2. Study design

The independent variable was labelling condition (three levels: no label, low credibility label, high credibility label). Labelling conditions were randomly allocated to each of the 15 six-day time periods of testing, with each machine being in each condition five times during the 13-week study. Condition was independently randomized within each machine. Sales volume was used as the outcome measure, measured separately for healthy and unhealthy snacks, and compared across time and machines. As with the vending experiment reported in Chapter 2, the study was implemented for longer than required if solely considering experimental power, to ensure that variability in sales across time was captured. The study used a shorter timeframe than the study reported in Chapter 2 due to practical constraints relating to procurement.

3.E1.2.3. Materials

3.E1.2.3.1. Vending machine layout

The same two vending machines used in Chapter 2 were used, and were located in the same settings again (the A&E machine, and the reception machine).

The planogram (diagram of the planned visual layout of stock) was kept constant throughout the trial (see Appendix 6). The fidelity of the compliance to this layout was monitored at each labelling condition changeover. As in Study 1, time logs of each changeover period during the trial were recorded.

Healthy products were given the most prominent locations within this set up (top two crisp rows, top confectionary row) to maximize their visibility within the machines. Product sold, location, exact time, and method of purchase (cash or card; first and last four digits recorded if card) were all recorded by the Nayax system.

3.E1.2.3.2. Vending snacks

The products to be sold in the mixed-stock vending machines were selected from the healthy and unhealthy range of products used in Study 1. Best sellers from the healthy and unhealthy categories were selected, again in consultation with the vending provider (JDJ Vending Services) and the research team (including a Public Health Wales Consultant and a Public Health Wales Dietitian). Further details on product nutritional values and wholesale costs can be viewed in the Methods section of Experiment 2.E1. and Appendices 4 & 5.

For the healthy condition, there were 12 distinct snacks, 4 of which occupied two coils. For the unhealthy condition, there were 11 distinct snacks, 5 of which occupied two coils. In this study, the mean wholesale cost of healthy products was 9p greater than that of the unhealthy products (Healthy = 54p (SD = 7p); Unhealthy = 43p (SD = 5p)), and all products were sold for £1.

3.E1.2.3.3. Labels

Two labels were designed (see Figure 8 and Appendix 7). The labels were placed underneath the product it referred to, after its coil number. Labels were 48mm wide and 18mm high and were vinyl removable adhesives. This allowed for clean removal of labels during each changeover period.

Figure 8. Low and high source credibility labels

The lighter choices claim was designed as a variation of the "NHS Choices" logo. The word lighter was added to the branding as a clear indicator of a choice with less calorific impact, without making claims about the relative healthiness of the products. The vending guidance used to categorize the products as healthy or unhealthy follows the same principle, making the calorific impact of choosing a product from this selection at the vending machine lighter than that of a standard product (Welsh Government, 2012). Lighter choices was therefore deemed to be a good fit, particularly as simple, succinct health claims have been found to be better received than longer, more complex ones (Wansink, Sonka, & Hasler, 2004; Williams, 2005). The low credibility health advice labels therefore contained the words "Lighter Choices", and for the high source credibility manipulation, the NHS logo was added to the label, to highlight the fact that the message was supported by this trusted, expert source (Barker et al., 2007; Evans et al., 2007).

3.E1.2.4. Analysis

The data were analysed as mixed models with the lme4 package in R (Bates et al., 2022). Individual products (N = 23) and time (N = 15) were included as random effects. This allowed for generalisation across time and product range. Model specification was maximal (Barr et al., 2013), in that all possible random effects parameters were included.

We computed an omnibus model that included labelling condition (no label, low credibility, high credibility), product health value (healthy, unhealthy) and machine (A&E, reception) as fixed effects, and product and time as random effects. Sales volume was the outcome variable. The omnibus model is shown below in pseudo-R code:

```
salesvolume ~ condition * healthvalue * machine + (1+condition*machine|item)
+ (1+machine*healthvalue|time))
```

The reference levels were unhealthy for health value, the reception machine for machine, and the low credibility label for label.

3.E1.3. Results

3.E1.3.1. Sales volume

Relevant statistical outputs are reported in text, and full details are available in Appendix 8. Sales across conditions and product health, averaged across time, are shown in Figure 9.

Significantly more unhealthy sales were made than healthy sales, $\beta = -4.32$, SE = .97, $t = -4.46$, $p < .001$ (Healthy N = 2633; Unhealthy N = 8110) and there were more sales in the A&E machine than in the reception machines, $\beta = 2.55$, SE = .90, $t = 2.85$, $p = .01$ (A&E N = 6470; Reception N = 4273).

There were no overall effects of labelling on sales. The low credibility label condition did not differ significantly to the no label condition, $\beta = 0.57$, SE = .66, $t = 0.87$, $p = .40$, nor did the high credibility label differ to the no label condition, $\beta = 1.45$, SE = 0.77, $t = 1.88$, $p = .08$, and the low credibility label did not differ to the high credibility label, $\beta = -0.88$, SE = 0.78, $t = -1.13$, $p = .27$.

However, there were significant three-way interactions of label with machine and health value, and two-way interactions of label with machine. These effects reflect that sales of unhealthy products were higher in the high credibility label condition than the other conditions for the A&E machine (Figure 9).

There were significant three-way interactions across machine, health value and label when comparing high credibility to low credibility label conditions (high credibility label *vs* low credibility label, A&E *vs* reception, healthy *vs* unhealthy) $\beta = -3.66$, SE = 1.52, $t = -2.41$, $p = .02$,

and the high credibility to no label condition (high credibility label *vs* no label, A&E *vs* reception, healthy *vs* unhealthy), β = 3.47, SE = 1.30, t = 2.66, p = .01, with no difference found between no label and low credibility label conditions (no label *vs* low credibility label, A&E *vs* reception, healthy *vs* unhealthy), β = -0.20, SE = 1.39, t = -0.14, p = .89.

There were significant two-way interactions between labelling and machine when comparing the high credibility label condition to the no label condition (high credibility label *vs* no label, A&E *vs* reception), β = -3.64, SE = 1.08, t = -3.38, p = .003, and the high credibility to the low credibility label conditions (high credibility label *vs* low credibility label, A&E *vs* reception), β = 2.95, SE = 1.31, t = 2.26, p = .03, but not when comparing no label to low credibility label condition (no label *vs* low credibility label, A&E *vs* reception), β = -0.69, SE = 1.18, t = -0.59, p = .56. Separate analyses were also carried out for each machine independently, using the omnibus model with the machine factor excluded and appropriate subsets of the data. The A&E machine analysis supported the findings of the omnibus model, showing that sales were higher in the high credibility label condition, when compared to when no label was presented (see Appendix 8).

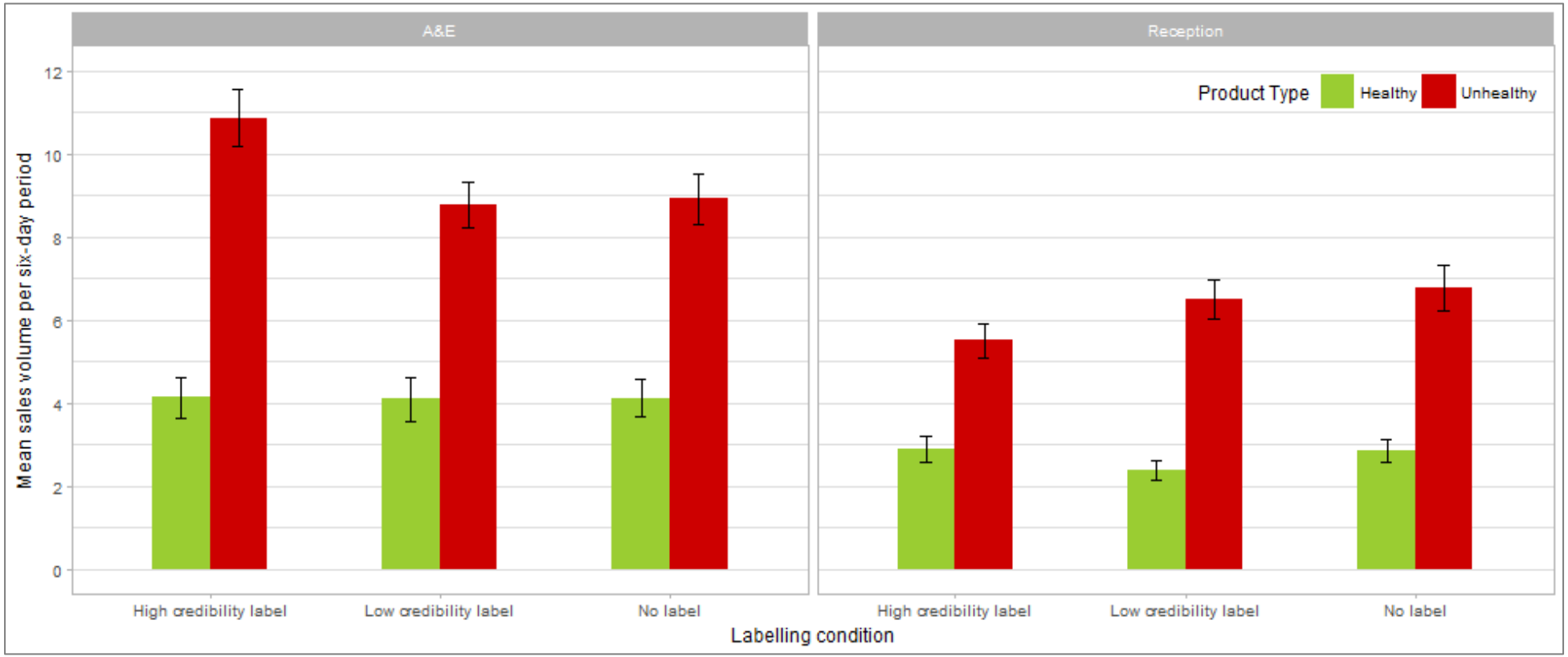


Figure 9. Mean sales volume within a six-day period within each machine, for each product type and labelling condition. Error bars show standard error of the mean with respect to time. In A&E, sales of unhealthy products are higher for the high credibility label than for the low credibility label and no label conditions.

3.E1.3.2. Estimates of multi-item purchasing

As was done in Chapter 2, we used credit card information logged within the sale data to estimate the impact of the health labels on multi-item purchasing. While labels could influence what kinds of products people chose, they could also make individuals consider health in other ways, namely, by shaping how many products they chose. This was measured by tracking the purchasing patterns of individual credit cards.

Of the 10,743 sales recorded, approximately 33% were made by card. The number of products purchased by each individual card user during each time period was tallied, before the number of single-item versus multi-item purchases made in each condition were compared.

The number of products bought by individual credit cards were relatively consistent when comparing across labelling conditions (No Label Single N = 301, No Label Multi N = 311; Low credibility Single N = 338, Low credibility Multi N = 323; High credibility Single N = 343, High Credibility Multi N = 288). No significant associations were found between purchase type (single or multi-item) and labelling condition when comparing across the no label and low source credibility conditions, (χ^2 (1) = 0.48, p = 0.49, φ = 0.02), the no label and high source credibility NHS conditions, (χ^2 (1) = 3.33, p = 0.07, φ = 0.05), or the two labelled conditions, (χ^2 (1) = 1.35, p = 0.25, φ = 0.03).

3.2 Chapter Discussion

Previous research has shown that messages from trusted sources, such as health organizations, are more likely to be viewed as credible. This in turn boosts their persuasiveness, increases the extent to which their claims are accepted by consumers, and ultimately improves product evaluations (Atkinson & Rosenthal, 2014; Boulding & Kirmani, 1993; Feunekes et al., 2008; Hovland et al., 1953; Kirmani & Rao, 2000; Parkinson, 1975; Rupprecht et al., 2020; Talati et al., 2016; van't Riet, 2013). The aim of this study was to establish whether health labels could be made more effective in promoting healthier food purchases by the inclusion of a high credibility source (NHS endorsement) in the label. Our results do not provide evidence that they do. Indeed, high credibility labels led to an increase in unhealthy sales in the vending machine located in A&E, a "backfire" effect. Potential explanations for this effect and its implications for public health are discussed below.

3.2.1. Backfire effect

We observed negative effects of the high source credibility label. There are at least two possible explanations for this effect. The first is that there was psychological reactance against the label (Brehm, 1966). Perhaps consumers objected to the suggestion that they should be making certain food choices (Brehm, 1966; Kleef & Dagevos, 2015), with the high credibility label perceived as a paternalistic violation of agency and freedom of choice (Eagle et al., 2004). Likewise, consumers could have been seeking to punish the NHS for their predicament (e.g. waiting a long time in A&E) and they reacted by deliberately choosing the products not endorsed by the NHS.

The second is that NHS labelling indirectly supported goal fulfilment. Evidence suggests that the presence of a healthier option within a selection of less healthy options can increase unhealthy consumer behaviour (Wilcox, Vallen, Block, & Fitzsimons, 2009). In their study, Wilcox and colleagues showed that high self-control individuals were more likely to select the most indulgent side option available within a range when the range included a salad option, compared to when it did not. The authors hypothesized that exposure to healthier items vicariously satisfied consumers' existing health goals, regardless of whether the product was chosen or not (Wilcox et al., 2009). Making a selection from a range that had a strong NHS branding presence could have been interpreted as making sufficient progress towards consumers' health goals.

3.2.2. Variability across location

The backfire effect was only evidenced in the A&E machine. Why was there such a difference between the two locations? We consider two possibilities. First, if consumers were reacting against the label, they may have been more likely to do so in A&E than in reception. Consumers would have been more stressed in A&E, they may have been waiting for a long time, concerned about those admitted to hospital, hungry or tired. These factors are likely to maximize irritation with the authority who they viewed responsible for their wait (the NHS).

Second, the effects of labelling more generally may be greater in A&E than in the reception area. Consumers in A&E are captive – many are waiting with little to occupy themselves, allowing time for using the labels and absorbing their content. In comparison, the reception area had high passing footfall and minimal seating. Participants in the reception area may not have attended to the labels to the same degree as those in A&E. The difference in mental states of consumers

between the two locations may have also contributed to greater use of the label in A&E. Mental shortcuts are more likely to be used in scenarios where individuals wish to exert minimal cognitive effort when making their choices (Chaiken, 1980; Kahneman, 2003; Kool et al., 2010) and indeed stress has been shown to increase reliance on mental shortcuts (Schaeffer, 1989). Participants in A&E may have sought to ease the decision process as much as possible by using cues available within the environment to help them make a selection.

3.2.3. Limitations and future work

Practical constraints limited our work to a single hospital across a thirteen-week time window. A greater sample of sites and longer study would have increased power to detect differences between labels (e.g. French and colleagues tested at 24 sites (French et al., 2001)). Furthermore, the hospital environment might have been unusual in that health is prominent and stress levels are high. Generalising our findings beyond a hospital setting will therefore require widening the range of sites tested.

In our experimental design, participants were not randomly allocated to a labelling condition. Instead they were randomly allocated as a group, based on the 6-day period in which they were at the hospital e.g. those who arrived at A&E in week 7 were allocated to the high credibility condition. This meant that observations (participants) were less likely to be independent than if we had allocated each participant individually to a labelling condition. This difficulty was partly alleviated by allocating each labelling condition to multiple time-periods within the study period, rather than just one, but an improvement would be to randomly allocate at an even finer level of temporal granularity e.g. each day rather than each 6-day period.

The applications of our findings are further limited as they only capture the mechanisms in action for these specific labels. As noted in prior work, the heterogeneity of the labels used when exploring the effects of health-promoting labels limits the generalisability of findings within the field (Grech & Allman-Farinelli, 2015; van't Riet, 2013). Different designs produce different effects. While in this study, our primary goal was to explore the effect of adding a credible source, there may still be some variability in effects when comparing across different sources e.g. another health authority.

On a related note, our work is limited as we used only one type of high credibility label, the NHS endorsement. The NHS in the UK is an unusual health body in a numbers of ways. First,

it is trusted by people from all political backgrounds. This can be contrasted with other public health bodies that can be perceived as being politically charged (e.g. World Health Organisation). Greater perceptions of political bias on a label might increase the backfire effects we observed here (as in the correction of misinformation, e.g. see Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012)). Second, the NHS not only provides health advice, it also manages health sites such as hospitals. It can therefore be seen as responsible for the predicaments of the consumer, e.g. long waiting times in A&E. A high credibility label divorced from the management of the health site may not lead to the same negative effects as the NHS label. Future research needs to investigate why we observed the negative effects of the NHS label and whether these effects generalise to other high credibility sources. Research that follows this investigation should combine the methods used here and those used by Feunekes et al. (2008), testing the effect of endorsements by multiple health authorities (as Feunekes et al. (2008) did but we did not) on real-life purchasing behaviour (as we did but Feunekes et al. (2008) did not).

3.2.4. Conclusion and implications

The purpose of this study was to determine whether highlighting a credible source would improve the performance of health advice labelling in promoting healthy snack choices. We found no evidence that it does. There were no positive effects of the labels, with or without high source credibility. In fact, in one location, we observed a significant backfire effect whereby consumers selected a greater proportion of unhealthy products when healthy products were accompanied by a high credibility label, the NHS endorsement. While testing on a larger scale, in a wider range of environments with a wider range of labels is needed to establish to what extent our results generalise, our findings suggest that high source credibility labelling may be ineffective in promoting healthier choices, and that in some circumstances they can even cause harm.

Chapter 4. Exploring the ways in which health labels influence the evaluation of product attributes and category membership

4.1. Chapter Introduction

Providing information at the point-of-purchase that eases the identification of healthier options could make the process of selecting a healthier option more accessible, which in turn could increase the occurrence of such choices.

As discussed in Chapter 3, health labels offer a cost-effective and easily implementable method of communicating health information to consumers at the point-of-purchase. Signposting individuals to healthier options makes it easier for them to be identified and chosen (Hoefkens et al., 2012). The notion that healthy choices need to become easier choices for individuals is a thread that weaves throughout this thesis. Labels may hold the potential to achieve this goal – by easing the process of identifying healthier products, through grabbing consumers' attention and providing health-relevant information, they may make it more likely for healthy products to be selected (Hoefkens et al., 2012). Placing health labels within the choice environment may well influence individuals' cognitive processing as they come to a decision, be that consciously as they consider the advantages and disadvantages of certain choices, or unconsciously solely through a process of drawing attention to the labelled products. However, relatively little is known about how these labels influence decisions at a functional level, and whether they can produce reliable, meaningful change in behavioural patterns (Mhurchu et al., 2018).

As demonstrated in Chapter 3, health labels do not always produce their intended effect. High credibility NHS labels ultimately led to increases in unhealthy purchasing in one location. This unexpected finding was not only theoretically interesting, but also highlights the fact that health labels hold the potential to produce counterintuitive effects, within certain settings. Our findings, combined with the fact that findings from the pre-existing literature are largely inconsistent (Grech & Allman-Farinelli, 2015; van't Riet, 2013) call to question the extent to which health labels can be relied upon as an effective tool for increasing the selection of healthier choices. Yet they are continually applied in practice, as a simple and affordable intervention. The existing acceptance of their use in practice may serve as justification for further developing their effectiveness. There is therefore a need to gain a deeper understanding of how this commonly

relied upon method of promoting healthy choices works at a functional level. What aspects of consumers' product evaluations might health labels influence, and how might they do so? This chapter explores these ideas through a series of online labelling experiments that progress from one to the other. The following paragraphs serve as a summary of the experiments to follow, and an overview of the logic used in determining our progression from experiment to experiment.

In the first experiment, 4.E1., we explore the ways in which the effects of health labels might differ dependent on product familiarity. As explored in the discussions that follow, prior experience and knowledge shape evaluations. We hypothesised that health labels most effectively communicate product category membership and related information (in this case, price) when products are less familiar. Ambiguous products were thought to be more expensive when labelled as healthy (a feature associated with healthy products), however a comparable shift in price evaluations was not found for familiar products with clear health values (healthy or unhealthy).

With the first experiment therefore providing some evidence in support of our hypothesis, in experiment 4.E2. we tested it further with another product attribute for which consumers have pre-existing beliefs about healthy products – taste. The pattern of results in 4.E1. were not replicated (despite evidence suggesting that healthy products are assumed to be less tasty, health labels did not shape taste evaluations of ambiguous or familiar products). We proposed that food neophobia might possibly play a stronger role in shaping taste evaluations under conditions of uncertainty.

Experiment 4.E3. therefore returns to explore evaluations of price, again comparing the differential effects of labels dependent on product familiarity but with a new range of labels that more closely resemble those used in practice. These labels offer subtler means of communicating product health (e.g. highlighting that a choice is "lighter", instead of overtly categorising it as "healthy"). We found no effect of health labels on price evaluations for any kind of product with these subtler labels, calling to question the extent to which these suggestive labels produce the shift in categorisation required for feature evaluations to follow suit. That is, the labels did not cause participants to see ambiguous items as members of the healthy category, therefore they were no more likely to give evaluations that resembled those given for other members of that category (for price, this means viewing them as being more expensive).

Experiment 4.E4. therefore explores the extent to which subtler, naturalistic labels shape evaluations of product health. If these labels do not change perceptions of product health, they are unlikely to change perceptions of any feature associated with healthy products (such as price). We found that these labels did not change health evaluations for healthy or ambiguous products. However, placing these labels on other products changed consumer evaluations of unhealthy (and unlabelled) products. These products were seen as even more unhealthy when presented alongside other products that were labelled as healthy. The absence of a label on unhealthy products therefore appeared to provide consumers with information that they used to shape their evaluations of these products. The lack of label was seen to suggest a lack of health.

We therefore asked whether the absence of a label could produce comparable effects for unfamiliar products. We compared the health evaluations of ambiguous products when healthy products were presented with or without health labels. We were unable to replicate the pattern of findings in two experiments – in 4.E5., where labelled and unlabelled products were equally as common (e.g. 12 healthy, 12 ambiguous), and in 4.E6., where the unlabelled products were the minority. The latter experiment was conducted to test our hypothesis in conditions that better reflected those in 4.E4 (where in the labelled conditions, there were 12 healthy and 12 ambiguous products, and 12 unlabelled unhealthy products).

A deeper discussion of the rationale for each experiment can be found within the narrative of the chapter, within the introduction and discussion sections for each experiment, aligning with how our ideas progressed as the experiments were conducted. The remainder of the introduction section therefore covers the ideas considered when designing the first experiment of this series.

4.1.1. Unpacking the function of health labels

Countless psychological studies have demonstrated that there are constraints on our capacity for mental effort, and that we have a strong inclination towards limiting the cognitive demands placed upon us (Kahneman, 2003; Kool et al., 2010). Labels help serve this preference. Labels draw attention to products (thus simplifying decision making and the process of identifying a healthier option) and provide information that helps consumers as they make their evaluations of available products (Atkinson & Rosenthal, 2014; Bialkova et al., 2016; Bialkova & van Trijp,

2011; Borgmeier & Westenhoefer, 2009). Resultantly, labels should make decision making easier. They offer ready-made product evaluations – if the labels are used and their messages are accepted, they can reduce the cognitive demands associated with the decision process as consumers do not have to exert effort in making these evaluations themselves. They can simply accept what is said and use this information as they come to their decision.

Despite their widespread use in practice and attractiveness as a potential tool, existing empirical evidence exploring the effectiveness of health labels as a means of promoting healthier choices have provided mixed results when tested in naturalistic settings (Grech & Allman-Farinelli, 2015; van't Riet, 2013). Placing nutritional information on products appears to have a robust positive influence on consumers' attitudes and self-reported healthy-purchasing intentions (Mhurchu & Gorton, 2007; van't Riet, 2013). However, when progressing from intentions and self-reported use to actual choices, discrepancies emerge between what people say they will do, and what they actually do (e.g. Mhurchu & Gorton, 2007). While some have found that health labels (when used either alone or in combination with other interventions) can positively affect health behaviours (e.g. Bialkova et al., 2016; French et al., 2001; Kocken et al., 2012), there are several other examples of studies that suggest that the impact of health labels on actual choices is limited (e.g. Borgmeier & Westenhoefer, 2009; Wagner et al., 2015).

Some have described how informed consumers are not more likely to be healthy consumers (Borgmeier & Westenhoefer, 2009), and there is now a general consensus that the effects of health labels, as they are currently used, are limited and highly variable across studies (Grech & Allman-Farinelli, 2015; van't Riet, 2013). Despite these findings, health labels are persistently being adopted as a method of promoting healthy options within choice environments, with this looking likely to become even more common as tougher government restrictions on food retail are rolled out (e.g. leading UK supermarkets have begun to expand their health-promoting practices, using shelf labels that signpost healthier options (Bodkin, 2022; Wolfson, 2022)). With these practices therefore becoming more commonplace, it is imperative that more research is conducted to improve our understanding of the ways in which health labels can, and cannot, influence consumer evaluations for the better.

4.1.2. Are health labels informative?

Signposting healthy options, drawing attention to them, and providing consumers with health-relevant information which could shape their evaluations and ultimately their choices are thought to be the main functions of health labels (Atkinson & Rosenthal, 2014; Bialkova et al., 2016; Bialkova & van Trijp, 2011; Borgmeier & Westenhoefer, 2009). However, we hypothesize that health labels do not always inform and shape choices. While health labels might draw attention to healthy products, we hypothesise that they rarely provide consumers with novel information about the healthiness of a product. If health labels are placed next to familiar products that are already known to be comparatively healthier, they are unlikely to serve an informative function. For example, a fruit-based snack should appear healthier than a chocolate bar, with or without it being labelled. In such a scenario, what function does using a label to confirm what is already known have?

Very little, according to those who have demonstrated that informing consumers is unlikely to increase their inclination to ingest familiar food, because they already possess the information that would guide their evaluations and choices (Martins, Pelchat, & Pliner, 1997; McFarlane & Pliner, 1997). When consumers are already informed, labels may be less likely to influence consumers' evaluations and ultimately their choices. They may reinforce already-known information, and make it salient within consumers' choices, but it is possible that health labels do not provide consumers with the novel information that might shape their product evaluations as often as is hoped. This chapter tests whether health labels influence consumers' evaluations and choices only if they reference novel, unfamiliar products with unknown health values. For such products, a health label would not only draw attention to the labelled product, but also provide the consumer with new information which could be taken into account as they evaluate the different features of a product.

4.1.3. Category labels and feature inferences

Further evidence that suggests that health labels might be most effective in informing consumers when placed alongside unfamiliar products can be found within the categorization

literature. Findings from this field suggest that category labels, such as “healthy” labels are most likely to shape evaluations when the item in question is unfamiliar.

Providing people with category labels alongside novel items often polarizes feature evaluations, causing them to mirror what would be expected from known incidences of the same category. Evidence of this tendency has been found in studies exploring the ways in which different fictional insects are categorized in the presence of category labels (Yamauchi & Yu, 2008). When asked to predict features of an unknown and novel insect (e.g. the shape of its antennae), individuals based their predictions on what they knew to be true about other members of the same category. For example, if when participants were originally shown insects in category A and they had curving, thin antennae, people were more likely to guess that a new insect would also have curving, thin antennae if it was labelled as being in category A (this is depicted in Figure 10). This was the case even when the new insect had features that did not fit within category A (e.g. possessing wings when the original example did not have any). People therefore demonstrate a strong tendency to rely upon category labels under conditions of uncertainty, using them to determine category membership and any associated features, with these effects persisting even in the presence of contradictory information.

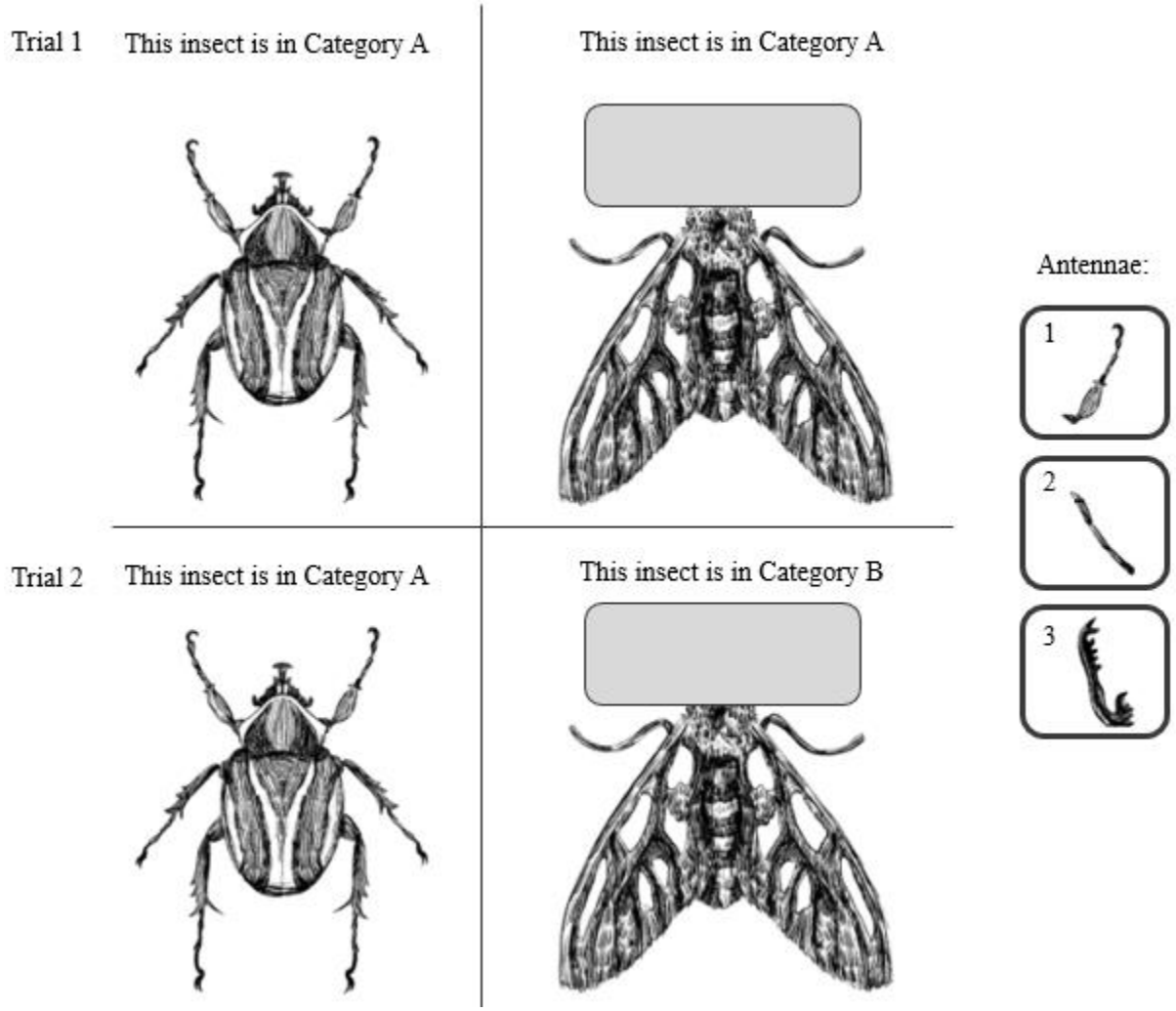


Figure 10. Adaptation of stimuli used in Yamauchi and Yu (2008).
In Trial 1, where the novel and original insects belonged to the same category, participants were more likely to predict that the novel insect had the same antennae (antennae number 1). This was not the case in Trial 2 when the original and novel insects belonged to different categories.

What might this mean for evaluations of foods presented alongside category labels (that is, labels that indicate their health values)? It is possible that labelling a novel food as healthy will cause individuals to base their evaluations of these products on those they would make for known examples of healthy products. If the same patterns can be expected for food products as were found in the Yamauchi and Yu (2008) study described above, under conditions of uncertainty, health category labels will aid consumers in categorizing a novel food, and their feature evaluations could begin to resemble those made for known examples of healthier food. Crucially, current evidence

suggests that the same labels are unlikely to shape evaluations of familiar healthy foods as they provide no new information for the consumer – there is no uncertainty to be resolved (Martins et al., 1997; McFarlane & Pliner, 1997; Vizcaíno & Velasco, 2019). If this is in fact the case, we would expect that health labels would alter product evaluations for novel foods, but not known healthy options.

Many different features are taken into consideration when we select our food – taste, ability to satiate, healthiness and cost are but a few. Each may be given different weight, across different people or across successive choices (see Chapter 5 for a further discussion on these attributes and the relationships between successive choices), and the extent to which a food satisfies these qualities contributes in shaping our dietary choices. Highlighting the healthiness of novel foods may therefore cause shifts in how these features are evaluated – if healthy products are generally thought to be more expensive, then a novel product that is labelled as healthy may also be considered expensive when individuals are asked to estimate price. Such preconceptions for how these features vary across healthy and unhealthy products are known to exist. For example, individuals do in fact tend to perceive healthier items as more expensive (Haws, Reczek, & Sample, 2017), and similar evidence has suggested that healthy items are thought to be less filling (Suher et al., 2016), and less tasty (Raghunathan et al., 2006). It is therefore possible that in conditions of uncertainty, people expect novel foods to resemble these features when they are labelled as healthy.

A point worth considering is the fact that the preconceptions about healthy products described above are all relatively negative. This raises the question of whether highlighting the healthiness of a product is truly beneficial if it serves to activate these negative perceptions about qualities of foods that are known to influence consumer choice. We know that interventions that have challenged these negative preconceptions about healthy products (e.g. through reducing the economic cost of making a healthier selection) have generated significant, positive effects (Appelhans et al., 2018; French et al., 2001). People are therefore sensitive to shifts in these features across foods, and care must be taken to ensure that health labelling does not in fact activate these negative biases.

Taken together, our review of the literature suggests that there is a need for developing greater knowledge about the ways in which health labels function. In experiment 4.E1., we explore two research questions that we developed through considering the literature described above.

Firstly, there is the potential that health labels do not fulfil the informative function intended when they are presented alongside known examples of healthier products (Martins et al., 1997; McFarlane & Pliner, 1997; Vizcaíno & Velasco, 2019). This needs to be tested. As discussed, healthy products are typically thought to be more expensive products (Haws et al., 2017). Therefore, if health labels do in fact contribute additional information even when the product is known to be healthier, we would expect that the presence of a health label would strengthen this categorization, and in turn, strengthen the extent to which this preconception about price manifests in consumer evaluations. Simply put, if a label adds information, products that are labelled as healthy will be more likely to be thought of as being healthy, and in turn, thought of as more expensive.

Secondly, evidence from the categorization literature suggests that presenting unknown foods with category labels could results in feature evaluations mirroring those made for known example of that category. With healthy products thought to be more expensive, we would therefore expect that labelling an ambiguous product as healthy would cause a spike in evaluations of product price, while labelling them as unhealthy would cause a dip. Testing whether labelling ambiguous products as healthy makes them appear more expensive would provide novel insights into the ways in which health labels shape product evaluations in conditions of uncertainty.

4.E1.1. Health labels as indicators of product health and associated attributes: price

Experiment 4.E1. explores these ideas through comparing the extent to which health labels shape product attributes for familiar and unfamiliar products. The outcome measure was the price participants would expect to have to pay for a product. With healthy products generally believed to be more expensive than less healthy ones (Haws et al., 2017), we tested whether adding a label indicating health value to products would shift participants' price expectations in a direction consistent with the health category indicated on the label (e.g., higher prices for products labelled as healthy). We tested whether labels could produce these effects both in known, familiar products, and in unknown ambiguous products.

Three product types were used: healthy, unhealthy and ambiguous. The former two product types were shown to participants with and without their respective labels, while ambiguous products were shown with both healthy and unhealthy labels (in separate conditions). For familiar products, we tested whether labels strengthened the tendency to see healthy products as more expensive, and unhealthy products as cheaper. For the ambiguous products, we tested whether their price evaluations would increase when the products were labelled as healthy, or decrease when the products were labelled as unhealthy (as the findings of Yamauchi and Yu (2008) would predict).

4.E1.2. Methods

4.E1.2.1. Participants

Prolific Academic was used to source participants in each of the six experiments described hereafter. One-hundred-and-one participants were sourced for the within-subjects healthy versus unhealthy label conditions. Inclusion criteria included being aged 18 or over, and currently being resident in the United Kingdom (as prices were measured in pound sterling). Of those recruited, 74% were female and 26% male (75 females, 26 males). Participant mean age was 39 (SD = 11yrs). Participants received £1.50 as payment.

For the no label comparison condition, one-hundred participants were recruited. Individuals who had already participated in the healthy versus unhealthy label conditions of the experiment were excluded. Within the one hundred participants, 73% were female and 27% male. Participant mean age was 35 (SD = 12yrs). Participants received £1.50 as payment.

Prior category label studies (such as Experiment 1 of Yamauchi and Yu (2008)) produced a medium effect size (d = 0.45) with a sample of 211 participants in a between subjects comparison with the category label condition (N = 58). Power analysis for our between subjects t-test comparisons, using G*Power, Windows Version 3.1.9.6 (Faul, Erdfelder, Lang & Buchner, 2007), suggested that a sample of 124 would be sufficient to provide power of 0.80 with $\alpha = 0.05$ if the same medium effect size were present. However, as health category labels have consistently produced small and mixed effects in prior literature, we opted to recruit additional participants to increase experimental power.

4.E1.2.2. Design

The independent variable was label type (three levels – healthy; unhealthy; no label). The dependent variable was expected price (£), with the changes in price expectations for ambiguous products being the key comparison of interest. The healthy and unhealthy label conditions were run within a within-subject trial, while the no label condition was run with a separate group of participants. These differences are accounted for in the analysis. Comparisons across labelled and non-labelled conditions were made between subjects to avoid demand characteristics (e.g. seeing the same item twice, once with and once without a label would highlight our research questions to our participants). In contrast, as different labels could be presented with different products throughout, the labelled conditions were operationalised within subjects (allowing for testing with a smaller sample size, thus reducing the recruitment costs associated with using an online participant panel).

To account for any variability that might occur as a result of the sales setting and context, these were included as between subject variables - venue (two levels – vending machine; shop) and venue context (two levels – healthy; standard-mixed stock). Two counterbalancing conditions were also included so that the labels shown with ambiguous items could be randomized across participants without risking showing the same items with different health value labels (see Procedure).

4.21.2.3. Materials

This study, and all others discussed in this chapter, were designed for online completion via the online platform Qualtrics, and distributed via the experiment management website Prolific Academic.

Twelve examples of healthy, unhealthy, and ambiguous products were used within the experiment. Within each category of the three product categories, there were four crisps, four bars and four nibble packs (see Appendix 9). The healthy and unhealthy products were products typically sold within the UK market, with the healthy products fitting the same criteria used in Chapters 2 and 3 for "healthy vending" products (Welsh Government, 2012). The ambiguous products were designed by the research team through editing images of pre-existing, uncommon food items and creating fictitious brand names. To assess whether products from the three product categories would be categorized as intended by participants, they were pre-tested with a sample of

30 participants. Participants were to rate each item on a scale ranging from 1 to 6 (Unhealthy - Healthy). The items were rated in the desired order. The mean ratings were 4.46 (SD = 0.65) for healthy items, 2.99 (SD = 0.62) for ambiguous items and 1.75 (SD = 0.52) for unhealthy items. The means for healthy and ambiguous items were found to be statistically significantly different, $t(29) = 13.58$, $p < 0.01$, as were the means for the healthy and unhealthy items, $t(29) = 17.85$, $p < 0.01$, and the means for the unhealthy and ambiguous items, $t(29) = -10.26$, $p < 0.01$. Despite the fact that ratings were generally skewed towards the less healthy end of the scale, each product category was deemed as intended relative to each other.

Labelled and no label versions of test images were then developed for each of the thirty-six products (see Appendix 10). Within these images, the products were always shown on the right-hand side, while the left-hand side always showed one of the four venue/venue context combinations within the experiment (e.g. an image of a healthy vending machine, an image of an unhealthy shop aisle). The labelled versions of the test images included a black border around the item, and either a green (for healthy) or red (for unhealthy) trim at the bottom. The trim also indicated the health value with the words “Healthy” or “Unhealthy” included. These labels were purposefully designed to be simplistic so as to clearly communicate health categories, using a combination of features from previous research (e.g. simple qualitative descriptors, colour coding (Grech & Allman-Farinelli, 2015)). For ambiguous products, no label, healthy label and unhealthy label versions of the test images were produced. For the healthy and unhealthy products, versions with no labels, and versions for only the labels that corresponded to their actual health values were produced (i.e. only healthy labels for healthy products).

Two control images were also created (with labelled and no label versions for each of the venue/venue contexts combinations). One image showed a low-cost biscuit, while the other showed a high-cost sandwich (see Appendix 9). Participants’ responses were excluded if they did not rate the high-cost product as more expensive. To maintain consistency across conditions, it was randomly determined that the control images would be labelled as unhealthy in all labelled conditions.

4.E1.2.4. Procedure

An information screen and consent form were displayed, along with instructions telling participants to read all questions thoroughly, and to answer each question in pound sterling using two decimal places and without any symbols (i.e. 0.60 for 60p, 1.24 for £1.24).

Participants were randomly allocated to see one of the four venue/venue context combinations on the left-hand side of each image across all trials (see Materials). Those partaking in the healthy versus unhealthy label comparison were also randomly assigned to one of two counterbalancing conditions, which determined which labels were shown with which ambiguous product. Each ambiguous product within the three product types (bar, crisps, nibbles) was assigned a number from one to four. Participants in counterbalancing condition 1 saw products one and two with healthy labels, and products three and four with unhealthy labels. Those in counterbalancing condition 2 saw products one and two with unhealthy labels, and products three and four with healthy labels.

All participants saw all thirty-six food products in a randomized order. Those taking part in the healthy versus unhealthy label comparison saw all products with labels (with the label type seen with the ambiguous products being dependent on their counterbalancing condition), while those partaking in the no label comparison saw all products without labels.

For each test image, participants were asked "How much would you expect to pay for this item?". Participants inputted their answers in a blank box (with a £ prompt), and pressed proceed to see the following test image. Following inputting expected prices for the thirty-six randomized products, participants were asked to do the same for the two control products (with these two products' presentation order also randomized independently). Participants were then debriefed and informed of payment procedures through Prolific Academic. Participation took approximately fifteen minutes.

4.E1.3. Results

Following excluding participants with outlier responses, the sample for the healthy versus unhealthy label conditions consisted of 90 subjects. For the no label comparison, 92 subjects were left following excluding outliers. Participants were considered to be outliers if they gave any values

above £5 (which was beyond the true market value of all products) or if they failed the high-cost low-cost check.

4.E1.3.1. Ambiguous products

The mean expected price given for ambiguous products in the healthy label, unhealthy label and no label conditions were calculated, and are presented in Figure 11.

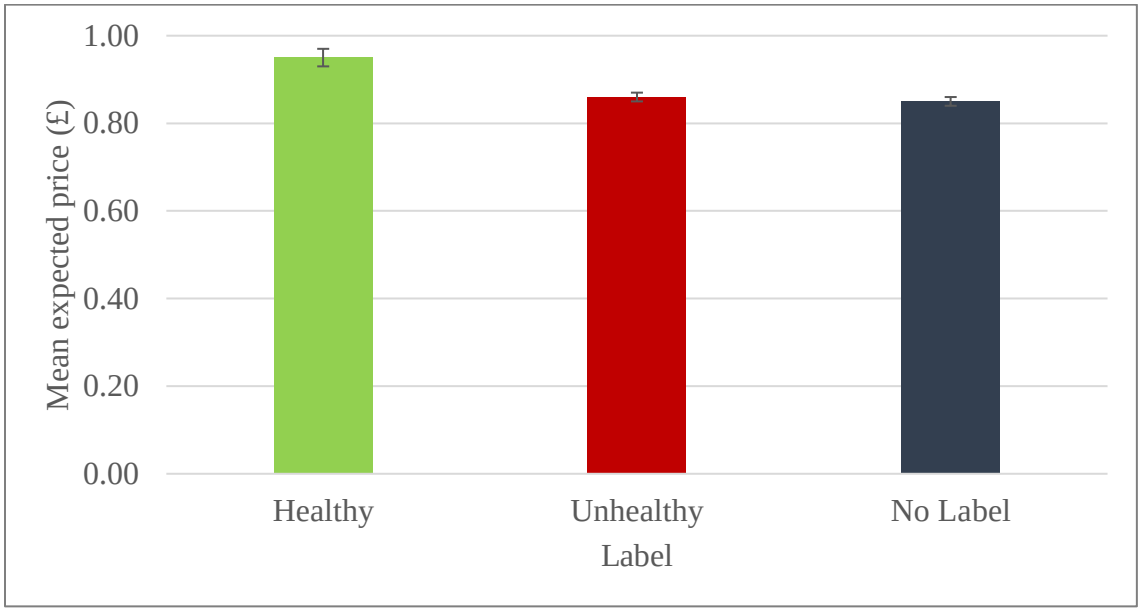


Figure 11. Mean expected price for ambiguous products with healthy, unhealthy or no labels. Error bars shown standard error of the mean.

As shown in Figure 11, ambiguous products were expected to be 9p more expensive when presented with healthy labels (M = 95p; SEM = 0.02) compared to when presented with unhealthy labels (M = 86p; SEM = 0.01). A paired samples t-test found this difference to be statistically significant, $t(89) = 4.76$, $p < 0.01$, $d = 0.50$.

Ambiguous products were expected to be 10p more expensive when presented with healthy labels (M = 95p; SEM = 0.02) compared to when presented without a label (M = 85p; SEM = 0.01). An independent samples t-test found this difference to be statistically significant, $t(180) = 2.46$, $p < 0.05$, $d = 0.18$. Contrastingly, when comparing the expected prices for ambiguous products without labels, and the expected prices for ambiguous products with unhealthy labels (M = 86p; SEM = 0.01), an independent samples t-test found that the 1p difference was not statistically significant, $t(180) = -0.35$, $p = 0.73$, $d = 0.03$.

4.E1.3.2. Healthy and Unhealthy Products

The mean expected price given for healthy and unhealthy products in the labelled and no label conditions were also calculated and can be seen in Figure 12.

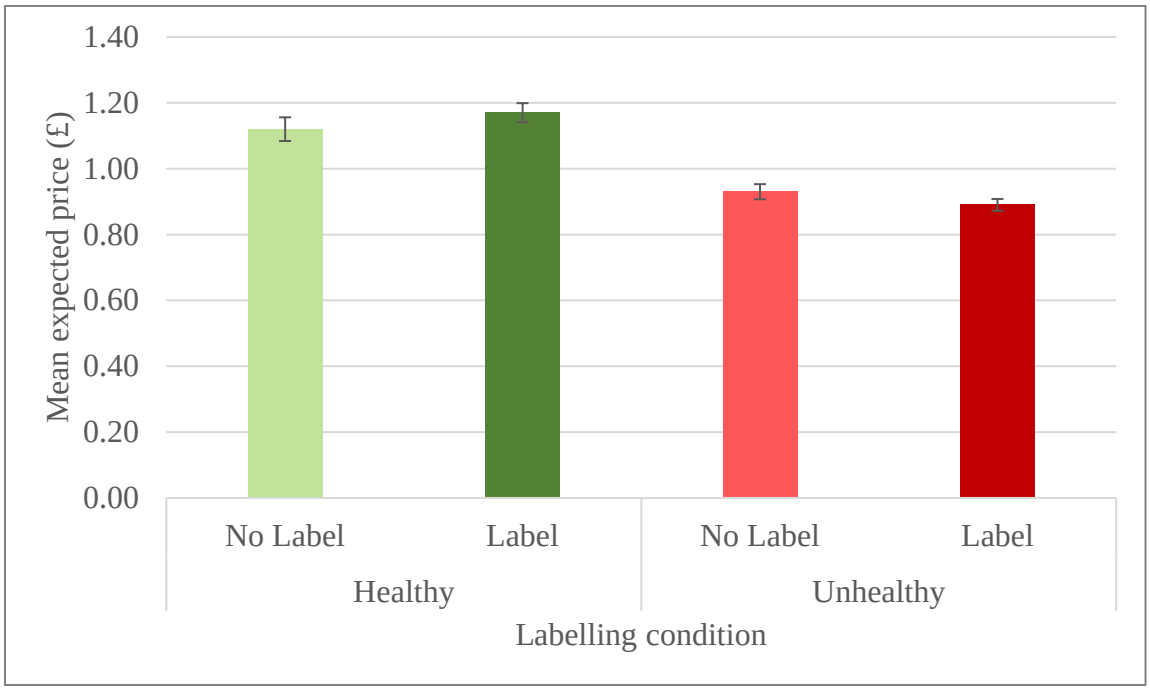


Figure 12. Mean expected price of healthy and unhealthy products in each labelling condition. Error bars show standard error of the mean. Colours indicate product health (green healthy, red unhealthy).

A mixed ANOVA found no main effect for label, F(1,180) = .01, MSE = .002, p = .91, η_p^2 < .001. Healthy products were expected to be significantly more expensive than unhealthy products, F(1,180) = 198.76, MSE = .10, p = <0.001, η_p^2 = .53. A significant interaction was found between product health and labelling, F(1,180) = 7.31, MSE = .19, p = .01, η_p^2 = .04, however price expectations did not differ based on whether there was a label or not present alongside both healthy (F(1,12) = 1.64, MSE = .07, p > .05, η_p^2 = .006) and unhealthy (F(1,12) = 1.13, MSE = .07, p > .05, η_p^2 = .011) products.

4.E1.4. Discussion

Experiment 4.E1. explored two research questions. Firstly, we investigated whether adding a health category label to products would alter expected prices compared to those made in the

absence of a label. We found no such effect. Secondly, we explored whether adding healthy or unhealthy category labels to novel foods would cause evaluations of those products to mirror trends seen in actual healthy and unhealthy products. We did find evidence that aligns with this hypothesis. We reflect on our findings and their possible implications in the following discussion.

Healthy foods were expected to be more expensive than unhealthy products, providing further evidence for the existence of the 'healthy = more expensive' bias (e.g. Haws et al., 2017). However, health labels did not broaden these differences in price expectations between healthy and unhealthy products. If health labels serve an informative purpose, we would expect that the presence of health labels would strengthen the healthy = expensive bias. Price expectations for known products (be they healthy or unhealthy) were however left unaffected by the presence of health labels. Prior literature has suggested that it is unlikely that health labels serve an informative function when the labelled products are already familiar, known exemplars of either healthy or unhealthy products (Martins et al., 1997; McFarlane & Pliner, 1997; Vizcaíno & Velasco, 2019). The pattern of results found in this study does align with these conclusions, and may contribute in explaining why health interventions that place labels on healthy products rarely produce large-scale, or any effects (as discussed by Grech & Allman-Farinelli (2015) and van't Riet (2013)).

The fact that health labels did not shape price expectations for these known products in our study cannot be taken as evidence that such an effect does not exist. However, our hypothesis that health labels are more likely to influence evaluations of unknown foods, rather than known foods, was given further support when we looked at the price expectations for unknown foods of ambiguous health value.

Unknown, ambiguous products were expected to be significantly more expensive when they were presented with a healthy label (compared to no label and unhealthy label conditions). Studies of categorization have demonstrated that category labels influence the predictions individuals make about features of a novel stimuli, causing evaluations to resemble those made for other known examples of the same category (Yamauchi & Yu, 2008). As discussed previously, if a new insect was presented as being a member of Category A, participants predicted that its antennae would match the antennae of a previously seen member of Category A in Yamauchi and Yu's (2008) study. Our participants demonstrated a comparable pattern of behaviour while

predicting food prices. Ambiguous products were expected to be more expensive (a feature associated with healthier products (Haws et al., 2017)) when labelled as healthy.

Of note, adding an unhealthy label did not alter price expectations compared to the no label condition. This may reflect that beliefs about product price are stronger for healthier products than unhealthy products. That is, while healthy products are typically expected to be more expensive, it may not necessarily be the case that unhealthy products are automatically considered to be cheap. Another viable explanation can be proposed when reflecting back on the results obtained at pre-test. Ambiguous products, when presented alone without labels in pre-test, were assumed to be more unhealthy than healthy (with their ratings, while being between those given for healthy and unhealthy products, being skewed towards the unhealthy end of the scale). If ambiguous products were already perceived to be slightly more unhealthy than healthy, adding an unhealthy label would have only confirmed participants' existing assumptions. As such, in line with our theory, their evaluations would be unlikely to change. Adding a healthy label, however, provided participants with new information about the category to which the product belonged. Even if the products possessed features associated with unhealthy products, Yamauchi and Yu's (2008) study demonstrated how category labels produce persistent effects that overpower any mismatch in features – in Yamauchi and Yu's (2008) study, individuals still based their predictions of a novel insect's features on its category label, even when other features of the novel insect were inconsistent with this category. Even if the ambiguous foods had features that resembled those of unhealthy products, the healthy category label overpowered these, and participants' price evaluations followed suit.

What might these findings mean for the use of health labels in naturalistic settings? In the introduction, we presented the idea that health labels, as currently used, may not fulfil their informative function as effectively as intended. This is due to the fact that they are typically placed next to products that are typically known to be healthier. In this study, healthy labels only impacted evaluations for products of ambiguous health values, and labels had no influence on evaluations of archetypal healthy or unhealthy products. It could be the case that health labels only serve an informative purpose when placed alongside novel, unfamiliar products. They may therefore be most effectively used to inform consumers and influence their evaluations about less familiar products, or those with hard-to-distinguish health values.

As mentioned earlier, this may contribute to why labelling interventions have historically produced such mixed effects (Grech & Allman-Farinelli, 2015; van't Riet, 2013). If labels only serve an informative function for novel products (not familiar ones), then quite often, they will not be adding any new information for the consumer that could sway their decision. They may make it more likely that healthy products are identified and attended to (through drawing attention), but they will not serve the informative purpose desired from such labels, nor shape evaluations beyond existing assumptions. Price expectations for known healthy foods are unlikely to shift in the presence of labels. In the next experiment we test this idea further through exploring how health labels might impact evaluations of another feature of food: taste.

4.E2.1. Health labels as indicators of product health and associated attributes: taste

People often assume that healthy foods are less tasty than unhealthy foods (Raghunathan et al., 2006). To further test our hypothesis that feature evaluations of novel food products will align to those associated with the category label presented alongside it, we compared the taste ratings given for labelled healthy and unhealthy products, and ambiguous products when labelled as either healthy or unhealthy. In experiment 4.E1., effects were found relative to each other (between healthy and unhealthy labelled conditions), and ambiguous products were assumed to be unhealthy unless labelled otherwise. We therefore decided that a no label condition was not necessary in experiment 4.E2. We hypothesized that healthy products would be expected to be less tasty than unhealthy products, as implied by Raghunathan et al. (2006), and that this same pattern would be replicated for the ambiguous products when presented alongside healthy and unhealthy category labels.

4.E2.2. Methods

4.E2.2.1. Participants

This experiment focused on replicating the within subject comparisons between ambiguous products labelled as healthy or unhealthy from experiment 4.E1, where a medium effect size (d = 0.50) was achieved with a sample of 90 subjects following exclusions (see 4.E1). While a power analysis using G*Power, Windows Version 3.1.9.6 (Faul et al., 2007) suggested that a sample of 34 would be the minimum required to provide power of 0.80 with $\alpha = 0.05$ and a medium effect size in a paired samples t-test, we opted to recruit a similar number of participants to that recruited

for the prior experiment, for consistency in our replication. We therefore recruited 96 individuals (which would also allow for some attrition in the case of missing responses etc). Inclusion criteria were the same as in experiment 4.E1. Participants who took part in experiment 4.E1. were ineligible. Of those recruited, 54 were female and 42 were male. Participant mean age was 37 (SD = 11yrs). Participants received £1.50 as payment.

4.E2.2.2. Design

The independent variable was label (two levels – healthy and unhealthy), and ambiguous products were shown with each in a within-subject design. The dependent measure was estimated tastiness, measured on a 7-point Likert scale (1 - not at all, 7 – very tasty). Healthy and unhealthy products (labelled as such) were also included. As in experiment 4.E1., participants were randomized into counterbalancing conditions that determined which label appeared with each ambiguous item, and randomized them into sales settings and contexts (see 4.E1.). Using a within-subject design and counterbalancing allowed us to test with a smaller sample size, reducing the costs associated with sourcing participants online.

4.E2.2.3. Materials

The same twelve examples of healthy, unhealthy, and ambiguous products used in experiment 4.E1. were used again (see respective Methods section), however only the labelled versions of the test images were used in experiment 4.E2. (see Appendices 9 & 10). The images were presented exactly as before, however the question below the product was replaced with "How tasty would you expect this item to be?", with a Likert scale underneath for inputting answers.

4.E2.2.4. Procedure

Participants were told they would be making evaluations of how tasty different food products would be. All participants saw all thirty-six food products presented with labels, in a randomized order. The label type seen with the ambiguous products was dependent on counterbalancing condition. For each test image, participants were asked "How tasty would you expect this item to be?", and responded on a sliding Likert scale. Pressing "proceed" would present the next test image, until all thirty-six product evaluations had been made. Participants were then debriefed and informed of payment procedures through Prolific Academic. Participation took approximately fifteen minutes.

4.E2.3. Results

All participants responded to all questions, therefore the sample consisted of ninety-six participants. The mean taste rating given for healthy and unhealthy products, along with ambiguous products in the healthy and unhealthy label conditions were calculated, and are presented in Figure 13.

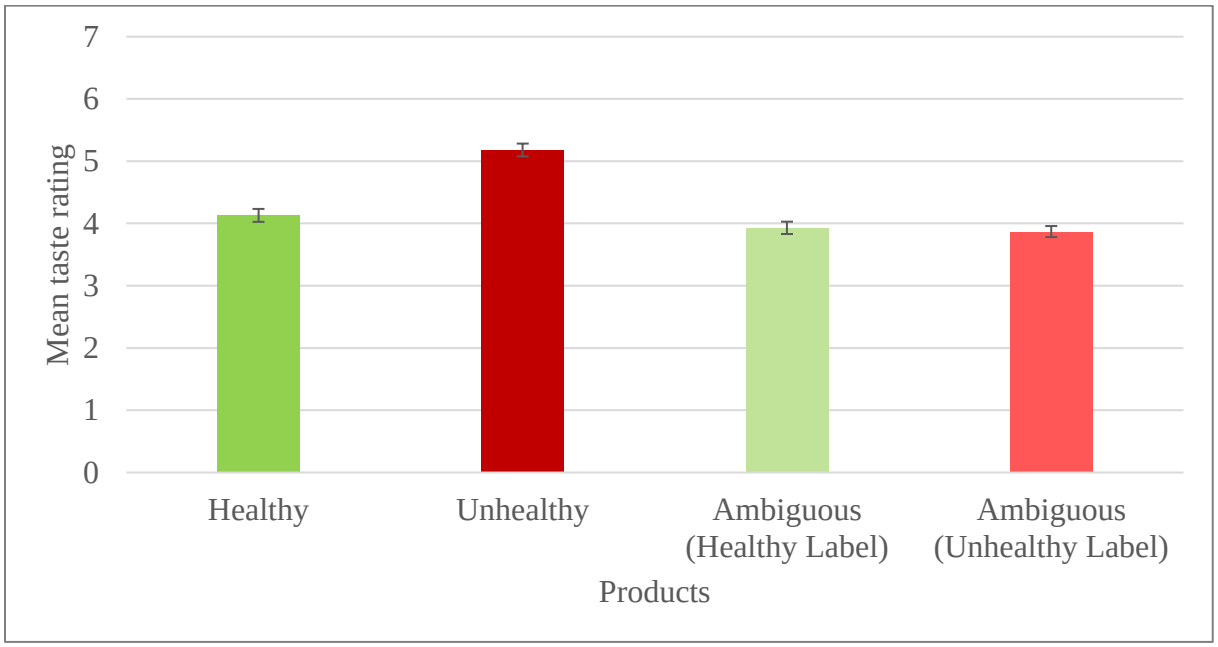


Figure 13. Mean taste rating for healthy, unhealthy and ambiguous products. Ratings for ambiguous products are split dependent on which label was presented alongside them. Error bars show standard error of the mean. Colours indicate the health value of the label (green healthy, red unhealthy).

Unhealthy products were rated as being significantly tastier than healthy products $t(95) = -8.43$, $p < 0.001$, $d = 0.86$. Labelling ambiguous products as healthy or unhealthy did not generate a parallel effect, $t(95) = .75$, $p = .46$, $d = 0.08$. Furthermore, taste ratings for healthy products significantly differed from those for ambiguous products labelled as healthy, $t(95) = 2.59$, $p < 0.01$, $d = 0.26$, as did taste estimates for unhealthy products when compared with ambiguous products labelled as such, $t(95) = 12.37$, $p < 0.001$, $d = 1.26$. Taste estimations were higher for healthy and unhealthy products than they were for ambiguous products that bared the same labels.

4.E2.4. Discussion

Experiment 4.E1. demonstrated that health labels placed on unfamiliar products can cause feature evaluations to align with those made for known exemplars of healthy products – healthy foods are thought to be more expensive, and ambiguous foods were thought to be more expensive if labelled as healthy. The aim of experiment 4.E2. was to determine whether a similar effect could be generated for another feature of foods: taste. Healthy foods are generally assumed to be less tasty (Raghunathan et al., 2006). Despite the fact that our participants judged known healthy products to be less tasty than known unhealthy ones, ambiguous products' taste ratings did not vary in a similar way when healthy and unhealthy labels were presented alongside them. Unlike price, taste ratings did not follow those given for known members of the category named on the label.

First and foremost, this study provides further evidence that healthy products are expected to be less tasty than unhealthy ones (Raghunathan et al., 2006) – a damaging preconception that makes healthy choices less attractive to the consumer. The ambiguous products were the focus of this study, however. While taste ratings of healthy and unhealthy foods followed the expected pattern (when presented with category labels), the same pattern was not replicated in the ambiguous products when they were presented with the same labels. Labelling ambiguous products as healthy did not lower their taste ratings compared to ambiguous products labelled as unhealthy. This conflicts with our argument that category labels shift feature evaluations to align with evaluations made for other exemplars of the named category, and goes against the pattern of results found for price evaluations in experiment 4.E1. prior. Why might price evaluations align with labelled categories, but not taste?

One possible explanation is that the unfamiliarity of the products, regardless of label type, contributed in making participants perceive the products as less tasty. Food neophobia is a widely documented phenomenon –individuals of all ages tend to show decreased willingness to taste novel foods when given the opportunity, although this tendency weakens as individuals age (McFarlane & Pliner, 1997). The novelty of the ambiguous products may have brought uncertainty, and made them appear less favourable than the familiar alternatives shown. Taste ratings for healthy products were significantly higher than they were for ambiguous products when they were labelled as healthy, as were taste ratings for unhealthy products compared to ambiguous products labelled as

unhealthy. Even when presented with the same label, the familiar products were assumed to be tastier than the novel ones.

Unlike price, taste is a visceral experience, and it may be the case that prior experience is an important factor for consumers when they make their evaluations. While the unhealthy = tasty intuition may manifest itself for familiar products, it may be the case that this effect is overpowered by an aversion towards novel foods when consumers were asked to predict features of unfamiliar products. This held true in this study despite it being conducted online, where there was no real potential of being exposed to these tastes, suggesting that this effect could be particularly persistent. While familiar healthy products are thought to be less tasty than unhealthy ones, for unfamiliar products, any effect of the health category labels may have been dampened by a general aversion towards novel foods. Taste may therefore be an exception to our hypothesis that feature evaluations of labelled novel foods will mirror those made for known members of the named category.

Experiment 4.E3. therefore shifts the focus back onto price, to further develop our understanding of the circumstances in which health labels shape product evaluations and the ways in which they do so. In particular, experiment 4.E3. sets out to test the external validity of the labels used in the two prior experiments. In experiment 4.E1., we purposefully used overt health labels that simply named the health category that the products belonged to (e.g. “Healthy” in green, “Unhealthy” in red). Within naturalistic settings, overt labels such as those used in our study are rarely used, and their relevance to what may be used in practice is limited for two reasons. First, unhealthy products are rarely labelled as such in typical commercial settings (where promotions, not deterrents are more commonly placed alongside products). Secondly, health labels are generally less direct, and make use of health-relevant motifs or images to convey the healthiness of a product. While indicative of category membership, these labels rarely overtly and solely state that the products are “Healthy”. More commonly, they allude to health e.g. “lighter”, “recommended”. We therefore deemed it important to explore whether the same effects could be replicated with more naturalistic labels, to allow for generalizing to typical consumer environments.

4.E3.1. Naturalistic health labels as indicators of product price

For experiment 4.E3., we created three healthy label designs based on those used in practice. We used these to test whether the same effects found in experiment 4.E1. (that feature evaluations for healthy-labelled ambiguous products follow those made for healthier products) could be replicated with more suggestive labels. Product price evaluations were compared in the presence and absence of the naturalistic labels. These labels included two health message labels ("EatWell" and "Lighter Choices") , and an "NHS Lighter Choices" label (see Chapter 3 for further discussion of label development and proposed source effects). We included a no label condition as a baseline measure for comparison for all three labels. We did not test unhealthy labels in experiment 4.E3. for two reasons – they are unlikely to be used in practice, and experiment 4.E1. demonstrated that ambiguous products were assumed to be unhealthy unless labelled otherwise – the unhealthy label would therefore be unlikely to serve any informative purpose for consumers. Healthy and ambiguous products were shown with and without labels, and unhealthy products were also included (but unlabelled throughout), to anchor evaluations and replicate the contrasts that labels generate in naturalistic settings.

As our labels were modelled on pre-existing health labels that communicate that products are categorized as healthy, we anticipated that they too would produce the same price-alignment effect demonstrated in experiment 4.E1 previously. This would be measured by analysing whether price expectations for ambiguous products would increase in the presence of a healthy label.

4.E3.2. Methods

4.E3.2.1. Participants

Inclusion criteria were as described in 4.E1., and two-hundred and forty participants were recruited. Power analyses were based on the medium effect size obtained in our first experiment (see 4.E1), with a minimum sample of 180 suggested for a four group F test to achieve power of 0.80 with $\alpha = 0.05$ and a comparable medium effect size (G*power, Windows Version 3.1.9.6 (Faul et al., 2007)). However, as the purpose of this experiment was to test whether subtler, naturalistic labels could produce effects as strong as the "healthy" category labels, we anticipated that any effects might be subtler too; therefore we recruited a greater number of participants in case the effects were weaker.

Any individuals who had participated in any of the prior studies were excluded (with the same applying to all experiments that follow within this chapter). Of those recruited, 157 were female (65%) and 83 (35%) were male. Participant mean age was 38 (SD = 11yrs). Participants received £1.50 as payment.

4.E3.2.2. Design

A mixed design was adopted. The between-subject independent variable was labelling condition (four levels – no label, EatWell label, Lighter Choices label, and NHS label), while product health (three levels – healthy, unhealthy and ambiguous) was a within-subject variable. Labelling condition was operationalised between subjects to avoid demand characteristics – presenting different health labels to the same participants may have made our research question more salient. In contrast, being exposed to products of different health values and levels of familiarity is commonplace in shopping environments, therefore we determined that product health could be operationalised within subject without alerting participants to the nature of our research question. The dependent measure was expected price (£).

4.E3.2.3. Materials

The products used were the same as in experiment 4.E1. Four test images, following the same layout as experiment 4.E1., were created for each of these products – one no label version, one EatWell label version, one Lighter Choices label version and one NHS label version (see Figure 14 and Appendix 11). All three labels were developed as adaptations of familiar health messages within the UK e.g. the Eatwell guide (UK Government, 2018). Only the healthy and ambiguous products were shown alongside labels (with unhealthy products unlabelled throughout). The no label control images from 4.E1. were used again (with a low-cost biscuit and high-cost sandwich) to filter out any participants that made unreliable price evaluations.

Figure 14. EatWell, Lighter Choices and NHS health labels

4.E3.2.4. Procedure

The consent and information screen, as used in 4.E1., were shown. Participants were then randomly allocated to one of the four labelling conditions. All participants saw all thirty-six test food products in a randomized order, inputting their expected price before proceeding to the next product. The two control images were presented last, randomized across the two. Participants were then debriefed and informed of payment procedures through Prolific Academic. Participation took approximately fifteen minutes.

4.E3.3. Results

Participants were excluded if they failed the high-cost low-cost control, or priced any item above £5. The final sample included 220 subjects.

Fifty-four participants were in the no label condition, fifty-two in the EatWell condition, and fifty-seven were in the Lighter Choices and NHS conditions. Mean expected prices for healthy, unhealthy and ambiguous products were calculated for each condition (see Figure 15).

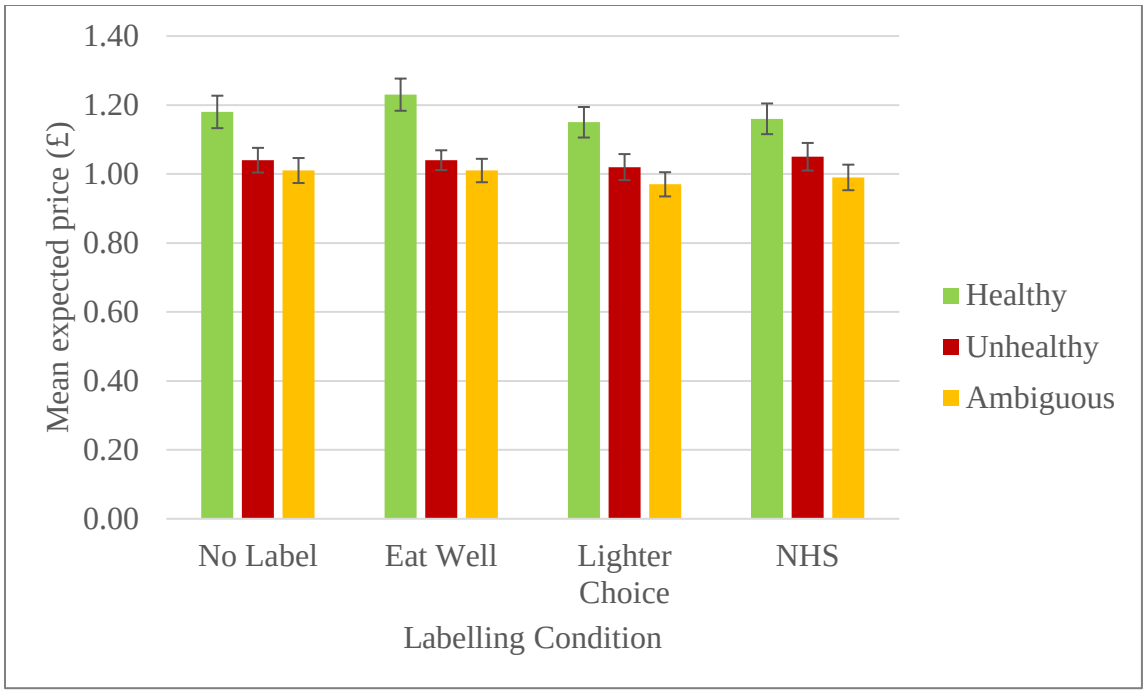


Figure 15. Mean expected price of healthy, unhealthy and ambiguous products in all four labelling conditions. Legend represents product health. Error bars show standard error of the mean.

As the labelling manipulation was operated differently for each product type (e.g. in the Lighter Choices condition, healthy products were given a label congruent with how they were typically perceived, unhealthy products were not given any label at all, and ambiguous products were given a label that provided new information to the consumer), we determined that carrying our analyses of the effects of labelling for each product type separately would be most suitable (with these corrected for multiple comparisons using Bonferroni corrections).

Our measure of interest was the effect of labelling condition on ambiguous product price evaluations. No significant difference was found between price expectations for ambiguous products across all labelling conditions, $F(3,216) = .23$, $MSE = .02$, $p = .87$, $\eta_p^2 = .003$. Similarly to experiment 4.E1., price expectations did not differ across labelling conditions for healthy ($F(3,216) = .58$, $MSE = .07$, $p = .63$, $\eta_p^2 = .008$) or unhealthy products ($F(3,216) = .11$, $MSE = .07$, $p = .96$, $\eta_p^2 = .002$).

4.E3.4. Discussion

In experiment 4.E3. we attempted to replicate the feature-alignment effect seen in experiment 4.E1. with health labels that bore a closer resemblance to those used in practice. In experiment 4.E1., labelling ambiguous products as "healthy" caused an increase in price evaluations, with these mirroring the higher prices given for known exemplars of healthy products. In experiment 4.E3., overtly categorizing products as "healthy" was avoided, with labels instead alluding to health e.g. encouraging eating well, making lighter choices, and highlighting a credible source of health information.

Contrary to the findings of experiment 4.E1., price expectations for products of ambiguous health value did not differ as a function of label. Where in experiment 4.E1., "healthy" labels caused an increase in price expectations for ambiguous products, no such effect was found with any of the naturalistic health labels. Our naturalistic labels were modelled on those commonly used within food choice scenarios to promote the selection of healthier products. Eating well, making lighter choices, and the NHS logo all generate images of health. Why then did placing these messages next to ambiguous products not generate the same effects as the overt "healthy" label did in experiment 4.E1.?

The answer may lie within the categorization literature. In experiment 4.E1., we proposed that healthy labels caused a shift in the categorization of ambiguous products, with their feature evaluations resultantly aligning with those made for known healthier products. It is possible that consumers did not view the ambiguous foods as more expensive in experiment 4.E3. as the more suggestive, naturalistic labels did not cause consumers to categorize these products as healthy. If a shift in categorization did not occur, it is likely that feature evaluations would also be left unchanged.

Our naturalistic labels were designed to be more covert indicators of health, in line with the types of labels used in practice (and in contrast to those used in experiment 4.E1.). They therefore solely suggested that these products were members of the healthy category, as opposed to directly stating so (as the "healthy" labels did in experiment 4.E1.). We anticipated that these suggestions could still generate a shift in categorization for ambiguous products (which would be paired with shifts in feature evaluations). However, the step away from overtly categorizing the

products could be key in explaining why feature evaluations were not mirrored across ambiguous and healthy products.

If the naturalistic labels were seen to communicate product features (as opposed to product categories), they may have had a diminished influence on evaluations of other non-related features. Category labels have greater influence on inductive inferences than feature labels, and individuals attend to them sooner and for longer (Yamauchi, Kohn, & Yu, 2007). Yamauchi and colleagues (2007) demonstrated this distinction in a study using a similar design to the 2008 study described previously. Participants were again asked to predict features of insects, however in this design, the name presented above the sample insects was framed as being either a category name, or the name for one of the features of the insect. Participants who were told that the label indicated category membership were more likely to predict that novel insects in the same category had the same features as the original sample (similar to our findings in experiment 4.E1., and Yamauchi and Yu's (2008) findings). Participants therefore carried features over when the category labels matched, and crucially, this was significantly more likely to occur when the same labels were framed as category labels instead of feature labels. The authors proposed that category labels work as guides when people make feature inferences, easing the integration of an array of features under one name and shaping the way that other features are processed. Feature labels do not serve the same function.

This distinction between category and feature labels may be at the heart of why price evaluations of ambiguous did not align with those made for healthy products in experiment 4.E3. If our more suggestive labels were seen to be communicating product features instead of product categories, participants may have been less likely to recategorize products as healthy and ultimately base their feature evaluations for ambiguous products on what they thought to be true for known healthy foods. With the more naturalistic labels suggesting category membership through highlighting features of healthy products (e.g. recommended, endorsed, lighter choices), the labels' influence on feature inferences may have been dampened. This could account for why price expectations for ambiguous products did not differ when presented with the naturalistic health labels. Taking this evidence into account, it may be the case that subtler labels like those used in practice may not be as effective in shifting product categorization and associated feature inferences as those that overtly state product health (as in experiment 4.E1.). To test this idea, we

determined that exploring the extent to which these naturalistic labels shape evaluations of product health was important. If naturalistic labels are ineffective in shaping evaluations of product health, it could lend weight to the argument that suggestive labels that highlight product features instead of placing them in categories cannot produce the same shifts in product evaluations.

In the second section of this chapter, we therefore move away from exploring the ways in which health labels shape evaluations of features associated with healthy products, and towards directly exploring the extent to which the kinds of labels used in practice are effective in communicating product health.

4.E4.1. Naturalistic health labels as indicators of product health

In this experiment, participants were asked to rate the healthiness of products, instead of estimating features of the products (such as price or taste). The aim was to establish the influence naturalistic health labels have on evaluations of product health, with a particular focus on exploring whether these labels would make ambiguous products with unknown health values appear healthier. We also sought to explore the effect these labels might have on health evaluations of known exemplars of both healthy and unhealthy products.

4.E4.2. Methods

4.E4.2.1. Participants

A minimum sample size of 147 was suggested in G*power, Windows Version 3.1.9.6 (Faul et al., 2007) to achieve power of 0.80 with $\alpha = 0.05$ and a medium effect size (as was found in our first experiment, see 4.E1) in a 3 group F test. We recruited 148 participants, of which 72% were female and 28% male. Participant mean age was 35 (SD = 13yrs). Participants received 84p as payment. Inclusion and exclusion criteria were as described for the prior experiments.

4.E4.2.2. Design

A mixed within-between subject design was adopted (see Methods, 4.E3. for rationale). The independent variables were labelling (between subjects, three levels – NHS Lighter Choices, Lighter Choices and no label) and item health (within subjects, three levels – healthy, unhealthy, ambiguous). The dependent variable was health rating, measured on a Likert scale ranging from 1 (unhealthy) to 7 (healthy).

4.E4.2.3. Materials

The thirty-six test items from the previous experiments were used, as were the test images for the NHS, Lighter Choices and no label conditions of experiment 4.E3. (see Appendix 11). A 7-point Likert scale was shown below the product, ranging from unhealthy (1) to healthy (7). Healthy and ambiguous products were labelled in the two labelled conditions, while unhealthy products were always presented without labels in all three conditions.

Two control images were created, to allow for identifying irregular responses. One image showed a high-calorie drink (Coke), and the other showed a low-calorie drink (Diet Coke) (see Appendix 9).

4.E4.2.4. Procedure

Participants were informed of the study procedures then they ticked a box confirming their consent to participate. Participants were instructed to make judgements about the food items presented and respond using the Likert scale provided. Participants were randomly allocated to one of the three labelling conditions, which determined how the healthy and ambiguous products were presented (either with no label, with a Lighter Choices label, or with an NHS label). Unhealthy products were always presented without labels.

All participants saw all thirty-six test items (12 healthy, 12 unhealthy, 12 ambiguous) in a randomized order, rating the healthiness of each product on a Likert scale before proceeding to see the next product. To test for irregular responses, the two control products were then shown, with the least healthy (Coke) always presented before the least unhealthy (Diet Coke), based on the premise that the Diet Coke should appear relatively healthier when presented after Coke (with any participants that deviated from this pattern being excluded). Participants were then debriefed and informed of payment procedures. Participation took approximately 10 minutes.

4.E4.3. Results

All participants met the criteria for inclusion, therefore the responses of all 148 subjects were included. Of these participants, fifty were randomly allocated to the no label condition, fifty to the Lighter Choices condition, and forty-eight to the NHS condition.

Each participant's mean health rating for healthy items, unhealthy items and ambiguous items when presented in the NHS, Lighter Choices and no label conditions were calculated. Overall means were calculated across all participants – these are displayed in Figure 16.

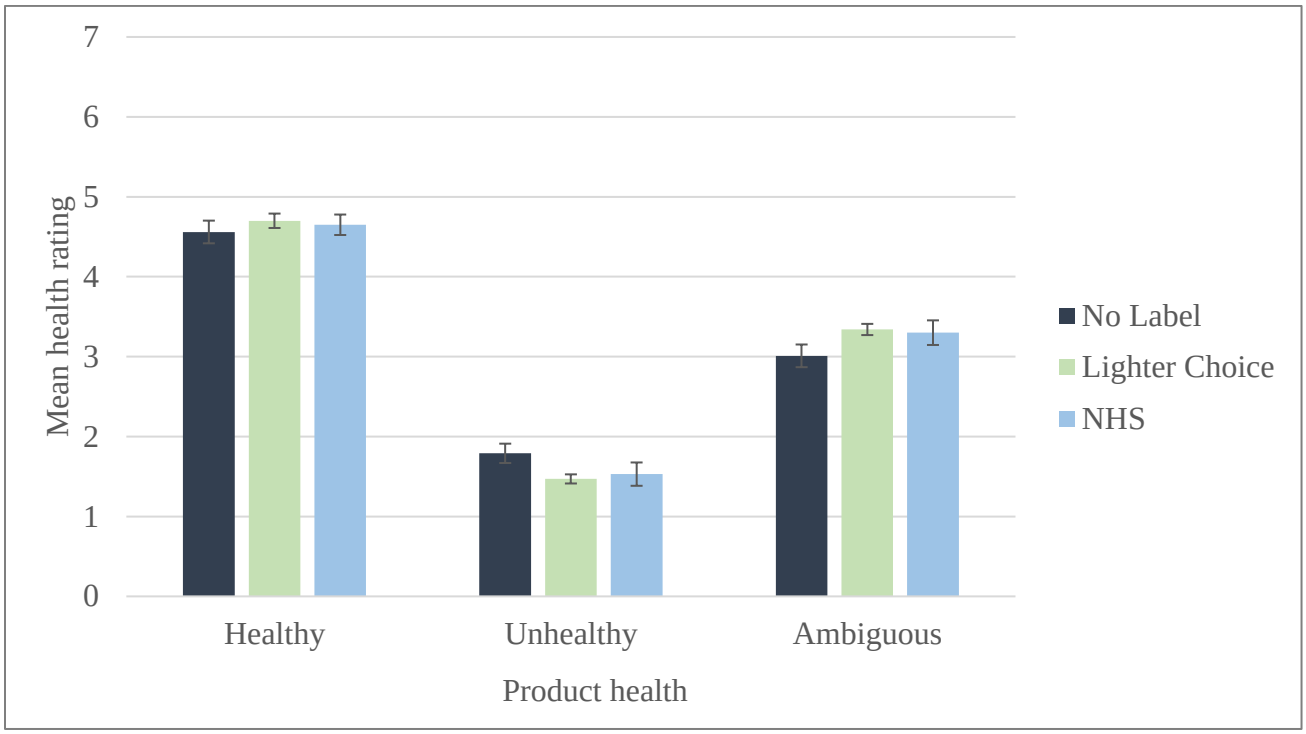


Figure 16. Mean health rating given to healthy, unhealthy and ambiguous products in the three labelling conditions. Legend portrays label type. Error bars show standard error of the mean.

As in experiment 4.E3., the labelling manipulation was operated differently for each product type therefore analyses were carried out separately (with these corrected for multiple comparisons using Bonferroni corrections, alpha level set at $p < .012$). We ran three separate one-way ANOVAs to explore the effect of labelling condition on product health estimations. No significant differences were found between health estimations of healthy products across labelling conditions, $F(2, 145) = .30$, $MSE = 0.27$, $p = .74$, $\eta_p^2 = .004$. The same held true for ambiguous products, $F(2, 145) = 1.53$, $MSE = 1.53$, $p = .22$, $\eta_p^2 = .021$. Interestingly, a significant difference was found between the health estimations of unhealthy products across the three labelling conditions, $F(2, 145) = 5.29$, $MSE = 1.43$, $p = .01$, $\eta_p^2 = .07$. Post hoc comparisons (Tukey) demonstrated that health estimates for unhealthy products dropped significantly within both

labelled conditions when comparing with the no label condition, while there were no significant differences between both labels (No Label vs NHS p = .04; No Label vs Lighter Choices p = .01; Lighter Choices vs NHS p = .84).

4.E4.4. Discussion

With experiment 4.E3. raising questions about the extent to which naturalistic health labels are able to influence feature inferences, in experiment 4.E4. we explored the extent to which these more suggestive labels shift evaluations of product healthiness. The presence of health labels alongside ambiguous products was predicted to make evaluations of such products healthier. Despite health ratings for ambiguous products displaying an upward trend in both labelled conditions, no statistically significant effect was found. The same was the case for healthy products. Interestingly, evaluations of unhealthy products (that were presented without labels throughout the experiment) did significantly differ across conditions.

When other products were labelled as healthy, ratings for unhealthy products became even more strongly skewed towards the unhealthy end of the scale. The absence of a label on the unhealthy products was a stronger communicator of health, or lack thereof, than the presence of a label alongside any healthy or ambiguous product. Reflections on the absence of an effect on ambiguous products, along with possible explanations and implications for the effect on unhealthy products are discussed below.

Firstly, we reflect on the fact that naturalistic health labels did not shift price evaluations in experiment 4.E3., nor did they shift evaluations of product healthiness in experiment 4.E4. These labels, that alluded to product health instead of overtly stating it (as in experiment 4.E1.), had no significant influence on either kind of evaluation. As discussed in experiment 4.E3., it is likely that these naturalistic labels, that are commonly used in practice, function as feature labels, indicating attributes of a product without overtly categorizing them (as done in experiment 4.E1.). Feature labels carry much less weight in consumer evaluations than category labels (Yamauchi et al., 2007). The findings from experiments 4.E3. and 4.E4. suggest that health feature labels, despite their persistent use in practice, are unlikely to shift consumer evaluations of healthiness or any feature thought to be associated with it (such as price). This was the case for both the ambiguous and known healthy products within our experiments. Evaluations of product healthiness and any

related factors were left unchanged when suggestive labels were used. It may be the case that suggestive health labels do little on their own to shape consumer evaluations - stronger manipulations may be needed.

Alluding to health is a safer route for those attempting to promote healthier choices – labels that highlight healthy features of a product are harder to contest than ones that overtly categorize these products as healthy. For example, a snack bar could be said to be a "lighter choice" when compared to a more energy-dense alternative. However, some may challenge its categorization as "healthy" if it is nutritionally poor. Categories are the sum of all of the product's features, while features themselves stand on their own (Yamauchi et al., 2007). Furthermore, the way in which health is defined may vary from context to context. Benchmarks for what constitutes a healthy product in one environment (e.g. those used within the Welsh Healthy Vending guidelines discussed in Chapters 2 and 3 (Welsh Government, 2012)) may differ substantially from those used elsewhere. More suggestive labels therefore avoid these impracticalities. While being more feasible to implement, our findings suggest that they may be ineffective in shaping consumer evaluations.

Participants were clearly aware of the presence of these labels, as their absence on unhealthy products did lead to a shift in product evaluations. Up until now, this chapter has focused on what effect the presence of a label might have on evaluations of a product. Our findings in experiment 4.E4. indicate that the notable absence of a label can also shape product evaluations. Health ratings for unhealthy products were significantly lower in both labelled conditions (where healthy and ambiguous products were presented with labels, and the unhealthy labels were not). The fact that the contrast created by the absence of a label can cause significant changes to evaluations of non-labelled products is a finding of particular interest. It would appear that instead of highlighting a feature that the product possessed (as the labels did for the healthy and ambiguous products), the absence of a label on the unhealthy products implied, by way of contrast, the absence of those features. This was reflected by the fact that unhealthy products were rated as less healthy within the labelled conditions.

The saying goes that 'absence of evidence is not evidence of absence'. However, when interpreting language, we often treat the omission of information as information in and of itself. The psycholinguistic study of implicatures, for example, has explored the wealth of information

that can be inferred not from what is said, but what someone decides not to say within conversations. For example, scalar implicatures describe when an individual opts against using a strong expression and instead uses a weaker alternative (e.g. saying "some of the children" indirectly implies that the sentence does not apply to all of the children (Bott, Bailey, & Grodner, 2012)). Omissive implicatures refer to when the intentional avoidance of stating something serves to suggest that the speaker had insufficient reason for saying it (Garcés-Báez & López-López, 2020; Grice, 1989). Listeners can infer meaning from what is not said.

Within this experiment, it appears that participants inferred that not providing a health label for the unhealthy products indicated the absence of the healthy attributes referred to on the labels. In turn, unhealthy products were perceived to be less healthy. Of note, the absence of a label on unhealthy products appeared to be more informative to participants than the presence of a label on ambiguous or healthy products – the labels did not make the latter two product types appear healthier. One hypothesis is that the omission of a label was seen to add negative information (i.e. that the product did not possess these healthy features), which held greater weight than comparable positive information (that the healthy products did possess them) in consumer evaluations. The notion that negatively valenced events have a stronger psychological influence than their positive equivalents is a well-established and thoroughly studied tendency. Dubbed the negativity bias, we give negative information greater weight in our judgments than comparable positive information (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Ito, Larsen, Smith, & Cacioppo, 1998; Kanouse & Hanson, 1972). Whether the omission of a label can be classed as being a way of providing negative information (in the same way that these studies do) may be up for contention. However, it would contribute in explaining why the absence of a label on unhealthy products had greater influence on our participants' evaluations than the presence of the label on healthier products.

Healthy labels are often turned to as a means of highlighting the positive attributes of healthy products. Our findings in experiment 4.E4. suggest that they may indeed be more effective at highlighting the absence of those attributes in unlabelled alternatives. It may well be the case that health labels shape consumer evaluations not through making the labelled products appear any healthier, but through indirectly making any alternatives appear less healthy in comparison. Creating contrast, between presence and absence, may be a key function.

We determined that this novel finding was worth exploring further in a follow up experiment. Shifting our focus away from what the label does to perceptions of a labelled product, and instead onto what it might do for perceptions of the unlabelled products around it may be more insightful. Omitting health information may have strengthened individuals' beliefs about unhealthy products – the absence of a label made them appear less healthy still. If it was indeed the omission of health information on unhealthy products that made them appear more unhealthy, we wondered whether comparable results could be found if products of ambiguous health value were presented without labels, alongside labelled healthier options.

4.E5.1. Contrast effects created by label absence

In experiment 4.E5., we explore whether ambiguous, unlabelled foods will be perceived as less healthy if presented alongside healthy products with health labels. Replicating the pattern of results seen in experiment 4.E4. with ambiguous instead of unhealthy products would serve as further evidence that omitting health information is informative in and of itself, and can alter product evaluations. In this experiment, only healthy products were labelled, while the ambiguous labels were presented without labels throughout. We hypothesised that health ratings for ambiguous products would become more unhealthy when healthy products were labelled.

4.E5.2. Methods

4.E5.2.1. Participants

As we hoped to replicate the pattern of findings from experiment 4.E4. with ambiguous products (instead of unhealthy products), we opted to recruit a similar number of participants and apply the same power calculations as adopted for 4.E4., as the statistical analysis would be identical (see 4.E4). Furthermore, the aforementioned power calculation assumed a medium effect size, and such an effect was evidenced in experiment 4.E4. (η_p^2 = .07). Therefore, to replicate the prior experiment with ambiguous products, we recruited 150 participants, with inclusion/exclusion criteria as described for earlier experiments. Of those recruited, 112 (75%) were female and 38 (25%) male. Participant mean age was 36 (SD = 13yrs). Participants received 84p as payment.

4.E5.2.2. Design

A mixed within-between subject design was adopted (see Methods, 4.E3. for rationale). The independent variables were labelling (between subjects, three levels – NHS, Lighter Choices and no label) and item health (within subjects, two levels – healthy, ambiguous). The unhealthy products were excluded, to avoid the possible confounding effect of participants aligning their evaluations for ambiguous products to the other unlabelled products available (which could potentially distort any effects of label absence). The dependent variable was health rating, measured on a Likert scale ranging from 1 (unhealthy) to 7 (healthy).

4.E5.2.3. Materials

The items and test images from experiment 4.E4. were used again, however the twelve unhealthy products were removed from the experiment, and ambiguous items were presented without a label in all three labelling conditions. Therefore, only healthy items were impacted by the participants' labelling condition allocation. Two health rating control products (as described in experiment 4.E4.) were used to identify irregular responses.

4.E5.2.4. Procedure

Participants were informed of study procedures and ticked a consent statement, before being instructed to use the Likert scales provided to make judgements about the food products presented.

Participants were randomly allocated to one of the three labelling conditions, which determined how the healthy products were presented (either with no label, with a Lighter Choices label, or with an NHS label). Ambiguous products were always presented without labels. The twenty-four test items (12 healthy, 12 ambiguous) were presented in a randomized order, with the next product being shown after Likert scale evaluations were given.

Following rating the twenty-four test items, the two health rating control products were shown (see experiment 4.E4. for procedure). Participants were then debriefed and given details regarding payment. Participation took approximately 10 minutes.

4.E5.3. Results

All participants met the criteria for inclusion, therefore the responses of all 150 subjects were included. Of these participants, 48 were randomly allocated to the no label condition, 51 to the Lighter Choices condition, and 51 to the NHS condition.

Each participant's mean health rating for healthy items and ambiguous items when presented in the NHS, Lighter Choices and no label conditions were calculated. Overall means were calculated across all participants (see Figure 17).

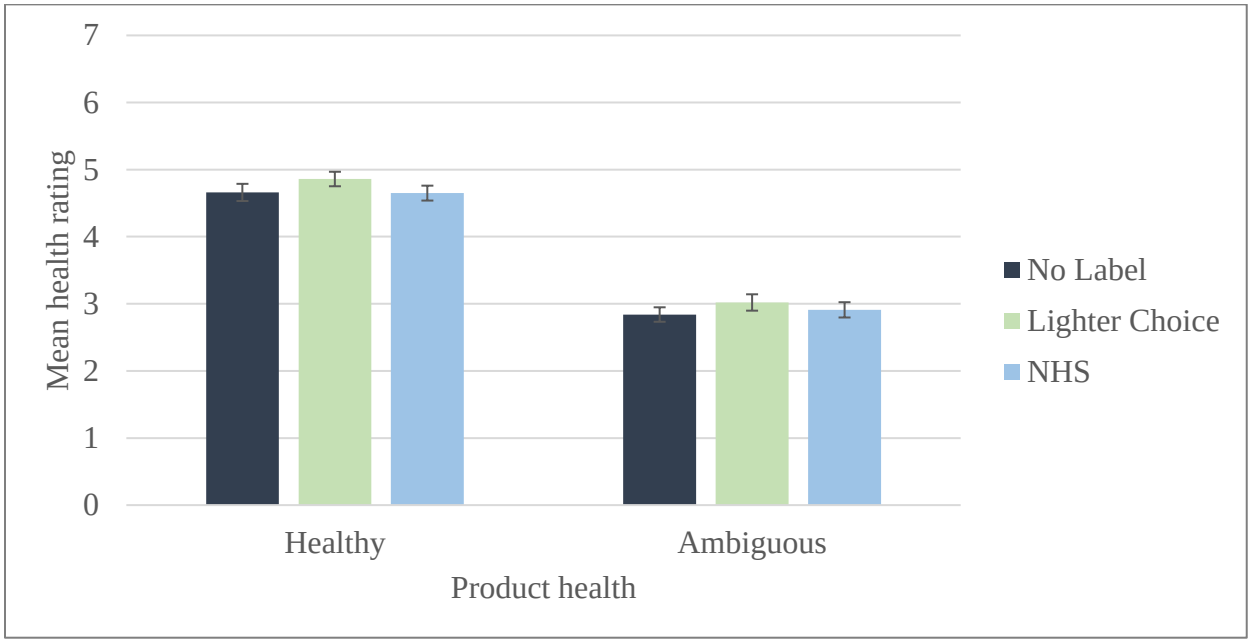


Figure 17. Mean health rating given to healthy and ambiguous products in the three labelling conditions. Legend represents labelling condition. Error bars show standard error of the mean.

Following the same logic as discussed in experiments 4.E3. and 4.E4., two separate one-way ANOVAs were run to explore the effect of labelling condition on the health estimations given for the two different product types (Bonferroni corrected alpha level set at $p < .025$). No significant differences were found between health estimations of ambiguous products across labelling conditions, $F(2, 147) = .63$, $MSE = .42$, $p = .53$, $\eta_p^2 = .01$. The same held true for healthy products, $F(2, 147) = 1.12$, $MSE = .75$, $p = .33$, $\eta_p^2 = .02$.

4.E5.4. Discussion

Experiment 4.E5. directly tested the hypothesis that the omission of health information can make products appear less healthy, as a follow up to novel findings suggesting the existence of such an effect in experiment 4.E4. In Experiment 4.E4., unlabelled unhealthy products were rated as less healthy when presented alongside alternatives that were labelled as healthy.

In Experiment 4.E5., equal numbers of labelled healthy products and unlabelled ambiguous products were presented in a randomized order, with participants asked to provide evaluations of product health. Creating contrast between labelled healthy products and unlabelled ambiguous products in this way did not negatively impact health evaluations of ambiguous products.

For unhealthy products, the absence of health labels was able to shift health evaluations, however the same was not the case for ambiguous products. By definition, the unhealthy products were selected for testing as they were characteristically unhealthy. Likewise, the ambiguous products were developed so that their healthiness would be more obscure. There was therefore a greater level of uncertainty regarding the healthiness of ambiguous products. While the absence of health labels would imply that the product does not possess the labelled health feature, participants would have been less certain that the product lacked other healthy attributes. For unhealthy products, the absence of a label aligned with prior beliefs and may have strengthened them. The greater level of uncertainty relating to the healthiness of ambiguous products may have meant that label absence did not provide sufficient information to reduce uncertainty and adjust product evaluations. This is one possible explanation for the lack of effect.

Another possible explanation is rooted within the experimental design. As both healthy and ambiguous products were labelled in experiment 4.E4., a total of 24 test products were presented with health labels. In contrast, only the 12 unhealthy products were presented without labels. These products were therefore a minority within the product range. This balance, where labelled products were the norm, and unlabelled ones the exception, may have heightened the contrast between labelled and unlabelled products, boosting the label absence effect. In experiment 4.E5. however, only the twelve healthy and twelve ambiguous products were shown, giving an equal ratio of labelled and unlabelled products. Could it be the case that any effect of label absence only occurs

when label absence itself is an exceptional occurrence? We explore this question in the final experiment reported within this chapter.

4.E6.1. Contrast effects created by label absence in a label-dominated environment

In experiment 4.E6., healthy products and unlabelled ambiguous products were tested again, however only six of the twelve ambiguous products were shown to participants. We tested the hypothesis that label absence, within an environment where label absence was uncommon, would heighten the contrast between the labelled healthy and unlabelled ambiguous products, with this being reflected by a tendency to perceive ambiguous products as more unhealthy.

4.E6.2. Methods

4.E6.2.1. Participants

As was the case in the prior experiment, 150 participants were recruited in an attempt to replicate the medium effect size (η_p^2 = .07) found with a similar sample in 4.E4. (see 4.34. and 4.E5. for discussion of power analysis). Inclusion and exclusion criteria were as described in earlier experiments. Of those recruited, 93 (62%) were female and 57% (38%) male. Participant mean age was 39 (SD = 13yrs). Participants received 84p as payment.

4.E6.2.2. Design

The experimental design was identical to experiment 4.E5., apart from the fact that the number of ambiguous food stimuli was halved.

4.E6.2.3. Materials

The products and test images from experiment 4.E5. were used again, however with half of the ambiguous products excluded, this left eighteen test images (12 healthy, 6 ambiguous). Two ambiguous products from each of the product type categories (bars, crisps, nibbles) were randomly selected for inclusion, with the others discarded. As in experiment 4.E5., these six ambiguous items were presented without a label in all three labelling conditions. Therefore, only healthy items were impacted by the participants' labelling condition allocation. As with experiments 4.E4. and 4.E5., the health rating control images were used to identify irregular responses.

4.E6.2.4. Procedure

The procedure was identical to experiment 4.E5., apart from being shorter due to the use of the smaller selection of products.

4.E6.3. Results

Following removing two irregular responders (who rated the least healthy product as healthier than the least unhealthy), the sample included 148 participants. Of which, 49 had been randomly placed in the no label condition, 50 in the Lighter Choices condition, and 49 in the NHS label condition.

Each participant's mean health rating for healthy products and ambiguous products when presented in the NHS, Lighter Choices and no label conditions were calculated. Overall means were calculated across all participants (see Figure 18).

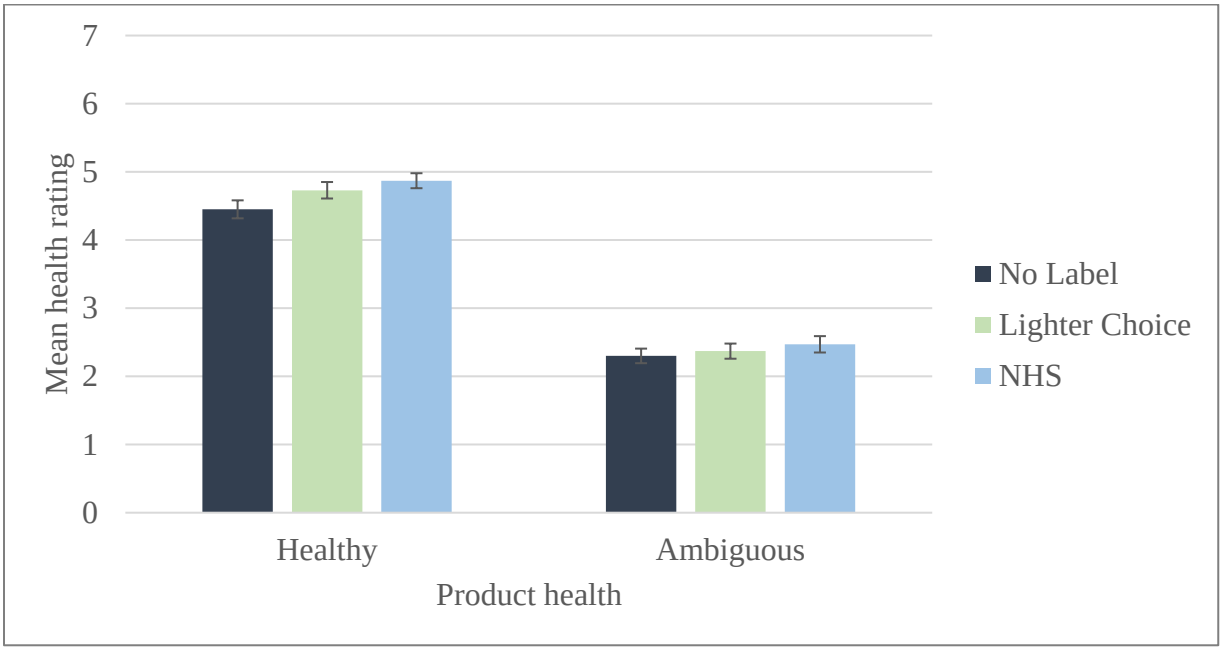


Figure 18. Mean health rating given to healthy and ambiguous products in the three labelling conditions. Legend represents labelling condition. Error bars show standard error of the mean.

As in experiments 4.E3, 4.E4. and 4.E5., analyses were run separately due to the differential operation of the labelling manipulation for different product types. Two separate one-

way ANOVAs were run to explore the effect of labelling condition on product health estimations (Bonferroni corrected alpha level set at $p < .025$). No significant differences were found between health estimations of ambiguous products across labelling conditions, $F(2,145) = .55$, $MSE = .34$, $p = .58$, $\eta_p^2 = .01$. The same held true for healthy products, $F(2,145) = 3.17$, $MSE = 2.29$, $p = .05$, $\eta_p^2 = .04$.

4.E6.4. Discussion

Experiment 4.E6. tested whether the absence of a health label on a product could make it appear less healthy, when the majority of other products were labelled. Such a pattern had already been found for unhealthy products in experiment 4.E4. – we sought to replicate this pattern with products of ambiguous health value in experiment 4.E6.

Contrary to what was hypothesised, health ratings for ambiguous products remained constant. Creating an environment where the majority of products were labelled as healthy (and therefore generating contrast between the labelled and unlabelled products) did not alter health evaluations for unlabelled products.

In our discussion of experiment 4.E5., we discussed two possible explanations for the fact that label absence did alter health evaluations of unhealthy products, but not ambiguous products. One being that an environment in which the majority of products are labelled as healthy creates contrast between labelled products and the unlabelled minority, with experiment 4.E6. used as a means of testing this hypothesis. Our second suggestion related to the products themselves, and the contrasts that are inherent between them (regardless of the composition of the choice environment). Participants could be more certain of the health values of the more familiar, unhealthy products. In contrast, the ambiguous products, by design, generated greater uncertainty. Under these conditions of uncertainty, label absence may not have provided sufficient information to alter product evaluations. In contrast, the absence of a label on unhealthy products would have served to corroborate prior beliefs, and reduce uncertainty. With experiment 4.E6. directly testing the first of these two explanations, the absence of evidence for such a majority-minority contrast effect could suggest that the second of our two explanations better resembles the processes at play. We consider these ideas in greater depth, and within the context of the chapter's other findings within the Chapter Discussion.

4.2. Chapter Discussion

In introducing this chapter, we discussed the possibility that providing additional health information is only helpful during conditions of uncertainty e.g. when facing unfamiliar products with unknown health values. The following offers a discussion of how our findings align with and diverge from these reflections and prior literature, while identifying any limitations and suggesting directions for future work.

4.2.1. Shaping product evaluations in conditions of uncertainty

We found some evidence in support of the argument that health labels shape product evaluations in conditions of uncertainty. In experiment 4.E1., ambiguous products were expected to be more expensive if labelled as healthy (with these feature inferences therefore aligning with those made for known exemplars of healthy products). Healthy products are generally perceived to be more expensive (Haws et al., 2017), therefore placing a "healthy" category label on the ambiguous products led to an increase in price expectations. As demonstrated within the categorization literature, feature inferences for novel objects presented with a category label resemble those made for known exemplars of the same category (Yamauchi & Yu, 2008). We provided further evidence for such a pattern. However, our findings in experiment 4.E2. suggest that the occurrence of this effect is dependent on the feature that is being inferred.

While price expectations for healthy-labelled ambiguous products aligned with those made for healthy products in experiment 4.E1., evaluations of taste remained unchanged in experiment 4.E2. regardless of whether ambiguous products were labelled as healthy. It may be the case that the healthy = expensive intuition (Haws et al., 2017) is a stronger preconception than the healthy = less tasty intuition (Raghunathan et al., 2006). Alternatively, we suggested that the general tendency to take caution when given the opportunity to taste novel foods (McFarlane & Pliner, 1997) could have lowered taste ratings across conditions, with this aversion towards novel foods shadowing any differences caused by health labels. Our findings do not allow for disentangling why experiments 4.E1. and 4.E2. generated different results. However, taken together, the findings from these experiments suggest that health labels can serve an informative function in conditions of uncertainty, however the extent to which they do so is dependent on what feature is being evaluated.

4.2.2. Overtly and covertly categorizing products as healthy – why might naturalistic health labels fail

Findings from our later experiments (experiments 4.E3. to 4.E6.) also indicate that the content of the label is important in determining whether it will shape how a product is categorized or the evaluations people make for its different features. In experiment 4.E1., when ambiguous products were labelled with a "healthy" category labels, their price began to align with those made for healthy products (they were expected to be more expensive). However, this pattern of results was not replicated in experiment 4.E3., where naturalistic labels were introduced.

The shift in product categorization we anticipated would occur in the presence of the label (that is, for products to be seen as healthy), and any resultant shifts in feature evaluations (for products to be seen as more expensive), were not evidenced. Alluding to health, as opposed to overtly stating it, did not generate the same shift in feature evaluations. Neither did it cause a shift in categorization for ambiguous products when tested in experiment 4.E4., with health evaluations remaining constant regardless of labelling condition.

This is particularly problematic if practitioners hope that the health labels currently used in practice help consumers identify healthy options. Prior work has suggested that these labels have little to no influence on healthy sales (Grech & Allman-Farinelli, 2015; van't Riet, 2013). Highlighting healthier features is one method that is used to avoid the challenges that are raised by placing products in a strict "healthy" category (e.g. benchmarks for denoting what is healthy vary from context to context). Messaging that is consistent with health, without prescribing it, avoids causing any conflict when benchmarks might be in contradiction.

However, watering down the messages on health labels may water down their influence on evaluations, and ultimately, consumer choices. While "healthy" labels shaped price evaluations for ambiguous products in experiment 4.E1., we found no effect on evaluations of either price or health across experiments 4.E3 to 4.E6. The content of the label shaped its influence on evaluations.

In contrast, regardless of their content, health labels produced no significant change in evaluations for more familiar healthy products across all experiments. Price, taste and health ratings remained consistent when comparing no label and labelled conditions, both when those labels simply categorized the product as "healthy", and when they alluded to health with a more

suggestive label (e.g. highlighting the fact that it was a "lighter" choice, or claiming that a product was recommended by a credible source of health information such as the NHS). Despite the labels providing additional information compared to when no label was presented, this additional information did not influence participants' evaluations. While the absence of an effect is not conclusive, this pattern of findings does align with both our predictions and observations from the prior literature. Additional health information is unlikely to change evaluations of products that are already known to be healthy (Martins et al., 1997; McFarlane & Pliner, 1997; Vizcaíno & Velasco, 2019).

4.2.3. The effects of label absence

The discussion above explores the ways in which the presence of a label can shape consumer evaluations. Experiment 4.E4. however highlighted that the absence of a label could be just as influential in shaping the ways in which consumers evaluate a choice set. Unlabelled, unhealthy products were thought to be even more unhealthy when presented alongside products with healthy labelling.

Through labelling a product, we try to communicate a truth about it to the consumer. However, choosing not to label a product can be taken to suggest the absence of this truth. As conversationalists, people have the capacity to identify when the absence of information is information in and of itself, with the omission of information sometimes implying that there is no sufficient reason for providing it (Garcés-Báez & López-López, 2020; Grice, 1989). We propose that the omission of health information for the unhealthy products was taken as indication that the things that held true for the other labelled products, did not for the unhealthy ones. In turn, health ratings for unhealthy products became even more unhealthy.

Of note, the presence of the same naturalistic labels on the healthy and ambiguous products had no influence on the way in which consumers evaluated them. For their absence to shape evaluations of unhealthy products, participants must have been aware of their presence on the healthy and ambiguous products, and had comprehended their meaning. Yet the positive information they provided for these labelled products had no bearing on how they were evaluated. Instead, the absence of the label suggested the absence of healthy attributes, with the unhealthy products in turn appearing less healthy.

It is possible that the omission of information proved more influential than its inclusion due to the negativity bias. The tendency for negative information to have a greater influence than comparable positive information is a persistent and well-documented psychological bias (Baumeister et al., 2001; Ito et al., 1998; Kanouse & Hanson, 1972). Whether absence of information can be equated to providing negative information in the ways that are referred to in these examples from the prior literature warrants discussion.

We propose that to the extent that omission of information can be inferred to be indication of the omission of a feature, it can be interpreted as providing information about the ways in which something is lacking (Garcés-Báez & López-López, 2020; Grice, 1989). If positive health information is omitted, it can be inferred as the absence of this healthful feature, suggesting that the unlabelled product is lacking in some way within the context of healthfulness. The lack of healthfulness, we propose, can be seen as negative health information. It is for this reason that we suggest that this negativity bias may have contributed in making the absence of positive information more influential than its presence. While there is a definite need to build upon our findings on label absence, we suggest that prior research on the negativity bias could prove useful in shaping further thinking.

That being said, there are clearly nuances in the ways in which the label absence effect might manifest itself. For example, we only found evidence of such an effect for unhealthy products. Attempts at replicating the result in experiments 4.E5. and 4.E6. provided no evidence that a similar effect could be generated for products of ambiguous health value. Health label absence may only cause health ratings to dip when the absence of the label is in line with pre-existing beliefs about product health.

For example, unhealthy products were already perceived as such. Not labelling them as healthy could have served as confirmation of this belief, strengthening the tendency to rate them as unhealthy. In contrast, ratings for unlabelled ambiguous products remained consistent. These products, by their very design, were generated to create more uncertainty. Label absence could have contributed in reducing this, but may have been unlikely to resolve this uncertainty fully. For unhealthy products however, label absence confirmed existing beliefs. Another persistent bias in our reasoning as humans is the confirmation bias. We actively seek out information that aligns with our existing beliefs, and give it greater weight in our reasoning (Jones & Sugden, 2001;

Nickerson, 1998). It is therefore possible that a combination of these two biases, the confirmation bias and the negativity bias, contributes in generating the label absence effect documented here.

A caveat to these reflections on label absence is the fact that unhealthy products were presented as an unhealthy minority within the choice set in experiment 4.E4. While replicating these conditions did not produce a similar effect for ambiguous products in experiment 4.E6., the research documented here provides no way of determining whether label absence would have a similar effect on unhealthy products within an environment where they were just as common as their labelled alternatives. Future work that seeks to expand on the knowledge generated here about the effects of omitting health information should explore this distinction. Exploring the ways in which the presence of labels not only shapes evaluations of labelled products, but evaluations of unlabelled alternatives will provide further insight into the ways in which health labels function within consumer choices. Perhaps the information provided on health labels serve little purpose in shaping evaluations of the labelled products, and that it is in fact the contrast they generate between these products and those that are left unlabelled that is key.

Practical implications

What might this mean for the use of health labels in practice? Firstly, our findings suggest that solely indicating that a healthy product is healthy is unlikely to shape consumer evaluations, and prior work has suggested that it rarely shapes consumer choices (Grech & Allman-Farinelli, 2015; van't Riet, 2013). We propose three key areas to focus research work.

Firstly, an alternative course of action to focusing on promoting health would be to use labels to tackle some of the negative preconceptions consumers hold about healthier products. As discussed, healthy products are often assumed to be more expensive (Haws et al., 2017), less satiating (Suher et al., 2016), and less tasty (Raghunathan et al., 2006). Interventions that subsidise healthier options have shown promising results (Appelhans et al., 2018; French et al., 2001), as have those using indulgent labels that highlight taste (Turnwald et al., 2017, 2019). Shifting the focus away from health, and towards enjoyment and satisfaction could boost the extent to which labels can generate healthier sales.

Secondly, we suggest that these methods may be most valuable when applied to new products when they are introduced to market. When products are less familiar, consumers may

find it harder to distinguish if they are healthy. As we saw in experiment 4.E1., adding a healthy category label to ambiguous products caused price inferences to mirror those made for known healthy products – participants thought they would be more expensive when they were labelled as "healthy". Helping consumers identify that these products are healthy, while also countering potential negative preconceptions could change consumer evaluations for the better. Pairing health labels with ones that focus on tastiness, or introducing products at discounted rates could help challenge negative preconceptions and make novel healthy products more appealing on introduction to market.

Lastly, our findings relating to label absence could suggest that future work should put greater emphasis on the ways that health labels can be used to deter less healthy choices, instead of promoting healthier ones. Highlighting the positive features of healthy products, and omitting comparable information for unhealthy options could help bias consumer evaluations in a way that benefits healthier choices. The ways in which labels affect both kinds of products should be accounted for in future work.

4.2.4. Conclusion

This series of experiments provides only limited insights into the function of a limited range of health labels. However, this exploratory work raises many questions about the ways in which health labels are currently used, and the ways in which they should be used in future. Testing these ideas in naturalistic studies, with real food choices, could help answer some of the questions left unanswered here. Crucially, while this work explored how health labels shaped evaluations of products, we did not measure their influence on consumers' choices. Future work should measure both, and explore the ways in which these evaluations translate to behavioural intentions and actual food choices. We have shown that in certain circumstances, naturalistic health labels can lead to an increase in unhealthy purchasing (see Chapter 3). We must therefore seek to better our understanding of the ways in which health labels, product evaluations and consumer choices interact.

Chapter 5. The influence of food environment interventions beyond target behaviours: successive behaviours and the potential for licensing effects

5.1. Chapter Introduction

Interventions are often developed with a narrow lens. A target intervention is put in action to address a target behaviour, and evaluations of success are tailored around this one target outcome (Maki et al., 2019; Nilsson et al., 2017). However, our behaviours and choices do not occur within a vacuum. They are interlinked, with the decisions we make at one time-point holding the potential to shape the ones that follow. As a result, when we try to influence one behaviour within this sequential chain, there is potential for effects to ripple beyond the behaviour of interest and shape any behaviours that follow. The positioning of our choices within a chain of related, successive behaviours is rarely considered to a thorough enough degree during intervention development. Many studies fail to take into account how their interventions could cause shifts in non-target behaviours, ultimately affecting intervention success. It is essential that we account for changes in behaviours beyond those that are being targeted when we design health interventions. In this chapter, we explore what these relationships between sequential behaviours might mean for interventions that seek to promote healthy food choices. Although restricting choices may produce healthier behaviour initially, here we explore how these restrictions and the behaviours that they produce could shape behaviours that follow.

To gain a comprehensive understanding of an intervention's net effectiveness, it is imperative that all potential behavioural consequences are accounted for and measured, be they ones that arise intentionally or unintentionally (Maki et al., 2019; Nilsson et al., 2017). These may include both positive and negative consequences, with the former boosting intervention effectiveness, and the latter proving detrimental. Only when these additional effects are taken into account can we begin to estimate the true impact of an intervention.

In situ studies of interventions that promote healthier choices have highlighted the potential for unintended side effects to detrimentally impact their effectiveness. As discussed in Chapter 2, in prior school vending experiments, restricting unhealthy choices at the vending machine did produce healthier behaviour on school grounds, however overall consumption remained stable or increased. These results suggest that the restrictions actually led pupils to engage in compensatory

behaviours elsewhere (e.g. Fletcher et al., 2010; Taber et al., 2014). Placing greater emphasis on healthier options e.g. through presenting them first or labelling them, is often adopted as a means of encouraging healthier choices. However, this too can produce counterintuitive effects. For example, labelling the same milkshake as "sensible" rather than "indulgent" and claiming different calorie contents can significantly impact ghrelin levels (a gut peptide linked to physiological satiation). In this study, consuming milkshakes with "indulgent" labels increased satiation, while "sensible" labels did not impact ghrelin levels at all, leaving participants wanting more (Crum, Corbin, Brownell, & Salovey, 2011). Labelling items as healthier could therefore lead to greater future consumption behaviours if individuals do not experience the same level of physiological satiation and remain hungry after consumption. Evidence in support of this idea was found in another study that demonstrated that sampling the same food item when labelled as healthy (as opposed to tasty) led to increased self-reported hunger and increased subsequent consumption (Finkelstein & Fishbach, 2010). These effects are not limited to labelling interventions. Emphasising healthier items through placing them first within a selection of dishes has been linked to greater overall consumption levels/increased unhealthy purchasing (Flores et al., 2019; Wisdom et al., 2010), suggesting that initial healthy choices can license increased consumption subsequently. Together, these studies demonstrate that attempts to produce healthier behaviours and reduce consumption can unintentionally lead to a net increase in consumption down the line.

Exposure to certain choice environments, and making certain choices within them can influence choices that follow for better or worse. Interventions that set out to promote healthier behaviours through manipulating the food environment might ultimately cause individuals to engage in less healthy behaviours subsequently. Acknowledging the existence of such behavioural patterns from choice to choice, and delving deeper into the mechanisms behind the trade-offs that individuals make is of particular importance when shaping the food environment to promote healthier choices. At present, there is little clarity around the mechanisms at play. Public health professionals and researchers alike would benefit from gaining greater insight into when such backfire effects might occur, and how best to avoid them.

In the vending study documented in Chapter 2, we included a measure of behaviour beyond the machine (at the nearby shop) to explore any potential compensatory effects. We found no evidence to support the notion that healthy machines led to unhealthy purchasing elsewhere. The

intervention successfully produced healthier behaviour at the machine, and the lack of evidence of any compensatory behaviour suggests that this was done without risking producing less healthy purchasing in another setting nearby. However, our work offered no way of measuring potential unintended behaviours beyond the hospital setting itself. We had no way of knowing what their next snack choice may have looked like, or what impact making a decision at the healthy machine had on consumers' perception of themselves and their goals. This chapter explores these concepts in a series of online and lab-based experiments, with the aim of broadening our understanding of this internal balancing act of goals that consumers perform as they move from one food choice to another, and offering greater insight into how this might impact the effectiveness of behaviour change interventions.

5.1.1. Behavioural spillover: lessons from environmental psychology

Exploring these trade-offs between consumption behaviours is particularly important in addressing the obesity epidemic. With engagement in some behaviours being likely to elicit the uptake of others further downstream, discovering how to shape these behavioural streams to include more healthy behaviours, and less unhealthy ones could play an important role in generating large-scale shifts in societal consumption behaviours within an obesogenic food environment.

Shifting societal consumption behaviours is a problem that environmental psychologists also face. Promoting more sustainable, pro-environmental behaviours (PEBs) is key in the efforts to tackle climate change. Both climate change and the obesity epidemic will require a combination of top-down policy-level and bottom-up individual-level changes to achieve significant progress (Carmichael, 2019; Gortmaker et al., 2011). Maximising the effectiveness of interventions that target these individual-level behaviours will play a key role (Nilsson et al., 2017; Thøgersen & Crompton, 2009). As such, environmental psychologists have sought to develop interventions that produce accumulative behaviour change, whereby effects of interventions that target certain behaviours ripple onto other related PEBs (including potentially more impactful ones) down the line (Thøgersen & Crompton, 2009). Harnessing this so-called "positive spillover" effect could hold great potential in generating large shifts in behaviour within the population, with a smaller level of input required in the process of generating behaviour change. Likewise, learning about the circumstances which might produce undesirable behaviours downstream – "negative spillover" –

is equally important in developing effective interventions that produce the intended effects on balance.

PEBs and healthy food choices share many similarities. Both require individuals to make choices that prioritise temporally distal gains over temporally proximal ones (Farias, Coruk, & Simão, 2021; Wilcox et al., 2009). For example, while driving to work may be easier, faster and more convenient on any given day, walking there will contribute to reducing carbon emissions and protecting the planet's resources for the future. Likewise, opting for a more nutritious but less flavourful snack may not offer as pleasurable a taste experience in the here and now, but it satisfies current hunger while also helping to prevent future weight gain if chosen consistently instead of a less healthy alternative. For both green and healthy behaviours, this need for prioritizing distal gains over proximal ones creates friction with our inherent tendency for temporal discounting and prioritizing the now over the future (Farias et al., 2021; Wilcox et al., 2009). Another similarity between PEBs and healthy behaviours is that they are often considered to be more virtuous (Flores et al., 2019; Khan & Dhar, 2006), with this having implications for how individuals perceive themselves once they engage in them (e.g. viewing their virtuous behaviours as indication that they are virtuous people, as described by self-perception theory (Bem, 1967)). With these parallels existing between healthy and green behaviours, mutually beneficial insights could be developed for the study of behaviour change within both fields through exploring how the effects demonstrated for one might replicate in the other. Here, we aim to inform the development of food behaviour change initiatives through exploring how behaviours can positively and negatively spillover from one to another.

Within environmental psychology, positive spillover is the term for when engaging in one PEB is associated with increased uptake of other PEBs, and it is thought to be linked to shifts in self-perception (Bem, 1967). Self-perception theory postulates that we use our behaviours to determine our attitudes and our internal dispositions. If we engage in a PEB, we use this as evidence that we have pro-environmental attitudes and are a pro-environmental person. This in turn, combined with our desire to act consistently across our attitudes and behaviours (see cognitive dissonance theory (Festinger, 1957)), could bring forth further PEBs or shifts in attitudes to align with the initial behaviour (Poortinga, Whitmarsh, & Suffolk, 2013; Whitmarsh & O'Neill, 2010). For example, incentivising green purchases with monetary inducements or positive verbal

feedback has been shown to positively influence the uptake of other self-reported pro-environmental behaviours such as switching lights off when not in use (Lanzini & Thøgersen, 2014) .

Negative spillover occurs when engaging in one PEB is associated with increased uptake of less environmentally friendly behaviours. A different mechanism, which is also closely linked to the self-concept can be used to explain negative spillover effects: moral licensing. Engaging in virtuous, morally sound behaviours, such as making a greener or arguably, a healthier choice, can licence future immoral behaviours e.g. a behaviour with a big carbon footprint, indulging in a less nutritious treat or even being less altruistic (Flores et al., 2019; Mazar & Zhong, 2010; Nilsson et al., 2017). This has been argued to occur through a process of founding "moral credentials" (Mazar & Zhong, 2010; Merritt, Effron, & Monin, 2010; Miller & Effron, 2010; Nilsson et al., 2017; Thøgersen & Crompton, 2009). An initial morally sound behaviour will boost the self-concept and positive emotions, inhibiting any negative emotions experienced when engaging in future behaviours that are more immoral.

Another argument for the occurrence of moral licencing effects is the "moral credits" hypothesis, whereby moral and immoral behaviours are balanced through meta-cognitive processes (Khan & Dhar, 2006; Merritt et al., 2010; Nilsson et al., 2017; Thøgersen & Crompton, 2009). An individual can perceive that they have done enough, or been morally good, so they now have room to diverge and indulge. For example; altruistic behaviour has been linked to more indulgent purchasing of luxury items (Khan & Dhar, 2006), making purchases from a store selling predominantly sustainable products as opposed to a conventional store has been associated with increased lying and stealing (Mazar & Zhong, 2010) and individuals that purchase carbon offsets have been shown to engage in environmentally harmful behaviours more frequently (Miller & Effron, 2010).

Negative spillover and moral licensing effects are therefore particularly important for environmental psychologists to identify and explore. Negative spillover effects demonstrate that even an intervention that can produce a targeted PEB might lead to a net negative impact on the environment if it licenses subsequently more harmful behaviours (Miller & Effron, 2010; Poortinga et al., 2013). Similar effects could be expected for health behaviours, and evidence in support of our claim is emerging (e.g. Flores et al. (2019) showing that making a healthy choice

first can increase overall consumption). Licencing effects therefore have the potential to sabotage the effectiveness of health interventions. This chapter therefore focuses primarily on exploring the ways in which licencing effects might occur when food environments are manipulated to produce healthier behaviours.

5.1.2. Balancing dietary goals

The "moral credits" hypothesis suggests that individuals determine through meta-cognitive processes that their engagement in a virtuous behaviour signals sufficient progress to warrant engaging in a less virtuous one afterwards (Khan & Dhar, 2006; Merritt et al., 2010; Nilsson et al., 2017; Thøgersen & Crompton, 2009). With healthy food choices arguably being more virtuous than unhealthy ones, choosing a healthier main meal or dessert could be used as justification for "going all out" when choosing another dish (Flores et al., 2019).

People make multiple choices about what food to consume throughout every day, with multiple factors influencing each of these choices (Fotopoulos, Krystallis, Vassallo, & Pagiaslis, 2009; Ogden, Karim, Choudry, & Brown, 2007). Taste, ability to satiate hunger, healthiness, availability and affordability are but few of the many factors in play, and how each food selection varies in each of these characteristics and satisfies an individual's goals may shape how they are prioritised in that person's next choice. When these goals compete, consumers may feel the need to balance their progress towards each goal across individual food choices e.g. opting for a combination of a healthy fruit with an indulgent sauce instead of a very healthy or very indulgent dessert, or across sequential food choices e.g. opting for a healthier main course if the entrée was particularly indulgent, or following an indulgent lunch with a healthier dinner (Chernev & Gal, 2010; Dhar & Simonson, 1999; Flores et al., 2019).

For many, maintaining an equilibrium between having a satisfying, tasty eating experience, and following a healthy diet is a consistent meta-cognitive balancing act from one food choice to the next. Biases such as the unhealthy = tasty intuition (Raghunathan et al., 2006) and perceptions that healthy foods are less able to satiate one's appetite (Finkelstein & Fishbach, 2010; Suher et al., 2016) mean that health goals are often pinned against factors such as taste, indulgence or satiation when people make their food choices. Therefore, if an intervention is successful in producing a healthier food choice, individuals may well use their engagement with this healthier behaviour as justification for making a less healthy choice further downstream.

There are an increasing number of studies that demonstrate such licensing effects following interventions that produce healthy food choices. As alluded to earlier, Flores et al. (2019) found that having participants make healthy dessert choices before selecting their other dishes within a cafeteria setting led to increased overall consumption. Similarly, Wisdom et al. (2010) found that reshuffling food menus in Subway restaurants so that healthy sandwich options would be chosen first ultimately led to increased unhealthy snack and drink purchasing. The initial healthy choices may therefore have licensed the unhealthy choices that followed. Interestingly, others have found such effects without necessitating that participants actually select healthy items. The mere presence of healthy options within a selection has been shown to be enough to license unhealthy behaviour (Wilcox et al., 2009).

While studies such as Flores et al. (2019) and Wisdom et al. (2010) demonstrate that making progress towards health goals through choosing a healthy option can license subsequent unhealthy behaviour, Wilcox et al. (2009) showed that making any choice from a selection that includes a healthy option can be enough to elicit a sense of goal fulfilment. This in turn leads to a relaxation in further efforts to build upon this goal progress, and therefore, an increase in unhealthy purchasing (Finkelstein & Fishbach, 2010; Flores et al., 2019). If replicable, such an effect would have serious repercussions for health interventions that aim to promote healthier choices through increasing the availability of healthier options.

Using research from environmental psychology as reference once more, making mostly green choices from a mostly green store has been shown to produce some unrelated licensing effects (e.g. increased lying and stealing) in prior research (Mazar & Zhong, 2010). In their study, Mazar and Zhong (2010) developed two online stores – one with predominantly green products, and the other with standard products. They found that those that made their purchases from the green store went on to lie and cheat more in a subsequent task, compared with those in the store with standard products. In this availability intervention, engaging in a green, morally sound behaviour, was followed by engaging in a less moral behaviour. Could similar effects be seen for healthy stores?

With increasing the availability of healthy options being welcomed as a strategy to make healthier choices more accessible (e.g. as in Welsh Government's Healthy Weight Healthy Wales

strategy (Welsh Government, 2020)), exploring the potential backfire effects of such an intervention, particularly on later food choices, is vital.

In this chapter, we consider the circumstances in which healthy food choices might license engagement in less healthy food choices downstream. We begin by exploring how interventions that increase the availability of healthy options might lead to negative spillover effects, and proceed to consider how nuances in the nature of these interventions (namely the extent to which the intervention creates a sense of enforcement and how this relates to self-perception) might alter these spillover effects.

In two online experiments (5.E1. and 5.E2.), we explore whether intervening in dietary behaviour through manipulating choice environments can lead people to engage in more indulgent behaviour within the choice environments that follow. Individuals may feel licensed to indulge after engaging in a healthy behaviour. While we found no such effect in our first experiment, we found evidence in support of our hypothesis in the second experiment, in which some of the weaknesses within the experimental design of the prior experiment were addressed (mainly, altering the outcome variable to increase its sensitivity). Participants who made a series of selections within a healthy store were more likely to select an indulgent second snack in a subsequent choice scenario than those that initially made selections from an unhealthy store.

The latter two experiments (5.E3. online, and 5.E4. in the lab), explored the ways in which the attribution of an initial healthy behaviour might influence the extent to which licensing effects occur. Prior evidence provided conflicting theories in this space, with some proposing that an externally attributed healthy behaviour would be more likely to produce licensing effects, and others proposing that behaviour must be internally attributed for licensing to occur. These conflicting accounts are discussed further from section 5.E2.4.1. onwards. In our online experiment, we asked participants to make healthy selections within a shop. The shop was framed as trialling a health-promoting intervention in the forced choice, external attribution condition (e.g. limit on number of unhealthy products that could be chosen, and lower availability of unhealthy products). The product selection was the same in the free choice (internal attribution) condition however the framing here highlighted personal choice. Our manipulation check suggested that this method was not strong enough to produce the desired changes in choice attribution. A stronger variation of our forced-free choice manipulation was tested in the lab in experiment 5.E4. Here,

the forced/free choice manipulation was operated as follows. Individuals were initially forced to sample a drink different to their initial selection (e.g. those choosing lemonade were asked to sample water instead), or allowed to drink the beverage of their choosing (be that healthy or unhealthy). They were then offered the opportunity to select a snack. The paradigm allowed participants to make truly free choices within the free choice condition, however the limited number of freely made healthy choices limit our ability to make meaningful comparisons across conditions. However, a post hoc analysis with a limited range of products suggested that those that freely made healthy choices were more likely to indulgent in a subsequent choice. These implications of these findings are explored further in the Discussion (see section 5.2).

We will now report the methods and findings from each experiment, and discuss the rationale of each experiment as they progress from one to another.

5.E1.1. Exploring the potential for high availability interventions to affect subsequent choices

With ample evidence to suggest that food choices can negatively spillover from one to another, we sought to explore how different health-promoting interventions might cause negative spillover effects. In experiment 5.E1., we explore whether healthy choices made within an availability intervention can backfire through licensing less healthy behaviours down the line. Availability interventions create food environments where healthier options have dominance. Building upon the rationale discussed within section 5.1., and using an adaptation of the experimental paradigm adopted by Mazar and Zhong (2010), experiment 5.E1. explored whether making a healthy choice within an environment that predominantly offers healthy options can licence making less healthy choices in a subsequent scenario. Participants either made predominantly healthy choices within a healthy shop, or less healthy choices within a regular shop. The opportunity to make a second choice then arose at the checkout. The healthiness of this second choice was our dependent measure and indicator of whether licensing had occurred. We hypothesised that initially healthy behaviours would produce licensing effects, in the form of a less healthy second choice.

5.E1.2. Methods

5.E1.2.1. Participants

A minimum sample size of 39 was suggested in G*power, Windows Version 3.1.9.6 (Faul et al., 2007) to achieve power of 0.80 with $\alpha = 0.05$ and a large effect size in a 3x2 Chi^2 test (based on large effect sizes demonstrated in Mazar and Zhong's (2010) prior work). However, as our nominal measure necessitated a non-parametric analysis, we opted to recruit additional participants to increase power. Sixty undergraduate Psychology students were recruited through Cardiff University School of Psychology's online experiment management system. Exclusionary criteria included having a prior history of eating disorders. Of those that participated, 58 were female and 2 male, with a median age of 19 years, IQR = 1yr.

5.E1.2.2. Design

The independent variable was shop healthiness. Participants were randomly allocated to one of two experimental conditions, healthy shop or regular shop. A between-subjects design was used to avoid carryover effects from setting to setting and behaviour to behaviour (as sequential behaviours were our dependent variables of interest). A between subject design also reduced the possibility that participants started displaying demand characteristics from interpreting that the nature of the first choice environment was expected to affect behaviour in a subsequent choice scenario (something that would have become clearer if the task was repeated in different contexts). The main dependent variable was a choice between a low-calorie snack, a medium-calorie snack and a high-calorie snack. A questionnaire was also included, which served as a manipulation check and offered an opportunity to compare health-related attitudes and behaviours across conditions (to explore shifts in self-perception).

5.E1.2.3. Materials

The experiment was designed and run using Qualtrics. Healthy products were a mixture of fruit, veg and nut based products. The less healthy products were a mixture of chocolates, biscuits, confectionary and potato crisps. For the healthy shop scenario, all nine healthy products and three of the less healthy products were displayed. The inverse was true for the regular shop. All items can be found in Appendix 12. For the secondary choice, participants could choose between six packets of crisps, with two core flavour variants and low, medium and high calorie options for each (see Appendix 13).

The questionnaire comprised of two parts – one as a manipulation check relating to the initial shop scenario (perceived shop healthiness, satisfaction with choice), and the other to measure participant health consciousness. All questions and their coding can be viewed in Appendix 14. The manipulation check section of the questionnaire comprised of two questions in 7-point Likert scale format, one measuring participants' satisfaction with the products available to choose from in the shop (1 = Very dissatisfied, 7 = Very satisfied), and the second asking them to rate the healthiness of the products available to choose from (1 = Unhealthy, 7 = Healthy) to ensure the two shops were perceived as intended (with this format of manipulation check being effective in prior research within the field (Finkelstein & Fishbach, 2010; Flores et al., 2019). The second part of the questionnaire included 4 questions in 7-point Likert scale format, measuring participants' perceptions of their health-related attitudes and behaviours.

5.E1.2.4. Procedure

Participants were told to imagine that they were shopping for snacks, and had space for nine items in their bag. They then saw a selection of products, displayed in random order. In the healthy shop condition, nine healthy products and three less healthy products were shown, and in the regular shop condition, nine less healthy products and three healthy products were on offer. Participants were asked to select a total of nine items to purchase.

Following making their selection, the chosen products were displayed in list-format, to make participants' selections more salient to them. Following viewing this list, participants were told that they could select an additional item at the store checkout. They were then shown six crisp products and their calorie content (in a random order), and were asked to select one. Following the second choice task, participants completed the questionnaire section before being debriefed.

5.E1.3. Results

5.E1.3.1. Manipulation check:

5.E1.3.1.1. Store health

A one-way between subjects ANOVA confirmed that the healthy shop was rated as significantly healthier than the regular shop (M Healthy = 3.90, SD Healthy = 1.37; M Regular = 2.10, SD Regular = .92), $F(1, 58) = 48.60$, $p < .0001$, $\eta_p^2 = .38$.

5.E1.3.1.2. Satisfaction

Participants in both conditions were more dissatisfied than satisfied with the range of available products. Those in the healthy shop gave a mean rating of 2.83 (SD = 1.39), while those in the regular shop gave a mean rating of 3.03 (SD = 1.43). A one-way between subjects ANOVA found no significant differences across conditions $F(1, 58) = .30$, $p = .59$, $\eta_p^2 = .01$.

5.E1.3.2. Second snack choice

Participants' second snack choices remained relatively consistent across conditions. Within the healthy shop condition, 13 individuals opted for low calorie snacks, 12 for medium calorie snacks, and 5 for high calorie snacks. Similarly, in the regular shop condition, 13 selected low calorie snacks, 9 selected medium calorie snacks and 8 selected high calorie snacks. There was no association between second snack choice and shop condition, $\chi^2(2) = 1.12$, $p = .57$, $V = 0.10$.

5.E1.3.3. Questionnaire measures

No significant interactions were found between second snack choice and shop condition for any of the included questionnaire measures (see Appendix 14).

5.E1.4. Discussion

Experiment 5.E1. explored whether healthy choices made within predominantly healthy shopping environments can license subsequent unhealthy choices. We found no evidence to support this hypothesis. Potential explanations for this pattern of results are discussed below.

Our manipulation check confirmed that participants perceived the healthy shop to be significantly healthier than the regular shop. However, making choices within this healthy environment did not appear to generate the anticipated licensing effect, nor did they result in any change in how healthy participants perceived themselves to be (as judged by the measures within the questionnaire). Why might the paradigm adopted by Mazar and Zhong (2010) have produced a licensing effect, while our adaptation did not?

The main difference between both studies is the measure of behavioural spillover. While Mazar and Zhong (2010) measured spillover in a task directly testing participants' virtuosity as opposed to further PEBs, we opted to measure spillover in a secondary food choice, as similar effects have been found for food choice within the prior literature (Flores et al., 2019; Wisdom et

al., 2010). While this was done so that our findings had greater relevance for practitioners and those that develop interventions to promote healthier food choices, we were unable to generate the expected licensing effects with this paradigm.

The main contrast between our study and others that have generated licensing effects following healthy food choices is that prior literature has been conducted in the field with actual food choices. Flores et al.'s (2019) study was conducted in a cafeteria, and Wisdom et al. (2010) conducted their work within a fast food restaurant. We were unable to carry out this work within naturalistic settings due to the COVID-19 pandemic. It may be the case that the real potential for consumption needs to be present within the experimental context for licensing effects to occur from one food choice to another.

Regardless of shop condition, relatively high levels of health consciousness were demonstrated in our participant sample (average scores for participants in all conditions were higher than the mid-point of 4 on each question relating to health attitudes and behaviours, see Appendix 14). The lack of licensing effect could potentially be explained by the fact that our participant sample were generally more health conscious than not. They may have already been quite committed to making healthy choices, with this being reflected by the fact that the most popular second snack option for both conditions was the healthiest. Arguably, making healthy choices in the healthy store could have highlighted individuals' existing health goals (Dhar & Simonson, 1999), motivating them to make further healthy choices afterwards (to maintain their perception of themselves as health-conscious people (Bem, 1967)). Those in the regular shop would not have had their health goals highlighted, however they could have been motivated to make a choice which cleansed them of their predominantly unhealthy behaviour. No such contrasts across conditions were found.

There are a range of potential reasons for why the second choice task may not have captured any spillover effects. Firstly, participants could have deemed that all of the secondary choices were generally unhealthy as they were all crisps (typically nutrient-poor foods, regardless of energy-density). If all items were considered unhealthy, then our effects would be dampened significantly, as none of the choices would have truly felt like a healthy one (despite the variability in calorie content suggesting that some were relatively healthier). Individuals were not asked how healthy they thought the second selection of items was, which limits our ability to determine whether

participants thought they were actually making a healthier, or less healthy choice. A greater problem is the fact that participants could choose among three different product categories (high, medium, low calorie), as opposed to making a clear distinction between healthy and less healthy products (as has been done in previous work). Medium calorie choices could reflect individuals opting for both more or less healthy choices, dependent on what their initial tendency looked like. We had no way of separating out these effects – those that opted for medium calorie choices in both conditions could be representing individuals that were making a relatively healthier, or less healthy choice. Finally, participants were exposed to the branding and packaging of each of these products, with variable prior knowledge and preferences across participants potentially influencing their choices. For example, the medium and high calorie products were variations of the same brand of crisps, with the low calorie option being produced by a different brand. Within both groups, preferences for one brand over the other could have held greater influence on participants' choices than the previous shopping task. These factors could have reduced the sensitivity of the task to any spillover effects.

As a result, some alterations to the research design were considered necessary for further exploration of the research question. While the shop manipulation was successful, there is less certainty on whether the secondary choice scenario produced the intended effect. The participants' interpretation of the healthiness of the products offered at checkout could have dampened the effects (with crisps potentially being considered unhealthy regardless of energy content). Experiment 5.E2. therefore explored the same research question, in the same two-store paradigm, with an altered secondary choice task.

5.E2.1. Exploring the potential for high availability interventions to affect a revised subsequent choice

Experiment 5.E2. adapted the design of experiment 5.E1. to ensure that any licensing effects were captured within the second snack choice task. The same two-store design was used, however upon completing the initial task, participants were asked whether they would then prefer a healthy or regular snack. This binary categorical measure made it explicit to participants that they were either choosing to be healthy, or choosing not to. Furthermore, participants were asked to select between both categories before seeing what products were available (so that the products themselves and participants' perceptions of them did not shape their decision). To explore the

persistence of any effect, participants were also asked in the questionnaire section to note the likelihood that the next snack they would buy would be healthy. The initial questionnaire was developed further to explore the mechanisms behind any licensing effects (see Methods). We hypothesised that those in the healthy shop would be more likely to select a regular snack within the second choice task.

5.E2.2. Methods

5.E2.2.1. Participants

The power analysis from experiment 5.E1. was altered to account for a 2x2 instead of 3x2 Chi^2 test. A minimum sample size of 32 was suggested in G*power, Windows Version 3.1.9.6 (Faul et al., 2007) to achieve power of 0.80 with $\alpha = 0.05$ and a large effect size. However, we again sought to recruit more participants to account for the non-parametric analysis, to protect against the effects of attrition, and to carry out a closer replication of experiment 5.E1. (yet with a stronger research design). Sixty-four undergraduate Psychology students were recruited through Cardiff University School of Psychology's online experiment management system. Exclusionary criteria included having a prior history of eating disorders, and prior participation in any of this chapter's experiments. Three participants' results were excluded due to missing data, leaving a sample of sixty-one participants. Of which, 51 were female and 10 male, with a median age of 19 years, IQR = 3yrs.

5.E2.2.2. Design

A between-subjects design was used (see Methods, 5.E1. for rationale), with shop healthiness being the independent variable again (and manipulated as in experiment 5.E1.). Contrary to experiment 5.E1., the main dependent variable was a binary choice between a healthy or regular snack. A questionnaire was included, which allowed for comparing health consciousness and indulgence characteristics across conditions, and the likelihood that participants would go on to buy a healthy snack following the experiment.

5.E2.2.3. Materials

Some adaptations were made to the materials used in experiment 5.E1.. The experiment was again built and run through Qualtrics, and the same healthy and less healthy products were

used in the healthy and regular shops (see Appendix 12) after findings from experiment 5.E1. confirmed that the target population viewed the healthy shop to be healthier than the regular shop.

For the secondary choice, those who chose a healthy snack could choose between a banana or an apple, and those who chose a regular snack could choose between a chocolate brownie or a cookie (see Appendix 15). The products were only revealed after participants decided between a healthy or a regular snack, and were included solely to maintain the experimental narrative.

The questionnaire comprised of two parts – one as a manipulation check relating to the initial shop scenario, and the other to measure participant health consciousness and indulgence characteristics. All questions and their coding can be viewed in Appendix 16. The manipulation check section of the questionnaire comprised of three questions. The first two were identical to those used in experiment 5.E1: 7-point Likert scales measuring participants' satisfaction with the products available to choose from and their evaluation of their healthiness. An additional binary question was included, which asked participants to indicate whether the products available to choose from were mostly healthy or mostly unhealthy. This was added in to ensure that participants categorized each shop as intended (while the healthy shop was rated as healthier than the regular shop in experiment 5.E1., both were rated below the mid-point of the scale). The second part of the questionnaire was a development of the questions used in experiment 5.E1. It included 9 questions in 7-point Likert scale format: 6 measuring health consciousness, 2 measuring indulgence characteristics and one asking the likelihood that the next snack they bought would be healthy, as an additional measure of spillover. All questions were measured on a scale of agreement (1 = Strongly disagree, 7 = Strongly agree).

5.E2.2.4. Procedure

The procedure was identical to that used in experiment 5.E1. up until the introduction of the second choice scenario. After viewing the list of items they had selected in the initial choice task, participants were told that they could select an additional item at the store checkout. They were then asked whether they would prefer a healthy snack, or a regular snack. Dependent on their choice, they could choose between an apple or a banana (if they opted for a healthy snack), or a cookie or a brownie (if they opted for a regular snack). As before, they then proceeded to complete the questionnaire section before being debriefed.

5.E2.3. Results

5.E2.3.1. Manipulation check:

5.E2.3.1.1. Store health

A one-way between subjects ANOVA confirmed that the healthy shop was rated as significantly healthier than the regular shop (M Healthy = 4.79, SD Healthy = 1.08; M Regular = 2.22, SD Regular = .83), $F(1, 59) = 109.70$, $p < .0001$, $\eta_p^2 = .65$. Every participant in the regular shop condition noted that the majority of products were unhealthy, while 21 of the 29 participants in the healthy condition noted that the majority of products were healthy.

5.E2.3.1.2. Satisfaction

Participants in both conditions were more dissatisfied than satisfied with the range of products available to choose from. Those in the healthy shop gave a mean rating of 3.59 (SD = 1.48), while those in the regular shop gave a mean rating of 3 (SD = 1.50). A one-way between subjects ANOVA found no significant differences across conditions $F(1, 59) = 2.35$, $p = .13$, $\eta_p^2 = .04$.

5.E2.3.2. Second snack choice

The number of participants in each condition choosing healthy or regular snacks at checkout can be seen in Figure 19.

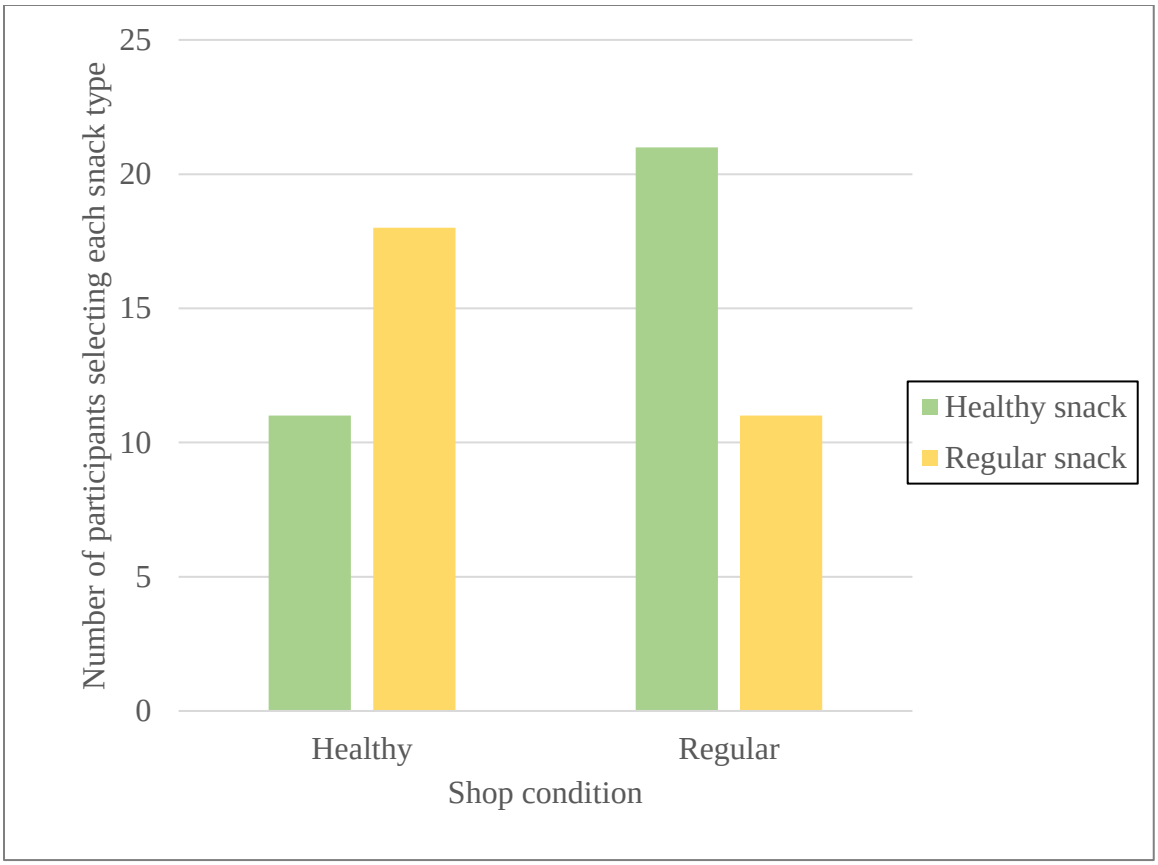


Figure 19. Number of participants in each condition selecting healthy or regular snacks at the checkout. Legend displays snack types.

A chi^2 contingency table analysis demonstrated that a significant association existed between shop condition and second snack choice, $\chi^2(1) = 4.68$, $p = .03$, $\varphi = 0.28$. Those in the healthy shop condition were significantly more likely to opt for a regular snack at the checkout, whereas those in the regular shop condition were more likely to opt for a healthy snack.

5.E2.3.3. "The next snack I buy is likely to be healthy" self-rated score

Following their secondary choice, participants filled in a questionnaire. One question asked participants to rate the statement "The next snack I buy is likely to be healthy". The mean ratings for this question across conditions and second snack choice groups were calculated. In both conditions, those that chose a healthy second snack (as opposed to a regular one) showed stronger agreement with the idea that the next snack they would buy would be healthy, when comparing with those that opted for a regular second snack. A two-way between subjects ANOVA confirmed

a main effect of second snack choice, with significantly higher ratings for those that chose healthy second snacks than regular ones, $F(1, 57) = 19.42$, $p < .0001$, $\eta_p^2 = .25$. There was no significant main effect of shop condition however, $F(1, 57) = 1.82$, $p = .18$, $\eta_p^2 = .03$, nor was there a significant interaction between shop condition and second snack choice, $F(1, 57) = 1.16$, $p = .29$, $\eta_p^2 = .02$.

5.E2.3.4. Scale development

In addition to exploring the likelihood that the next snack participants bought would be healthy, the questionnaire sought out to measure participants' health consciousness and indulgence. Answers from the relevant questions for each measure were combined to form a scale for each characteristic (see Appendix 17 for composition of each scale). The internal consistency of each scale was explored by calculating Cronbach's alpha (Health consciousness: $N = 6$, $\alpha = .85$; Indulgence $N = 2$, $\alpha = .78$), with both scales passing the criterion for further exploration ($\alpha \geq .70$).

5.E2.3.5. Questionnaire analyses

5.E2.3.5.1. Health consciousness across conditions

Participants' scores on the health consciousness scale were compared across conditions, and across second snack choice groups. There was no main effect of shop condition, $F(1,57) = 1.65$, $p = .20$, $\eta_p^2 = .03$. There was however a main effect of second snack choice, $F(1,57) = 5.84$, $p = .02$, $\eta_p^2 = .09$. Participants who made a healthy choice at the checkout rated themselves as more health conscious than those who opted for a regular snack. There was no significant interaction between shop condition and second snack choice, $F(1,57) = .27$, $p = .61$, $\eta_p^2 = .01$, (Healthy Shop & Healthy Snack M = 5.23, SD = 1.00; Healthy Shop & Regular Snack M = 4.72, SD = .90; Regular Shop & Healthy Snack M = 5.02, SD = 1.13; Regular Shop & Regular Snack M = 4.24, SD = 0.85).

5.E2.3.5.2. Indulgence across conditions

Participants' scores on the indulgence scale were compared across conditions, and across second snack choice groups. There was no main effect of shop condition, $F(1,57) = 1.72$, $p = .20$, $\eta_p^2 = .03$. There was however a main effect of second snack choice, $F(1,57) = 12.81$, $p = .001$, $\eta_p^2 = .18$. Participants who opted for a regular snack as opposed to a healthier one rated higher for indulgence. There was no significant interaction between shop condition and second snack choice, $F(1,57) = .27$, $p = .61$, $\eta_p^2 = .01$, (Healthy Shop & Healthy Snack M = 4.00, SD = 1.72; Healthy

Shop & Regular Snack M = 5.332, SD = .87; Regular Shop & Healthy Snack M = 4.60, SD = 1.44; Regular Shop & Regular Snack M = 5.59, SD = 0.30).

5.E2.4. Discussion

In experiment 5.E2., we again sought to explore whether making healthy purchases within a healthy shopping environment would be predictive of either healthy or less healthy behaviour in the near future. As with experiment 5.E1., the shop manipulation was successful, with participants perceiving the healthy and regular shops as intended. The adapted measure of behavioural spillover (a binary choice task between a healthy and a regular snack) produced different results to experiment 5.E1. Those in the healthy shop condition were significantly more likely to opt for a regular snack in the subsequent choice task (a licensing effect), while those in the regular shop condition were significantly more likely to opt for a healthier snack (a cleansing effect).

These findings suggest that those in the healthy shop condition could have determined that they had made sufficient progress towards health goals to licence subsequently less healthy behaviour. Our findings provide evidence to support the conclusions of several others, that manipulations that successfully produce healthier target behaviours can actually lead to the occurrence of less healthy untargeted behaviours downstream. While Flores et al. (2019) and Wisdom et al. (2010) demonstrated this through moving healthier options to the start of a selection within naturalistic settings, we found a licensing effect when individuals made choices from settings with high levels of healthy option availability, in an online paradigm.

The focus of experiment 5.E2. was whether healthy behaviours would lead to less healthy behaviours down-the-line. It was therefore interesting to find that less healthy behaviours produced the inverse pattern of results. Those that made predominantly less healthy choices (by shopping at the regular shop) went on to make healthier choices in the secondary choice task. One possible explanation for this would be a cleansing effect, associated with theories of self-perception and cognitive dissonance (Bem, 1967; Festinger, 1957). The sample rated above mid-point on health-consciousness, suggesting that health goals were relatively important for them. Those in the regular shop condition were manipulated to make a series of less healthy choices, which could have threatened their self-image as a health-conscious person. When individuals behave in ways that conflict with their self-beliefs, they experience discomfort and are motivated to either alter their

attitudes, behaviours or beliefs (Festinger, 1957). The less healthy choices here served as a behaviour which may have conflicted with participants' image of themselves as health-conscious individuals. Here, its plausible that participants alleviated the discomfort caused by this conflict by changing their next behaviour to be more consistent with their beliefs about themselves. With healthy choices considered as more virtuous or moral than unhealthy ones, it is possible that this reflects a moral cleansing effect. Individuals cleansed their self-image through taking restorative action.

Another possible explanation is goal-balancing. Making a series of unhealthy choices would prove detrimental to progress on any health goals, therefore participants opted to behave in a healthier way in the next choice scenario that required balancing dietary goals. As was discussed earlier, individuals often balance health and indulgence/tastiness across successive food choices (Chernev & Gal, 2010; Dhar & Simonson, 1999; Flores et al., 2019). While those in the healthy shop condition could have determined that they had made enough progress on health goals to license subsequently less healthy behaviour, those in the regular shop condition could not make such an inference. In fact, they may have determined that they had taken action which was detrimental to their progress towards any health goals. As such, they would have been more motivated to make healthier choices when next given the opportunity. In both the healthy and regular shop condition therefore, participants appeared to be making choices that served to balance their progress across dietary goals.

Why might experiment 5.E2. have produced the hypothesised licensing effect, while experiment 5.E1. did not? The main difference between both experiments was the changes made to the secondary choice. In experiment 5.E1., participants could choose between six products. These included two low-calorie options, two mid-range options, and two high-calorie options. These were crisp products that participants were likely to be familiar with due to their common presence in UK stores. They may therefore have possessed preconceptions about the healthiness of these products, which would have impacted their choices in the experiment.

The fact that participants could choose between two extremes and a middle option was also problematic in experiment 5.E1. Those that may have felt somewhat licensed to make a less healthy behaviour may have opted for the middle option as opposed to the lower calorie option, and those that may have felt somewhat motivated to make progress towards health goals could

have selected the middle option instead of the highest calorie option. These patterns of behaviours could have cancelled each other out, making it harder to identify whether the effects observed were actually licensing effects, or positive spillover effects. Both of these problems were resolved in experiment 5.E2.

The secondary choice task was simplified to include only two options, with this also making the healthiness of their choices salient to participants. Importantly, participants selected between both categories of products (healthy or regular) before seeing what products were actually available, avoiding any confounding effects of product type or product familiarity. The changes made to the experimental design allowed for obtaining a clearer understanding of which direction participants were pushed in following making either a healthier, or less healthy choice in the first task.

An additional question was added to the questionnaire in experiment 5.E2. which asked participants to state the likelihood that the next snack they would buy would be healthy. While shop condition was not predictive of participants' ratings on this question, their choices at checkout were. Participants thought they were likely to act consistently from checkout to their next choice, with those opting for a healthy snack predicting the next snack they would buy would also be healthy, while those that opted for a regular snack were significantly less likely to predict the same.

Participants therefore appeared to base the likelihood of their next choice being healthy on their most recent behavioural example – the choice they made at the checkout. Shop condition had no independent effect on their predictions, despite being associated with the second snack choices which in turn influenced the likelihood estimates given. Although we had no measure of health-consciousness following the initial shopping task to gage its impact on self-perception, we know that participants' choices in the second task were associated with their perception of themselves as health conscious or indulgent individuals. Those that made a healthy choice saw themselves as more health-conscious, while those that did not rated themselves as being less health conscious and more indulgent, consistent with self-perception theory (Bem, 1967). Any shifts in self-concept that occurred due to the initial choice may have been overshadowed by those created by the second choice.

A factor which might differentiate both choices is the fact that the initial choice task still allowed for making some unhealthy choices in the healthy scenario (or healthy choices within the

less healthy scenario). While on balance, their choices would have been biased towards one or the other, they were not forced to exclude all options that were contrary to the majority. In contrast, at checkout, participants were forced to select one option over another – actively rejecting an option, and committing to selecting another, may have had a stronger effect on the self-concept, and thus, predictions of any future behaviour.

While predicted behaviour may not have been affected by shop condition, experiment 5.E2. provided evidence that healthy choices from healthy environments can lead to licensing effects and increased unhealthy purchasing. This adds to the existing evidence that efforts to promote healthier choices can eventually lead to unhealthy behaviour. This has repercussions for individuals interested in developing interventions that generate healthier choices. At present, little is known about these licensing effects and what kinds of behavioural interventions might be more or less likely to spark their onset.

5.E2.4.1. The impact of external influences on behaviour

The idea that the level of engagement a participant has in their choice has differential impact on their self-perception and ultimately their predicted or actual behaviour has already been touched upon. Independently opting for a healthy option (as in the second snack choice task), as opposed to defaulting to making predominantly healthy choices due to the store layout (in the initial shopping scenario) had differential effects on participants' predictions for future behaviour. This raises the question about whether licensing or spillover effects differ dependent on the attribution of the behaviour. Choices we make might be more likely to influence our self-perception if we attribute them to ourselves. How might licensing effects differ if behaviours are externally attributed?

Licensing effects are thought to be associated with boosts in "moral credentials" or "credits". When an individual has engaged in a virtuous behaviour, this can be taken as a reflection of that individual's virtuosity or progress. Some have claimed that these boosts cannot occur when the virtuous behaviour is attributed to an external source.

For example, one social psychology study found that freely choosing to write about a positive experience with a Black person (as opposed to being instructed to do so) led to more bias in favour of White candidates in a subsequent job suitability estimation task (Bradley-Geist, King, Skorinko, Hebl, & McKenna, 2010). Freely choosing to write about their positive experience led

to a diminished sense of racial bias, and a relaxation in further efforts to behave in a racially unbiased way in the subsequent task. This in turn was manifested as a bias for White candidates in the job suitability task. In contrasts, the authors suggested that for those who were instructed to write the piece, the behaviour could be attributed to an external influence – there was external justification for why they wrote the piece. In turn, these participants could not attribute the behaviour to themselves and would not experience the same sense of "doing enough" in terms of behaving in a racially unbiased way. They were therefore less likely to relax their efforts in remaining unbiased. It is hard to determine whether comparable effects could be found when comparing dietary choices that are freely or enforcedly made. At present, there is little evidence of research that considers how the extent to which a health intervention affects freedom of choice may impact dietary behaviours that occur downstream.

One example of a study that did compare how freely made and enforced food choices can licence subsequent ones was conducted by Finkelstein and Fishbach (2010). In contrast to Bradley-Geist et al. (2010), they found that forced choices, not free choices, produce licensing effects. Their experiments explored the impact attributing a food choice to an external influence might have on an individual's future behaviour. Participants who freely chose to sample a bar framed as healthy consumed significantly less in a subsequent consumption scenario compared to individuals who were forced to do so. The authors claimed that those that freely made a healthy choice not only made progress towards their health goals, but demonstrated commitment to them, motivating them to act consistently in the future. Those in the forced choice condition however had made progress without making any level of commitment. The authors therefore argued that these individuals were not more motivated to act consistently, and could take this progress as licence for consuming more afterwards.

There are some problems with applying Finkelstein and Fishbach's (2010) paradigm to interventions applied in practice. Firstly, their method of enforcing a healthy choice does not translate to how they would be enforced in the real-world. In their experiment, participants that were forced to sample a healthy option were told that they had been assigned to sample one healthy bar as opposed to another healthy bar. Within the food environment, when interventions enforce healthier options in some way, they typically do so by restricting less healthy options. Despite being an effective way of separating out the effects of framing condition (healthy or tasty) and

freedom of choice condition (free or forced), the paradigm adopted by Finkelstein and Fishbach (2010) is not reflective of the choices people face in real life.

On a related note, the free choices made by participants in Finkelstein and Fishbach's (2010) study did not require individuals to choose healthy options in lieu of less healthy options. We propose that choosing between two virtuous options is less likely to produce "moral credits" or "credentials" than choosing a healthy option instead of a less virtuous alternative. Participants were not committing to one course of action that opposed another, which could in turn produce changes in the self-concept that also opposed each other. This may be why their experiment did not produce the licensing effects we might anticipate in the free choice condition.

Our last concern with applying the Finkelstein and Fishbach (2010) paradigm within naturalistic settings is the framing of the task. Participants were choosing between two small samples of a bar under the pretence of a food tasting study. Scenarios where individuals take free samples of foods and evaluate their taste may not translate well to environments where individuals typically purchase foods e.g. supermarkets, vending machines, cafeterias. The findings from this study therefore may not be reflective of what might be found for consumer choices made within these choice environments.

Behavioural interventions, if noticed, may be perceived to introduce different levels of external control. How this impacts the causal attribution of a behaviour may influence how it then spillsover downstream. This has important repercussions for behavioural interventions that may introduce overt restrictions on people's choices. At present, there is little evidence to suggest whether free or forced choices might be more or less likely to produce licensing effects. In the next experiment, we attempted to fill this gap.

5.E3.1. Does the attribution of a healthy choice affect the extent to which health interventions influence subsequent behaviours? (Online study)

Experiment 5.E3. explores whether free or forced food choices are more or less likely to produce licensing effects. The healthy shop from the first two experiments was used again, to ensure that participants made predominantly healthy choices (but could still choose some unhealthy products if they wished). In experiment 5.E3., half of the participants were told that they could freely choose from the selection of items on offer in the store, while the other half were told

that store-restrictions meant they could only choose a maximum of three unhealthy products. While the choice available to participants was therefore the same, the framing of its causal attribution was not. This framing was strengthened by the inclusion of text that explores the free or forced nature of participants' choices in more depth (see Appendix 18). We explored what impact freedom of choice condition had on participants' choices in a slightly altered secondary choice task. As the stores were framed as either allowing free choices or enforcing healthy ones, the second task was described as happening in another store. We hypothesised that the second snack chosen would differ dependent on whether participants freely made a healthy choice, or were forced to do so.

5.E3.2. Methods

5.E3.2.1. Participants

A power analysis (conducted in G*power, Windows Version 3.1.9.6 (Faul et al., 2007)), based on the large effect sizes (Study 3 d = 0.75; Study 4 d = 1.38) found by Finkelstein and Fishbach (2010) in their studies on forced and free choices, suggested that a minimum sample size of 32 would be sufficient to achieve a power of 0.80 with $\alpha = 0.05$ and a large effect size in a 2x2 Chi^2 analysis. However, we recruited additional participants to account for the differences in experimental design (e.g. Finkelstein and Fishbach's study was conduced face to face - effects could be subtler in our online study) and statistical analysis (we were reliant on non-parametric analyses).

Eighty undergraduate Psychology students were recruited through Cardiff University School of Psychology's online experiment management system. As before, exclusionary criteria included having a prior history of eating disorders and prior participation in any of this chapter's experiments. Three participants' results were excluded due to missing data, leaving a sample of seventy-seven participants. Of which, 73 were female and 4 were male, with a median age of 19 years, IQR = 1yrs.

5.E3.2.2. Design

The independent variable was freedom of choice. Participants were randomly allocated to one of two experimental conditions, forced choice or free choice. Although the independent

variable was different to that used in the prior two experiments, the rationale for using a between-subject design was much the same (see Methods, 5.E1). Completing the experimental task after a free choice and again after a forced choice (or vice versa) would likely produce demand characteristics. As in experiment 5.E2., the main dependent variable was a binary choice between a healthy or regular snack, and a questionnaire was also included firstly as a manipulation check, secondly to compare health consciousness and indulgence characteristics across conditions and thirdly to gauge the likelihood that participants would go on to buy a healthy snack following the experiment.

5.E3.2.3. Materials

As before, the experiment was run using Qualtrics. Participants in each condition were given different introductory texts to read (see Appendix 18). Those in the free choice condition were told to imagine they were browsing what's on offer at a nearby store as they wanted to buy some snacks. They were told they could only carry 9 items. Those in the forced choice condition were given the same details, but were also told that this particular store was trialling a health promoting policy which reduced the number of unhealthy options available, and limited high-calorie purchases to a maximum of three products per basket.

All participants were then shown the same range of twelve items, nine being healthy and three were less healthy (as in the Healthy Shop condition in the prior experiments, see Healthy Shop section of Appendix 12).

A condition reinforcement text was also presented to participants (see Appendix 18). In the free choice condition, this text emphasised that the participants actively chose to make healthier choices, before discussing the benefits of making healthy choices on a regular basis. In the forced choice condition, the text emphasised that the participants successfully followed the store's policy (therefore attributing the choice to an external influence), and discussed how the government is trying to curb the increasing levels of obesity within the population by introducing interventions at point-of-purchase.

Much the same as experiment 5.E2., for the second choice tasks, the healthy options included a banana or an apple, and the regular snack options included a chocolate brownie or a cookie (see Appendix 15).

The questionnaire comprised of two parts – one as a manipulation check relating to the initial shop scenario, and the other to measure participant health consciousness and indulgence characteristics. All questions and their coding can be viewed in Appendix 19.

The manipulation check section of the questionnaire comprised of four questions, all relating to the initial choice made from the range of twelve products. The first three questions were 7-point likert scales. The first measured participants' satisfaction with the products available (1 = Very dissatisfied, 7 = Very satisfied). The second question asked participants who had the greatest influence on their product selections (1 = the participant, referred to as "Myself", 7 = the store) to ensure the freedom of choice manipulation was successful, and the third question asked them to rate the healthiness of the products available to choose from (1 = Unhealthy, 7 = Healthy). The fourth question was a binary choice, asking participants to indicate whether the products available to choose from were mostly healthy or mostly unhealthy.

The second part of the questionnaire was a development of what was used in experiment 5.E2. It included eleven questions in 7-point Likert scale format: 6 measuring health consciousness, 2 measuring indulgence characteristics, one asking the likelihood that the next snack they bought would be healthy, and two questions explored participants' attitudes to external influences on food choices. All questions were measured on a scale of agreement (1 = Strongly disagree, 7 = Strongly agree). All questions and their coding can be viewed in Appendix 19.

5.E3.2.4. Procedure

Participants were told to imagine that they were shopping for snacks, and had space for nine items in their bag. Those in the forced choice condition were also informed that the store was taking part in a public health intervention, therefore shoppers could not buy more than three high-calorie products. Following the introductory screen, all participants saw the same selection of products, displayed in random order (nine of which were healthy, three were less healthy), and were asked to select a total of nine items to purchase.

Following making their selection, the chosen products were displayed in list-format, to reinforce the nature of the selections made by participants. Subsequently, participants in each condition were shown messages which either reinforced the idea that they had made their selections from their own free will (free choice condition), or that their selections were made to comply with store policy (forced choice condition).

Following reading this text, participants were told to imagine they had paid for these items at the checkout. They were then told that they were now going to shop at a different store (in the forced choice condition, it was emphasized that this store was not trialling the same health-promoting policy). The second choice task was then identical to experiment 5.E2., with participants asked whether they would prefer to buy a healthy snack, or a regular snack, before being prompted to select one of the two available options within their chosen category. As before, the products were only revealed after participants decided between a healthy or a regular snack. The questionnaire section and a debrief then followed.

5.E3.3. Results

5.E3.3.1. Manipulation check

5.E3.3.1.1. Influence on choice

Participants in both conditions determined that they themselves had the greatest influence on their selection of products as opposed to the store. Participants in the free choice condition gave a mean rating of 3.35 (SD = 2.01), while those in the forced choice condition gave a mean rating of 3.68 (SD = 2.20). An independent samples t-test found no significant differences across conditions $t(75) = -.68$, $p = .50$, $d = 0.08$.

5.E3.3.1.2. Satisfaction

Participants in both conditions were more dissatisfied than satisfied with the range of products available to choose from. Those in the free choice condition gave a mean rating of 3.88 (SD = 1.86), while those in the forced choice condition gave a mean rating of 3.46 (SD = 1.57). An independent samples t-test found no significant differences across conditions $t(75) = -1.06$, $p = .30$, $d = 0.12$.

5.E3.3.1.3. Store health

Participants in both conditions thought that the store was healthy, with 90% of all participants determining that the majority of the products sold in the store were healthy (95% in the forced choice condition, 85% in the free choice condition). An independent t-test demonstrated that there were no significant differences in store health ratings across conditions (M Free = 5.08, SD Free = 1.05; M Forced = 4.95, SD Forced = 1.03), t(75) = -.55, p = .59, *d* = 0.06.

5.E3.3.2. Second snack choice

Within the forced choice condition, 19 individuals selected healthy options, while 18 opted for a regular snack. Within the free choice condition however, 18 individuals opted for a healthy snack while 22 chose a regular snack. A chi^2 contingency table analysis demonstrated that freedom of choice was not associated with second snack choice, $\chi^2(1) = 0.31$, p = .58, $\varphi = 0.06$. Freely making primarily healthy choices, or doing so by force, was not associated with the snack choices participants subsequently made.

5.E3.3.3. Next snack

Following making their secondary choice, participants filled in a questionnaire. One question asked participants to rate the statement "The next snack I buy is likely to be healthy". The mean ratings for this question across conditions and second snack choice groups can be seen in Figure 20.

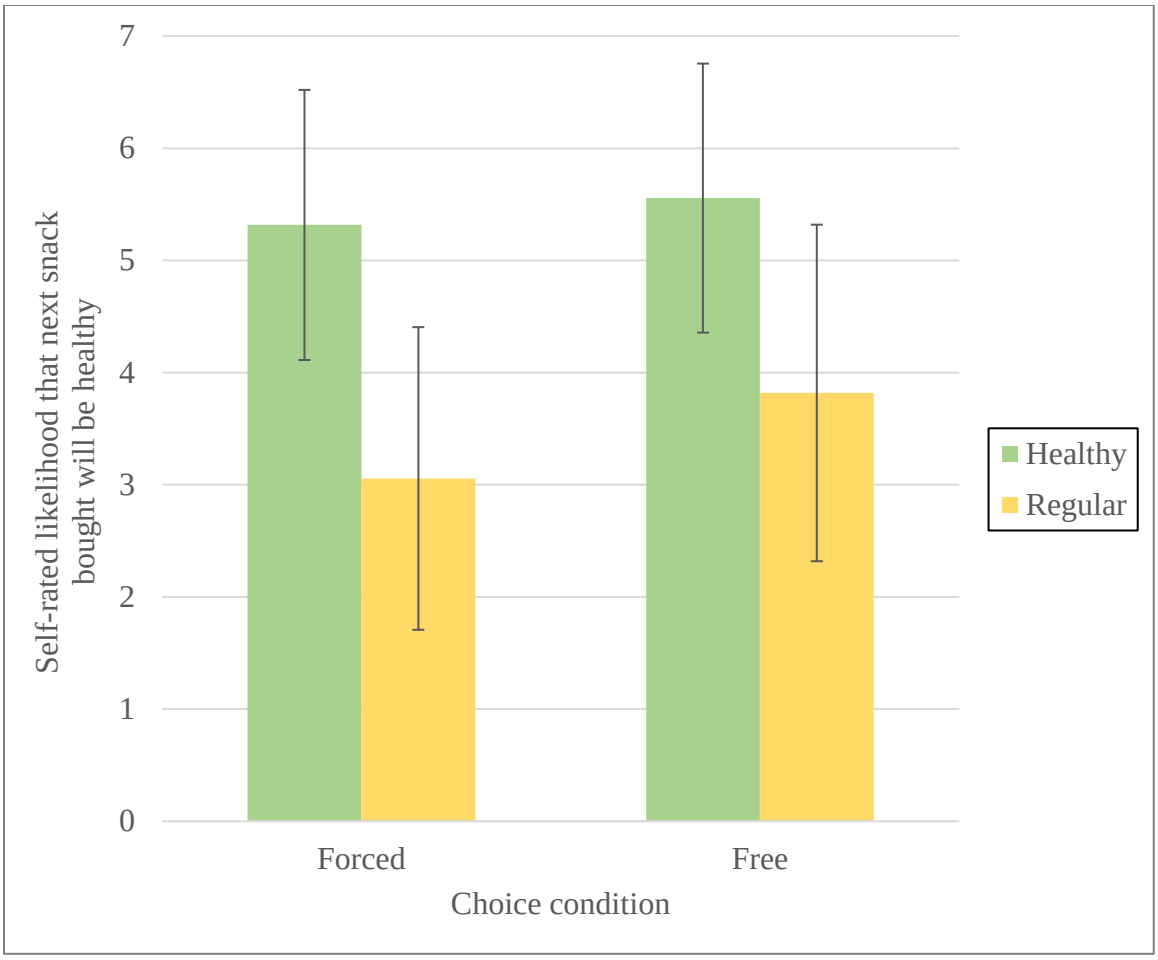


Figure 20. Mean ratings for "The next snack I buy is likely to be healthy" across choice conditions and second snack choice groups. Legend shows snack type chosen in the second task.

Those that selected a healthy second snack, regardless of choice condition, gave higher likelihood ratings for their next snack being healthy. A two-way between subjects ANOVA demonstrated a significant main effect of second snack choice, with higher ratings for those that chose healthy second snacks when comparing to those choosing regular ones, $F(1,73) = 43.31$, $p = <.00001$, $\eta_p^2 = .37$. This effect did not significantly differ across freedom of choice conditions - there was no significant interaction between freedom of choice and second snack choice, $F(1,73) = .74$, $p = .39$, $\eta_p^2 = .01$, nor was there a main effect of freedom of choice, $F(1,73) = 2.72$, $p = .10$, $\eta_p^2 = .04$.

5.E3.3.4. Scale development

In addition to exploring the likelihood that the next snack participants bought would be healthy, the questionnaire sought to measure participants' health consciousness, indulgence, and attitudes to external influences on food choices. The former two were used to create scales for each characteristic (see Appendix 17 for composition of each scale), with the same criterion as prior being used to determine scale acceptance (Cronbach's alpha of 0.70 or above). Only the health-consciousness scale met this criterion (Health consciousness: N = 6, $\alpha = .83$; Indulgence: N = 2, $\alpha = .61$). All other questions were explored independently. Significant effects are reported below, and any non-significant comparisons are available in Appendix 19.

5.E3.3.5. Questionnaire analyses

5.E3.3.5.1. Health consciousness across conditions

Participants' scores on the health consciousness scale were compared across conditions, and across second snack choice groups. A main effect of freedom of choice was found, with those in the free choice condition rating themselves as more health conscious than those in the forced choice condition, $F(1,73) = 8.40$, $p = .01$, $\eta_p^2 = .10$. There was also a main effect of second snack choice, $F(1,73) = 24.22$, $p = <.0001$, $\eta_p^2 = .25$. Participants who made a healthy choice at the checkout rated themselves as more health conscious than those who opted for a regular snack. There was no significant interaction between freedom of choice and second snack choice, $F(1,73) = .54$, $p = .47$, $\eta_p^2 = .01$, (Free Healthy M = 5.59, SD = .69; Free Regular M = 4.73, SD = .91; Forced Healthy M = 5.15, SD = .95; Forced Regular M = 3.99, SD = 1.00).

5.E3.3.5.2. "I like to treat myself when snacking" (compared across conditions)

Participants' scores were compared across conditions, and across second snack choice groups. There was no main effect of freedom of choice, $F(1,73) = .06$, $p = .81$, $\eta_p^2 = .001$. There was however a main effect of second snack choice, $F(1,73) = 9.58$, $p = .003$, $\eta_p^2 = .12$. Participants who opted for a regular snack as opposed to a healthier one rated higher for liking to treat themselves when snacking. There was no significant interaction between freedom of choice and second snack choice, $F(1,73) = .36$, $p = .55$, $\eta_p^2 = .01$ (Free Healthy M = 4.17, SD = 1.62; Free Regular M = 4.95, SD = 1.05; Forced Healthy M = 4.05, SD = 1.68; Forced Regular M = 5.22, SD = 1.11).

5.E3.3.5.3. “I believe that the government should regulate people’s diets” (comparison across conditions)

Participants’ scores were compared across conditions, and across second snack choice groups. There was no main effect of shop condition, $F(1,73) = .02$, $p = .90$, $\eta_p^2 = <.001$. There was however a main effect of second snack choice, $F(1,73) = 5.13$, $p = .03$, $\eta_p^2 = .07$. Participants who opted for a healthier snack showed greater support for the government regulating people’s diets. There was no significant interaction between freedom of choice and second snack choice, $F(1,73) = 1.14$, $p = .29$, $\eta_p^2 = .02$ (Free Healthy M = 3.89, SD = 1.71; Free Regular M = 2.73, SD = 1.42; Forced Healthy M = 3.47, SD = 1.50; Forced Regular M = 3.06, SD = 1.47).

5.E3.4. Discussion

Experiment 5.E3. aimed to test whether freely choosing to engage in a healthy behaviour as opposed to being forced to do so would produce differential licensing effects. Participants in both conditions determined that they themselves had the greatest influence on their choice, as opposed to the store, suggesting that our manipulation did not produce the intended effects of differentiating choice attribution and freedom of choice. Caution must therefore be taken in interpreting these findings as indicative of the influence of freedom of choice on potential spillover/licensing effects. However, some significant differences were found between individuals that opted for either a healthy or a regular snack in the secondary choice task. Possible explanations for these effects and the potential reasons for the fact that our manipulation did not produce the intended effects within the forced choice condition are considered below.

Responses to some of the questionnaire items differed between individuals that chose healthy and less healthy snacks in the second choice task. Interestingly, there was a replication of a pattern of results found in experiment 5.E2. Those that opted for a healthier option in the second choice scenario thought it was more likely that the next snack they would buy would be healthy, compared to those that opted for an unhealthy second snack. As discussed previously, participants appeared to base the likelihood that their next choice would be healthy on their most recent example of their own behaviour. Alternatively, they may have felt motivated to appear consistent in their behaviours, or at least their predictions of them. Once again, it is impossible to determine whether this prediction would manifest itself in their actual behaviour.

Individuals that opted for a healthier option in the second choice task also gave higher self-reported ratings of health-consciousness, were less likely to report liking to treat themselves when snacking, and showed greater support for governmental regulation of diets. The fact that the questionnaire was presented following the second choice task means it is impossible to disentangle the effects to determine whether individuals were more likely to choose healthy options in the second task because of these pre-existing underlying attributes, or if selecting a healthy option in the second task caused shifts in participants' self-perceptions that were then reflected in their responses to the subsequent questionnaire. In the same vein, it cannot be determined whether those that opted for an unhealthy option did so because of an underlying liking towards treating themselves when snacking (a questionnaire item for which these participants scored more highly), or whether opting for the unhealthy option made them perceive themselves as individuals who typically like to treat themselves with snacks. For us, as behavioural scientists interested in predicting and shaping health behaviour, the more interesting question is whether participants' predictions of the nature of their next snack choice accurately reflects their actual behaviour.

Despite efforts to strengthen the manipulation beyond what would be experienced in a typical shopping environment (with texts emphasising either the importance of making free choices, or the importance of interventions that enforce them), it did not shape participants' perceptions of freedom of choice. Why might this be the case? In Finkelstein and Fishbach's (2010) study, they enforced choices upon participants by assigning them to sample certain foods, stripping them of any semblance of choice. In the same vein, Bradley-Geist et al. (2010) instructed participants to write about a positive experience in their forced choice condition. We opted for a different approach as we determined that such overt methods would not translate well to real-world interventions that typically enforce the selection of healthier options through subtler means (e.g. restricting the availability of unhealthy options), where participants still possess a degree of agency over their choice.

While selecting this more covert approach may have been beneficial when applying these findings to practice, it did not produce any effect. It appears that more overt methods may be necessary to invoke a sense that another external agent holds responsibility for their actions. Store restrictions on unhealthy purchasing may not be perceived as enforcements, but limitations to the range of choices available to individuals. This may bode well for practitioners who wish to enforce

healthier choices – we found no evidence to suggest that our overt manipulation had any bearing on participants' perceptions of their agency in making their choices. Manipulations used in practice are generally more covert, and may be less likely still to shape perceptions of agency and self-perceptions, in turn making potential licensing effects less likely to occur.

A second factor likely to have contributed to the fact that our manipulation did not shift perceptions of participant's agency as intended is the fact that this was not a real choice, with real foods to be sampled, but one made in an imagined online store. This setting may be too far detached from individuals for them to experience the limitations enforced upon them. For example, being forced to sample one bar as opposed to another may carry with it a more visceral response - the potential of tasting one option is lost, and participants must actually eat the bar that has been assigned to them (as in Finkelstein and Fishbach's (2010) work). The inability to choose more unhealthy options in our experiment did not have any impact on what was actually available for them to eat. The loss of freedom experienced may therefore have been dampened. This may contribute to why Finkelstein and Fishbach's (2010) manipulation check confirmed that the experimenter had greater influence on individuals' choices in the forced choice condition, while the manipulation check in our experiment produced no such effect. However, the fact that Bradley-Geist et al. (2010) did demonstrate licensing effects in a questionnaire-style experiment raises questions about the extent to which enforced behaviours need to be "real" for them to be influential.

Finally, while our paradigm highlighted that only a maximum of three high-calorie products could be selected, there were only three high-calorie products available to choose from. This was done to ensure that the majority of products chosen would always be healthy (regardless of freedom of choice). However, it did mean that the participants in the forced choice condition were not being deprived of any of the unhealthy options visibly available. We hoped that the messaging prior to and post exposure to the shop environment would have been successful in framing their selections as ones that had been made due to the restrictions put in place in the store. However, our manipulation check indicated that this was not the case. As such, participants were able to choose as many of the unhealthy items that were available to them as they wished, and this was done with no perception of this being a restricted choice that had been enforced upon them. Participants could choose to act as unhealthy as they liked, within the confines of the rules applied

in the store (that is, choosing three unhealthy products). The majority of individuals within the forced choice condition did just that – 16 of the 37 (43%) selected three unhealthy snacks, with only 2 (5%) choosing only healthy snacks. The maintenance of this ability to behave in the most unhealthy way possible may have dampened any effect of the freedom of choice manipulation.

These three problems are resolved in experiment 5.E4. There are some contrasts between the experimental designs (the choices available to participants in the initial choice scenario are between drinks, not snacks), however the experiment still offers an opportunity to further explore the impact that forcing a healthy choice might have on the occurrence of any licensing effects.

5.E4.1. Does the attribution of a healthy choice affect the extent to which health interventions influence subsequent behaviours? (Lab-based study)

In experiment 5.E4., the second choice scenario bares a closer resemblance to that employed by Finkelstein and Fishbach (2010). Participants in the forced condition were told they had been assigned to sample one option instead of another, therefore invoking a sense of loss of choice. This was done in a lab-based experiment, where participants made real choices and sampled actual food.

Participants in the free choice condition were truly free to choose either a healthy or less healthy option throughout, and those that sampled a healthy option in the forced choice condition did so after having their initial less healthy choice taken away from them. It was thought that this overt loss of choice would make clear that an external agent was in fact enforcing their choice, and that they had lost all agency within this experimental scenario.

The experiment was framed as a drinks sampling task, and following completion, participants were told they could choose one snack from a selection (including both healthy and less healthy options) before they left. The healthiness of the snack chosen was the dependent variable.

5.E4.2. Methods

5.E4.2.1. Participants

The same power analysis as described in 5.E3. was applicable to this study, as the statistical analysis exploring the association between freedom of initial choice and the nature of the second

choice was to be identical. The power analysis suggested that with a large effect size (as seen in Finkelstein and Fishbach's (2010) prior work) and $\alpha = 0.05$, a power of 0.80 could be achieved in a 2x2 Chi^2 analysis with a minimum sample of 32 (analysis conducted in G*power, Windows Version 3.1.9.6 (Faul et al., 2007)).

However, this experiment faced unique practical challenges. Not only did we need to account for the differences in statistical analysis (unlike Finkelstein and Fishbach (2010), we were reliant on non-parametric analyses), we also needed to account for the fact that we were reliant on participants' free choices in our efforts to obtain enough observations in each condition. The focus on producing naturally occurring choices necessitated collecting data from a larger still sample. As we could not allocate the nature of the choices made by participants, we aimed to recruit additional participants to obtain enough observations of healthy and regular selections in each condition to make meaningful comparisons.

For example, in experiment 5.E3. we recruited 80 participants, half of which were in the free choice condition. To create a suitable comparison, having 40 participants freely select a healthy option, and 40 being forced to do so would have been considered acceptable. However, in experiment 5.E4., participants also had the opportunity to freely choose unhealthy options (or be forced to do so). This would mean recruiting at least twice as many participants (and more if participants showed a bias for unhealthy free choices).

Unfortunately, data collection for this study was cut short due to the COVID-19 pandemic, therefore the sample size is significantly smaller than was anticipated. This should be considered when interpreting our findings.

One hundred and twelve undergraduate Psychology students were recruited through Cardiff University School of Psychology's online experiment management system. Exclusionary criteria included having a history of eating disorders, having dietary constraints such as food allergies or intolerances, and prior participation within the experiments documented in this chapter. Two participants' results were excluded due to missing data, leaving a sample of 110 participants. Of which, 94 were female and 16 male, with a median age of 19 years, IQR = 3yrs.

5.E4.2.2. Design

The independent variable was freedom of choice. Participants were randomly allocated to one of two experimental conditions, forced choice or free choice (see Methods, 5.E3. for rationale behind using a between-subjects design). The main dependent variable was snack choice (healthy/regular). A questionnaire was administered to compare characteristics across participants (and maintain the experimental narrative of the task being a drink sampling task). The questionnaire was administered either before or after the snack choice, which the order of which being counterbalanced across both conditions.

5.E4.2.3. Materials

Products were pre-tested with the target population in a product preference survey (see Appendix 20). The findings from this survey determined which drink products were to be used in the experiment (see Appendix 20). A jug of tap water was also available (for participants to cleanse their palettes following the sampling task). For the subsequent snack choice, four healthy and four less healthy options were available (see Appendix 20).

The questionnaire consisted of two sections – the first to give participants the opportunity to rate the drink sampled (to maintain the experimental narrative), and the second to measure their attitudes towards maintaining healthy diets and their views on external influences on dietary choices. All questions were measured on five point Likert scales (see Appendix 21).

5.E4.2.4. Procedure

Participants were randomly allocated to a free or forced choice condition. For all participants, the drinks were presented on a table. Participants were asked to indicate which drink they would prefer to consume. Following conveying their preference, participants in the free choice condition were given a sample of their preferred drink. In the forced choice condition, the participants were told that the experimenter had to check which selection of drinks they had been allocated to test. In every instance, participants in the forced choice condition were told they had been allocated to test a drink from the opposite category to their preferred drink. Following sampling their drink, participants were offered some tap water to cleanse their palette.

The order of presentation for the questionnaire was counterbalanced across conditions, with half of the participants in each condition being given the questionnaire before selecting their free snack, and half completing it after making their snack selection.

The snacks were presented on a table, with the healthy and less healthy options laid out randomly amongst each other. Participants were told that they were entitled to a prize for their participation, and were asked to select one snack from the selection.

5.E4.3. Results

The focus of this experiment was comparing the snack choices of individuals that consumed a healthy drink in both the free and forced choice conditions.

5.E4.3.1. All snack options

The number of participants choosing healthy or regular snacks after freely choosing, or being forced to sample a healthy drink was compared. Forty-seven participants were forced to sample a healthy drink, while seven freely chose to do so. Of the participants that freely chose to engage in the initial healthy behaviour, not one participant opted for a healthier snack afterwards, while seven opted to engage in a less healthy behaviour (choosing a regular snack). Looking at the forced choice condition, regular snacks were also chosen by a greater proportion of those individuals that were forced to sample a healthy drink. In the second choice task, six chose a healthier snack while forty-one chose a less healthy snack.

Unfortunately, our low sample size and the sample's preference for unhealthy options in all conditions meant that an insufficient number of individuals freely made healthy choices to allow for effective comparison across conditions (with a Fisher's exact test not finding a significant association between condition and snack chosen for those that sampled a healthy drink, $p = 1.00$).

An alternative analysis was therefore devised post-hoc, to further explore whether participants' choices became relatively more or less healthy within the range of regular snack options that were available. More than half of all participants (57 of 110) opted for either a Malteser Teaser or KitKat from the selection of snacks - these were the most popular options within our sample. The former is a small snack with a relatively low level of calories (45 kcals per unit). The latter is a bigger snack with a higher level of calories (104 kcals per unit). To test whether any subtler effects occurred across conditions (e.g. not shifting behaviour from a healthy snack to a less healthy snack or vice versa, but shifting from a high calorie snack to a lower calorie one, or vice versa), we compared whether participants were more or less likely to select each of these two snacks in each condition (and dependent on the drink they sampled).

5.E4.3.2. Most popular snacks

The number of participants choosing a Malteser Teaser or a KitKat after freely choosing or being forced to sample a healthy drink was compared (see Figure 21).

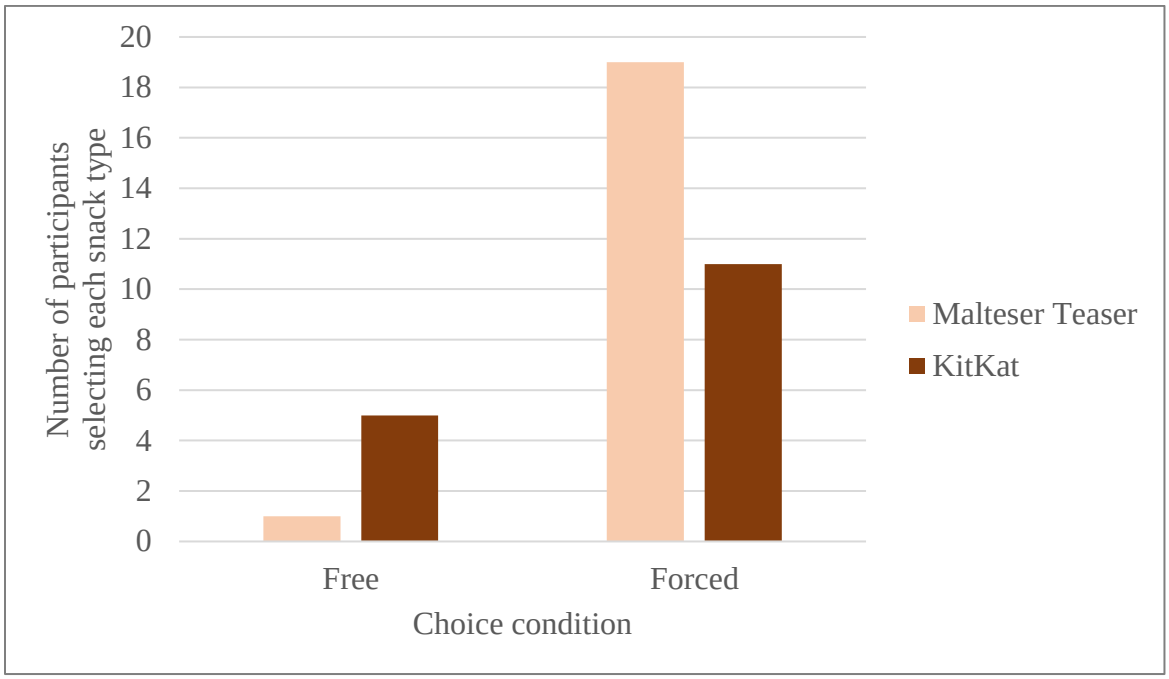


Figure 21. Number of participants selecting a low-calorie Malteser Teaser or a high-calorie KitKat following freely choosing or being forced to sample a healthy drink. Legend displays snack choices.

Thirty of the participants from this sub-set were forced to sample a healthy drink, while six freely chose to do so. Of the participants that freely chose to engage in this healthy behaviour, only one opted for the lower calorie Malteser snack afterwards, while five opted for the higher calorie KitKat. However, the inverse was true for the forced choice condition. Those that were initially forced to engage in a healthy behaviour were more likely to opt for the healthier of the two snack options subsequently – nineteen of those forced to sample a healthy drink opted for a lower calorie snack, while eleven of these participants opted for the higher calorie KitKat. These inverse trends approached the threshold for statistical significance ($\alpha = .05$) in a Fisher's exact test, $p = .07$, $OR = 8.64$.

5.E4.3.3. Questionnaire analysis

No significant differences were found for any of the three questionnaire measures across conditions or snack choice within the subset who sampled healthy drinks, both when comparing the full range of healthy and regular products, and when comparing across the two most popular options (see Appendix 21).

5.E4.4. Discussion

In a free choice scenario in experiment 5.E2., we found that healthy choices made in an unconstrained, independent shopping scenario resulted in licensing effects. However, previous work has suggested that freely made healthy choices are less likely to produce licence effects than forced ones (Finkelstein & Fishbach, 2010). With others (outside of the food-research domain) reporting that it is in fact freely made virtuous choices that are most likely to produce licensing effects (Bradley-Geist et al., 2010), the lab-based experiment 5.E4. built on the questions asked in the online experiment 5.E3., to further explore the direction of any effects that choice attribution may have on sequences of food choices. No significant effect of freedom of choice was found, however, trends in the data bare greater resemblance to the findings of Bradley-Geist et al. (2010) than Finkelstein and Fishbach (2010). These trends, and what they may mean for the further study of food choice are discussed below.

The main comparison of interest was whether freedom of choice shaped the influence engaging in a healthy behaviour (sampling a healthy drink) might have on subsequent behaviour (snack choice). In contrast to the findings of Finkelstein and Fishbach (2010), freely or forcedly sampling a healthy drink had no bearing on participants' subsequent snack choices - they all demonstrated a preference for less healthy options. This preference for less healthy snack selections could be seen as a generalized licensing effect, regardless of freedom of choice condition (with all those sampling a healthy drink showing a preference for more indulgent snacks). Alternatively, the general preference for more indulgent products (79% of all participants in the experiment opted for a snack from the regular range instead of the healthy range), could also indicate that any licensing effects, if they were to occur, would do so within this category of products. A marginally significant trend in our data suggests this may be the case.

When comparing the selection of the two most popular options within the less healthy range of snacks, those that freely chose to sample a healthy drink were more likely to opt for high-calorie snacks afterwards, while those that were forced to do so were more likely to opt for lower-calorie options (a small chocolate sweet instead of a big chocolate bar). The direction of this marginal effect suggests that freely made healthy choices may be more likely to license subsequent less healthy behaviour. Looking back on the contradictory findings of Bradley-Geist et al. (2010) and Finkelstein and Fishbach (2010), our findings bare closer resemblance to the former. We found no evidence to support the conclusions of Finkelstein and Fishbach (2010) that forced healthy choice are more likely to be followed by less healthy choices. In our study, participants who were forced to sample a healthy drink appeared more likely to produce positive spillover effects, going on to freely make their own healthy choices afterwards. It was in fact those that freely chose a healthy option in the initial task that were more likely to select less healthy options afterwards. The strong effects to the opposite direction evidenced by Finkelstein and Fishbach (2010) were not replicated here.

Theories of moral licensing postulate that engaging in a virtuous behaviour might licence less virtuous behaviours in future. Our findings contribute to the evidence that suggests that this effect may only surface if the individual can attribute the initial virtuous behaviour to the self. Aligning with the conclusions of Bradley-Geist et al. (2010), external influences offer a justification, outside of the self, for engaging in an initial virtuous behaviour. In turn, this means that any boost to the self-concept or the sense of progressing towards these goals is not experienced by those in the forced choice condition, halting the development of any licensing effects which would have manifested in an increase in less healthy selections. This theory opposes the explanation offered by Finkelstein and Fishbach (2010), who found evidence to suggest that forced choices are more likely than freely made choices to produce licencing effects. Their explanation suggested that forced healthy choices are commitment-free healthy choices, that can still be taken as contributing to goal progress (while free choices also contribute to goal progress but do so while making health goals salient, motivating more consistent behaviour in future).

The fact that we failed to replicate the findings of Finkelstein and Fishbach (2010) across two experiments, both online and in a lab-based setting, raises many questions. Why might our studies have generated such contradictory findings? One major difference between the

experimental designs used in experiment 5.E4. and Finkelstein and Fishbach (2010) is that in the latter, those in the forced healthy choice condition were forced to sample one healthy bar in lieu of another, while in our study, a forced healthy choice meant losing a less healthy choice. We intentionally designed the experiment in this way to boost the applicability of its findings, with in-practice interventions typically restricting less healthy choices, and promoting healthier ones.

Individuals in Finkelstein and Fishbach's (2010) study were never offered the opportunity to engage in a less healthy initial behaviour – they just could not sample the other healthy bar on offer if they were in the forced choice condition. In contrast, our participants had their initial less healthy selection taken away from them, and replaced by a healthier alternative. Perhaps a restriction that prevented a less healthy choice was more easily accepted by participants in our study, with a health-related justification (with trends in the data suggesting that they may even have been prompted to take greater consideration of health goals in their next choice). In contrast, a restriction which enforces one healthy option as opposed to another, as was used by Finkelstein and Fishbach (2010) may be less easily justifiable from participants' perspective, potentially leading to the development of reactance effects. Reactance occurs when individuals experience a threat to or a loss in their personal freedom (Brehm, 1966), and become motivated to recover their freedoms when given the opportunity. An unjustified restriction of choice may have prompted such a response, leading to license-like effects occurring in Finkelstein and Fishbach's (2010) forced choice condition. This may account for the contradictory findings across both studies.

It is also of note that Finkelstein and Fishbach (2010) reported these findings with a sample of 53 participants, claiming a medium-large effect size of d = .75. Their experimental paradigm allowed for exploring the differences in hunger ratings across groups, while ours focused on associations between choice condition and snack chosen. This categorical measure may not have been as sensitive as a scale measure, and the experimental design gave way for certain conditions to be underrepresented (e.g. the numbers freely choosing healthy drinks were small, making comparing snack choices among them difficult). In contrast, Finkelstein and Fishbach's (2010) measure may have enabled them to identify subtler effects across conditions. Our marginal effects only emerged when exploring the subtleties between choices within the less healthy range (with a smaller subset of 36 participants). The retrospective adoption of this comparison post hoc is a limitation, as our experimental design did not account for these limited numbers. As such, these

comparisons had limited statistical power. We had anticipated effects to be stronger (due to the effect sizes seen in other studies such as Finkelstein and Fishbach's (2010)), and based our a priori power calculations on exploring associations using the full range of healthy and regular snacks. Comparing across two snacks within the less healthy range therefore reduced our sample significantly and reduced statistical power.

Even when exploring the selection of all available snacks, a much greater sample may be required in future research that hopes to capture naturally-occurring freely made healthy choices. Of our 110 participants, only 7 freely opted for a healthy drink in the initial task. Future work seeking to test the trend reported in our work should set out to explore the subtler effects of opting for relatively healthier or less healthy options as opposed to making categorical comparisons. A priori power calculations should account for this consideration, and our findings could be used as indication of the expected rate of freely-made healthy choices to guide future sample size calculations.

The experimental design adopted in experiment 5.E4. limits its practical applicability. Enforcing healthier choices is often done through subtler means in naturalistic settings (e.g. removing unhealthy alternatives as we did in the vending study in Chapter 2). As our subtler intervention (experiment 5.E3.) proved unsuccessful, we adapted a research design used by Finkelstein and Fishbach (2010), and not only enforced choices, but refused participants access to a visible, preferred option. The introduction of such an overt barrier to individuals' choices is unlikely to be emulated within real-life choice setting such as supermarkets, vending machines or cafeterias.

That being said, our findings call to question the direction of change that the external attribution of healthy behaviours might produce, warranting further exploration of food-related licensing effects.

5.2. Chapter Discussion

This chapter served as an exploration of the downstream influences of healthy behaviours generated by health interventions. At its heart is the acknowledgement of the interlinked nature of our behaviours and choices, and the need to account for this while developing behavioural interventions. Experiments 5.E1. and 5.E2. explored whether healthy choices produce licensing

effects, and experiments 5.E3. and 5.E4. explored how these might vary under different behavioural interventions that enforce healthier choices. Experiments 5.E2. and 5.E4. were improvements on the experimental designs adopted in Experiments 5.E1. and 5.E3. respectively, therefore this discussion will focus on the findings from these two studies.

Experiment 5.E2. provided evidence that supports the conclusions of a growing body of literature (e.g. Flores et al., 2019; Wisdom et al., 2010), that manipulations that successfully produce healthier behaviours can ultimately lead to the occurrence of less healthy behaviours further down the line. Individuals that made healthy purchases in the virtual shop were more likely to make unhealthy choices at checkout. An interesting additional finding was the fact that unhealthy behaviours produced the inverse pattern of results. Those that made predominantly unhealthy choices at the virtual store went on to make healthier choices in the secondary choice task at checkout. In both the healthy and unhealthy shop condition, participants appeared to be making choices that served to balance their progress across dietary goals, across successive choices.

Experiment 5.4. sought to explore how these spillover effects might manifest under conditions where healthy or unhealthy choices are enforced. While the selection of healthy and unhealthy snacks did not differ across forced and free choice conditions following sampling a healthy drink, a marginally significant trend suggested that individuals opted for more high-calorie products following freely sampling a healthy drink than being forced to do so. While these results originated from an underpowered comparison of only two of the snack choices available to participants, it serves as a suggestion that licensing effects may be more likely to occur following freely made choices than enforced ones. This aligns with the conclusions of Bradley-Geist et al. (2010) who found evidence to suggest that enforced choices cannot alter the self-concept as the behaviours cannot be attributed to the self. Our findings indicate that explorations of spillover effects across food choices may require large sample sizes to firstly generate a sufficient sample of freely made healthy choices, and secondly to maximise statistical power to identify subtle effects across comparable foods.

Although our findings are inconclusive, they highlight how there is much to be learnt about the direction of any change associated with the external attribution of healthier food choices. While effects may be subtle, they still hold the potential to jeopardize the effectiveness of health

interventions that place restrictions on individuals' food choices. Acknowledging the interlinked nature of our behaviours and choices is essential if hoping to develop effective health behaviour change interventions. Gaining a better understanding of the conditions in which food choices might spillover will help inform the development of more successful interventions for the future.

This chapter serves as an initial step forward, compiling current knowledge and generating more to shape work carried out in future. There is still much to be learnt about the mechanisms at play and the circumstances in which they might manifest. Efforts to shape consumers' choices for the better may be in vain if we fail to broaden our focus and begin to understand and account for these cascading behavioural patterns.

Chapter 6: General discussion

Within an increasingly obesogenic food environment, developing better ways to promote healthier dietary behaviours is key to reduce global rises in overweight and obesity (Folkvord & Hermans, 2020; Swinburn et al., 2011; Uzogara, 2017). The aim of this thesis was to explore how psychology could contribute in improving public health interventions that seek to produce healthier dietary behaviours within obesogenic food environments.

In Chapter 2, we investigated whether the complete replacement of less healthy foods within vending machines could produce healthier behaviour (both at the machine and beyond it), and whether this could be done without sacrificing vendor profitability. Chapters 3 and 4 explored the ways in which health labels can be used to influence choices, with Chapter 3 testing whether the source credibility heuristic could be used to boost the effects of health labelling, and Chapter 4 investigating how health labels function to shape consumer evaluations. Finally, Chapter 5 built on prior work on the caveats to intervening in dietary choices, taking an exploratory approach to inspect the relationships between successive dietary choices made during and after intervention exposure.

In this concluding chapter, we consider the key implications of our findings, both in terms of their contribution to the evidence base and in informing policy, practice and future research. These ideas are divided into the three key themes that have emerged from our research. We conclude through considering broader issues of relevance to dietary behaviours and interventions implemented within food environments.

6.1. Evaluating the complete replacement approach

Chapter 2 provided novel insights into the ways in which increasing the availability of healthy options and reducing the availability of unhealthy options can influence dietary behaviours. Despite our intervention (completely replacing less healthy options) being relatively intrusive, it is promising that healthier behaviour was achieved without causing a catastrophic decrease in sales. Of the sales that were made in the unhealthy condition, the healthy condition generated the equivalent of 73% of them. When considering the health gains (a 61% decrease in calories sold), this drop in sales volume could be considered to be an acceptable compromise when vendors wish to balance profitability and public health aims.

6.1.1. Evaluating the impacts of complete replacement interventions on sales

Prior work has successfully made vending healthier without any evidence of the need to sacrifice profitability. For example, French et al. (2001), Kocken et al. (2012) and Appelhans et al. (2018) all implemented interventions that increased the proportion of healthy sales made without detrimentally affecting overall sales. However, there is an important distinction between these studies and ours. Their interventions were much subtler, and so too were their health gains. Although we found a 27% drop in sales during healthy vending (which was significant for the specific product range tested), we produced substantially greater health gains. All sales made within our vending machines were healthy. A complete replacement approach can produce significant health benefit, and its impact on profitability is highly dependent on the composition of the product range itself.

This latter point is important. In many ways, our findings can be seen to corroborate those of the aforementioned studies that found no impact on sales when applying healthy vending interventions. According to our model, the losses we observed could only be guaranteed if we were to use the exact same product range again. Another selection of products could generate a different set of results. The healthiness of a product is not what determines its ability to generate a profit. This is a critical distinction, which could contribute in making healthier vending more attractive to vendors. The right product selection can produce a win-win for both health and profitability. Our findings could contribute in helping design such a selection. Accounting for sales at a micro, not macro, level allows for designing product ranges that align with consumer preferences, and boost the effectiveness of healthy vending interventions.

For this reason, we believe that one of the key strengths and novel contributions of this thesis is the fact that we measured sales at the individual product level within our vending studies. To our knowledge, none of the aforementioned studies accounted for variability in sales across individual products, with analyses instead being collapsed across different categories (e.g. low, moderate, high energy-density foods). We believe that our study serves an important function in highlighting the value of exploring sales at a more granular level. The composition of the product range is important, and failing to account for this through collapsing sales across product categories could oversimplify findings, and increase the risk of overgeneralising. This is particularly true when considering how different vendors have access to different ranges of products.

More advanced vending technology makes tracking sales at the individual product level easier. Within our vending studies in Chapters 2 and 3, the vending machines ran the Nayax system. This allowed for digitally tracking sales in real-time on the web or through an app, and offered a simple method to export detailed sales data. In contrast, prior work has had to rely on manually exporting sales data from the machines, before manually matching them to products as set out on planograms (see methods, Kocken et al. (2012)). Increased connectivity therefore makes the process of tracking sales at the individual product level substantially easier and less time-consuming. Our work not only demonstrates that measuring sales at the product level is a valuable addition to research within the field, but also that it is a viable option that can and should be more widely adopted as the roll out of more advanced vending technology continues.

6.1.2. Evaluating the impacts of complete replacement interventions on health

With a complete replacement intervention, we had to approach evaluating the healthiness of purchases in a new way. While in previous work, health interventions within vending machines have proven their success through reporting significant increases in the proportion of healthy sales made (or decreases in the proportion of particularly unhealthy sales), such a measure becomes obsolete with a complete replacement approach which by its very nature only produces sales of healthier products. To our knowledge, there had been no prior work exploring the complete replacement approach for vending snacks, and a new measure of success needed to be developed. Analysing sales data alone would not be sufficient in this case. Our work provided three novel measures for estimating the healthiness of vending interventions, which accounted not only for objective measures of intervention success, but also the ways in which our psychological responses to such an intervention could shape its potential for success.

Firstly, we linked each sale to its respective product information to calculate calories sold. Averaging calories sold per condition, per machine, and per time period allowed for estimating the calorific contribution of both healthy and regular vending, while controlling for variation across time and location. The calorific contribution of vending has been estimated in prior work but not with the specificity offered in Chapter 2. For example, Kocken et al. (2012) defined the healthiness of the products sold in their school vending study through dividing the product range into three categories based on their calorific content. Sales for each category were then calculated. In Chapter 2 however, each sale was linked to its associated product information, including nutritional

content, with this in turn allowing for assessing the calorific contribution of each individual sale. As mentioned earlier, advancements in vending make tracking individual sales easier, and resultantly, tracking the healthiness of each sale becomes easier too.

The second measure of vending healthiness we offered was a development of ideas flagged in prior work – that behaviour beyond the machine is equally important to measure. The health impacts of vending restrictions may be counteracted if individuals move their behaviour away from the machine, and engage in compensatory behaviours elsewhere. Three school studies have suggested that this behavioural pattern is a potentiality. In the Kocken et al. (2012) study mentioned above, the researchers suggested that the ability to leave the school grounds altered the intervention's effect (Kocken et al., 2012). In other studies, overall consumption of soft drinks has remained unchanged or even increased despite school vending restrictions, with researchers proposing that students were seeking out less healthy options off-site (Fletcher et al., 2010; Taber et al., 2014). The latter two studies used self-report measures to track consumption. Tracking sales at a nearby shop, as was done in Chapter 2, provided us with a direct measure of potential compensatory dietary behaviour, while maintaining the covert nature of the study.

In contrast to looking beyond the machine, our last measure of the healthiness of dietary behaviour during healthy vending involved looking more closely at the nature of the sales made at the machine itself. Satiation is a key dietary goal, and a healthier range may be viewed as one that is less able to satiate one's hunger (Suher et al., 2016). We measured whether consumers were motivated to counter this potential drop in satiation through buying more products. We tracked single-item and multi-item purchases using observation, and through tracking credit card sales. We believe that the latter in particular is an innovative approach that allows for covertly inferring individual behaviour in fine detail, despite having an anonymised dataset consisting only of sales data. Matches for partial credit card numbers were inferred to be recurring purchases by the same individual, and the frequency of multi-item purchases could therefore be compared across conditions. The risk of increasing repeated purchases may be a phenomena unique to the complete replacement approach, and to our knowledge, there are no other examples of work evaluating the healthiness of vending in this manner. We suggest that it is a valuable addition to future work.

In fact, the three measures described above offered the opportunity to explore the health impacts of our vending intervention in much finer detail. There is limited evidence of prior

investigations of the complete replacement approach, however we suggest that these three measures could be adopted in any future evaluations of vending interventions, to contribute in capturing the many potential behavioural consequences of intervening in consumer choice.

6.1.3. Implications for policy and practice

Our findings on the complete replacement approach have implications for existing and future policies. The Welsh Healthy Vending directive which restricted the products that could be sold within hospitals was introduced in 2008, yet empirical evaluations of such an approach, where less healthy options are completely replaced, were few and far between (Welsh Government, 2012). Our findings suggest that such an intervention can bring about significant improvements in the quality of choices made at vending machines (e.g. a 61% decrease in calories sold). While the product range we tested reduced sales by 27%, the value of the improvements to health may be seen as warrantable within healthcare settings. Of note, the reductions in sales that we observed is not a guaranteed outcome for healthy products – our findings demonstrated the importance of variability across products, suggesting that well developed product ranges could alleviate some of these losses. Investing time in the intuitive development of the product ranges made available within vending machines could produce a win both for public health, and healthcare budgets as this directive continues to be followed in Wales. Our research therefore offers unique insights to those managing the procurement and implementation of hospital vending in Wales, which could be used to improve both the health benefits and affordability of this longstanding policy intervention.

6.2. Unintended consequences of intervening within food environments

6.2.1. Compensatory behaviours

The two measures of potential compensatory behaviours discussed within the last theme were important inclusions within Chapter 2. Our intervention was much more intrusive than those tested previously. Restricting freedoms (i.e. the freedom to select a less healthy option) can cause reactance effects, with individuals showing an increased desire for the restricted option (Brehm, 1966). It is also known that more intrusive interventions are more likely to cause frustration and dissatisfaction within those subjected to them (Bos et al., 2015). Measuring whether this potential frustration and dissatisfaction was translated into unintended behavioural consequences was therefore deemed vital.

We found no evidence of an increase in compensatory behaviours during healthy vending. This is a promising pattern of results. Assuming that these two measures were sufficiently powered to find any existing effects, it is quite possible that healthy vending was achieved without producing these unintended negative consequences. If healthy vending can be implemented without causing an increase in compensatory behaviours, it could be considered to be a particularly promising health intervention.

That being said, we are acutely aware that these measures of compensatory behaviour were not comprehensive. There are several possible others that our measures were not able to capture. This limitation is one that our study and others before share. While we broke new ground in addressing the measurement of compensatory behaviours (through measuring sales beyond the machine, and taking a more granular look at sales within it), consumers would have had ample opportunity to engage in other behaviours that would have gone undetected within our research design. We had no way of determining what people chose to do after buying (or choosing not to buy) a snack at the machine.

Previous work has suggested that individuals may be sufficiently motivated to seek out less healthy options elsewhere when the opportunity to select them is removed from a specific food environment, even if this means going off-site (Fletcher et al., 2010; Kocken et al., 2012; Taber et al., 2014). Intervention success can therefore be dampened by behaviour occurring off-site. We had no way of measuring behaviour beyond the hospital setting in which we tested. This limitation will apply to most interventions of dietary behaviour – capturing all relevant dietary behaviour that might differ due to an intervention is often not practically feasible.

Others have attempted to bridge this gap through surveying self-reported behaviour, and gathering data that allows for comparing how overall consumption differed under vending restrictions (Fletcher et al., 2010; Taber et al., 2014). Although such reports are not always accurate, complementing our work with self-reported data from vending machine users may have been beneficial in painting a fuller picture of behaviour beyond the machine, and in predicting intervention longevity. However, we opted against doing so to maintain the covert nature of the investigation. In future, a more holistic approach that combines self-reported and sales-based measures could be useful in determining the extent to which an intervention achieved its health gains. While the data we collected suggested that compensatory behaviours did not occur (across

the two potential sources tested), this does not rule out the possibility that such behaviours were occurring elsewhere, in ways that we were unable to measure. When taken with prior evidence, a more global roll out of interventions that restrict unhealthy choices may be required across multiple outlets to guarantee that they produce their intended health benefits.

6.2.2. Successive choices

The importance of taking a more holistic approach and capturing behaviour beyond that which is targeted by the initial intervention was explored further in Chapter 5.

We know that people balance their dietary goals across successive choices (Chernev & Gal, 2010; Dhar & Simonson, 1999; Flores et al., 2019). When we intervene to shape dietary behaviours, we therefore have influence not only on the choices made during the intervention, but those made after exposure too. One idea of key concern is the possibility that engaging in a healthy behaviour can actually serve as licence for engaging in indulgent choices afterwards. We considered this idea to be important to explore within this thesis. If making a good, healthy choice boosts a person's sense of fulfilment for health-related goals to such an extent that they feel licenced to indulge beyond what they would typically, then health interventions could actually lead to more indulgent behaviour when looking at overall consumption. Intervention success would not just be dampened but sabotaged in such a scenario – others have found evidence of similar effects (Flores et al., 2019; Miller & Effron, 2010). In Chapter 5, we set out to directly explore how the ways in which we balance goals across successive choices might translate into behaviour, and ultimately, shapes intervention success.

We conducted four experiments to test these ideas, however methodological concerns restricted the applicability of the first and third (these limitations are discussed in detail in Chapter 5). Here, we focus on how the findings from the second and fourth experiments weave into the key themes of the thesis.

Many interventions within food choice environments aim to increase the availability of healthy options, and decrease the availability of less healthy options (e.g. Kocken et al., 2012). We firstly sought to explore how such interventions might affect successive behaviours. While a healthier environment might produce healthier choices, making such choices might ultimately serve as licence for making less healthy choices when next given the opportunity (Flores et al., 2019; Miller & Effron, 2010; Poortinga et al., 2013; Wisdom et al., 2010).

In experiment 5.E2., we manipulated the food choice environment in such a way that consumers would have to make predominantly healthy choices (while still giving them the opportunity to select some less healthy options). We found evidence to suggest that this initial healthy behaviour was more likely to be followed by less healthy behaviour in a subsequent choice scenario. Those who made predominantly healthy choices were more likely to select a less healthy snack when they were next given the opportunity to do so at the checkout.

These findings add to the body of evidence that suggests that health interventions that produce an initial healthy food choice can lead individuals to make less healthy food choices downstream (e.g. Flores et al., 2019; Wisdom et al., 2010). Consumers who make healthy choices within food choice environments that offer high availability of healthy options may counteract the benefits to health through making an unhealthy choice afterwards. While the aforementioned studies demonstrated such balancing of behaviours in product placement interventions (e.g. placing a healthy option at the start of a cafeteria selection or menu, where they are likely to be seen first), our evidence suggests that similar effects might be found in interventions of availability. This potentiality may therefore need to be accounted for in intervention design and implementation.

Of note, individuals in the high unhealthy item availability condition also balanced their behaviour across successive choices. Those that made predominantly unhealthy choices in the initial scenario were more likely to make relatively healthier choices when next given the opportunity. This finding aligns with prior literature which has suggested that individuals often balance considerations of health and indulgence/tastiness across successive food choices (Chernev & Gal, 2010; Dhar & Simonson, 1999; Flores et al., 2019).

One concern that these findings highlight is the idea that interventions that increase the availability of healthy options are unlikely to improve overall behaviour. For example, with those making an initial healthy selection being more likely to choose an unhealthy snack afterwards, and those making an initial unhealthy selection being more likely to choose a healthy snack afterwards, individuals ultimately end up making one healthy and one unhealthy choice each, regardless of condition. That being said, in our study, individuals made numerous healthy or unhealthy selections in the initial scenario, but only one selection in the second choice task. The extent to which this balancing of behaviours occurs might be dependent on the strength of the initial

behaviour. People may be more motivated to cleanse after a particularly unhealthy visit to the shop, and more likely to indulge after being particularly good and buying many healthy options. Further work is therefore needed to test the nuances of this effect.

The second section of Chapter 5 tested another nuance to these interventions which might impact intervention success. With prior work suggesting that the attribution of a behaviour can shape its influence on subsequent behaviours, we wanted to test whether the extent to which an intervention enforced a healthy choice shaped any potential licensing / balancing effects (Bradley-Geist et al., 2010; Finkelstein & Fishbach, 2010). Prior work has produced conflicting findings. While Bradley-Geist et al. (2010) found evidence to suggest that free choices are more likely to produce licensing effects (as people feel that they have taken positive action, and are now licensed to do the opposite), Finkelstein and Fishbach (2010) suggested that forced choices are more likely to produce licensing effects (as individuals have made positive progress without commitment, reducing the motivation to act consistently in future).

A trend in the data from experiment E5.4. gives greater support to Bradley-Geist et al.'s (2010) account. Licensing effects may be more likely to occur when the initial healthy behaviour can be attributed to the self (not an external influence). Individuals who freely chose to sample a healthy drink in this study were more likely to select an indulgent chocolate bar in a subsequent choice. Those that were forced to sample the same drink were more likely to select a smaller chocolate treat. It must be noted that this result was not statistically significant ($p = 0.07$). The reliance on free choices limited our sample size and statistical power. However, the odds ratio (8.64) for this effect might serve as justification for further exploration of the research question, and establishing whether the effect replicates.

Nevertheless, the trend in our data does serve to suggest that individuals may have a tendency to reward themselves when they have made healthier choices, to a greater degree than they would if others had a say in this choice. With that in mind, it could be the case that having some level of awareness that another extrinsic agent is involved in the decision process could actually protect against such licensing effects. This too should be explored further in future work, particularly as we found evidence of the potential detriments of highlighting external influences within Chapter 3.

6.2.3. Backfire effects

Our second vending study (reported in Chapter 3) demonstrated that highlighting an external influence within a choice environment can produce counterintuitive effects. In this study, we tested whether adding credible sources to health labels boosts their effects and leads to healthier purchasing. Prior studies have suggested that health labels produce heterogeneous and weak effects (Grech & Allman-Farinelli, 2015; van't Riet, 2013; Wagner et al, 2015), therefore we explored whether they could be strengthened by capitalizing on heuristic processing. Credible sources hold greater influence, and messaging that comes from a credible source can be used to shape consumer choices (Atkinson & Rosenthal, 2014; Boulding & Kirmani, 1993; Dong, 2015; Feunekes et al., 2008; Grewal et al., 1994; Hawley et al., 2013; Kirmani & Rao, 2000; Michie et al., 2013; Parkinson, 1975; Rupprecht et al., 2020).

Our aim for this intervention was to test whether presenting healthy products with high source credibility health labels (NHS endorsement) would boost their sales in two hospital vending machines. We found no such effect – sales of healthy products were left unchanged in the presence of labels with and without credible sources. In fact, unhealthy sales in one machine (in A&E) were boosted when healthy products were labelled with an NHS endorsement. Our intervention backfired.

We proposed two possible explanations for this effect, with the first being psychological reactance (Brehm, 1966). Highlighting that the NHS suggested a certain course of action over another could have been interpreted as a paternalistic violation of freedom - objections to this violation could have led to individuals resultantly doing the opposite to what was suggested (Brehm, 1966; Eagle et al., 2004; Kleef & Dagevos, 2015). This could have been more so true within A&E where individuals were likely waiting for treatment by the NHS while in pain or distress. Reactance may have been more likely to occur in the A&E machine, where stress levels could be higher, waiting times could be long and levels of discomfort high. Objecting to NHS messaging could be seen as one way to react against those responsible for your situation.

Our second explanation was that the mere presence of the high credibility NHS labels and healthy options within the choice set was enough to fulfil consumers' health-related goals, with consumers in turn feeling more justified in making less healthy choices. Prior work has suggested that the presence of a healthier option within a selection of less healthy options can ultimately

boost the selection of unhealthy options (Wilcox et al., 2009). Merely being exposed to healthy options could satisfy consumer health goals to a sufficient extent for them to feel justified in making less healthy choices. The strong NHS branding on the labels may have boosted this effect in our study.

The difference in effects between the two machines highlights the importance of understanding the context in which in intervention will be implemented. The two locations where the trial occurred were unique. A&E is a high stress environment, where people are idle for long periods of time - consumers are captive here. Whereas the reception area had minimal seating and high passing footfall. Those in A&E may have had more time to observe and use the labels than those in the reception area. Furthermore, stress has been shown to increase the reliance on heuristics such as source credibility (Schaeffer, 1989) – those in A&E may have been more likely to take note of the NHS messaging on the labels.

Whether this effect occurred due to reactance or vicarious goal fulfilment, and the reasons for differing effects across machines cannot be disentangled from our findings. However, Chapter 3 provides another important reminder of the ways in which health interventions can produce counterintuitive effects dependent on the context in which they are implemented. Great care must be taken to ensure that other characteristics of the environment in which an intervention is implemented, that could react with the psychology of the people within them, are accounted for within intervention designs.

6.2.4. Implications for policy and practice

Firstly, including measures of behaviour beyond the main outcomes of an intervention is key in evaluating success. While we attempted to do so in our vending study in Chapter 2, we did not measure behaviour beyond the hospital environment. Our findings in Chapter 5 could be seen to suggest that behaviours beyond the machine, that occur after the selection of a healthy product, could be important to measure. We propose that a more holistic approach should be adopted, with policies maximising the rollout of availability interventions that make healthy food more accessible, and practitioners including measures of behaviours occurring in the wider food environment as they determine intervention success.

Secondly, while further research is needed, the external attribution of healthy behaviour may prevent licensing effects from occurring. Policymakers and practitioners should consider the

extent to which their interventions overtly highlight their influence on consumer choice, and how this might translate within successive choices.

Lastly, policymakers and practitioners should seek to produce interventions that withstand variation across locations. As we saw in Chapter 3, health labels can have differing effects dependent on where they are implemented. The experiences of people within the food environments being manipulated, and the psychology associated with these experiences, should be considered thoroughly before implementing any changes.

6.3. Rethinking healthy labelling interventions

Prior literature has suggested that health labels have limited and mixed impacts when used to promote healthier choices (Grech & Allman-Farinelli, 2015; van't Riet, 2013), and our efforts to strengthen their effects in Chapter 3 may have done more harm than good. However, we argue that there is still much value to be gained from exploring their utility. The clearest reason would be their existing acceptance as an intervention method. Practitioners value their ease of use and affordability. Further developing their effectiveness would be valuable as they continue to be applied in practice. As such, widening our understanding of the ways in which consumers use them, and the contexts in which they hold most influence is useful. The studies described in Chapters 3 and 4 attempted to fill some of these gaps. We discuss the main implications of our findings within this theme.

Firstly, we found no evidence to suggest that health labels (with or without messaging that played to the source credibility heuristic) can increase sales of healthy products. As described in section 6.2.3., sales of healthy products were left unchanged in our intervention in Chapter 3. While there are examples in prior work of health labels producing changes in healthy sales (Bialkova et al., 2016; French et al., 2001; Kocken et al., 2012), there are equally as many examples where their effects are limited or absent (Borgmeier & Westenhoefer, 2009; Grech & Allman-Farinelli, 2015; van't Riet, 2013; Wagner et al., 2015). Our findings contribute to the latter body of work. Others before have highlighted how the heterogeneity of labels tested may contribute to the heterogeneity of the findings within this space (Grech & Allman-Farinelli, 2015). In addition, the contexts in which labels are tested vary from study to study, which in turn contributes to producing varying

findings. As already discussed, the backfire effect in Chapter 3 demonstrated how the same labels can shape behaviour in different ways in different spaces.

Secondly, we found no evidence to suggest that health labels (both direct categorizations of products as 'Healthy' and subtler naturalistic labels) alter evaluations of known healthy products in our experiments in Chapter 4. Across several studies, price, taste and health ratings for healthy products remained consistent when comparing no label and labelled conditions. Prior work has suggested that adding health information is unlikely to shape evaluations of known healthy products (Martins et al., 1997; McFarlane & Pliner, 1997; Vizcaíno & Velasco, 2019). Although our non-significant results cannot be taken as evidence that evaluations of familiar products were not influenced at all, our findings are in alignment with the conclusions of these previous works. When the healthiness of a product is known, confirming this information with a health label is unlikely to alter product categorization, and in turn any associated feature evaluations. Our studies cannot rule out the possibility that labels shape product liking and selection, however with this work, we focused on establishing what health labels communicate, and how this shapes consumer perceptions of product features. In that respect, we argue that health labels are unlikely to shape evaluations of product features when the labelled products are already known to be healthy.

While health labels may not help consumer identify healthy products when the options available are already familiar, our work does suggest that they could serve a useful function under conditions of uncertainty. Research on the psychology of categorization has shown that individuals rely on category labels to guide their feature evaluations under conditions of uncertainty (Yamauchi & Yu, 2008). When novel objects are presented with a category label, feature evaluations begin to resemble those made for other members of the same category. In line with this idea, we found that labelling an unfamiliar product as healthy caused consumer evaluations of price to align with those made for known healthy products. This suggests that in these uncertain circumstances, labels helped consumers categorize unfamiliar products as healthy. For foods of ambiguous healthiness, health labels can resolve some of this uncertainty about category membership, and consumer evaluations begin to resemble those made for known healthy products. Of note, we did not find such effects using subtler health labels that highlight features of healthy options while avoiding overtly categorizing products as 'healthy' ones. Explicitly highlighting that a product belonged to the 'healthy' category appeared to be key.

Labels that categorize new products as healthy might therefore be useful in helping consumers identify novel healthy options. Using healthy category labels could prove useful in signposting individuals to healthier options when they are first introduced to market. That being said, caution should be taken in ensuring that this does not in turn activate damaging preconceptions about healthy options. Prior work has highlighted the existence of preconceptions such as the healthy = expensive bias (Haws et al., 2017), the healthy = less tasty bias (Raghunathan et al., 2006), and the healthy = less satiating bias (Suher et al., 2016). In experiment E4.1. we saw that ambiguous products were thought to be more expensive when labelled as healthy. Measures taken to highlight new healthy products should be accompanied with measures that counter the activation of these perceptions at point of purchase e.g. through introducing products at discounted prices.

Our findings from experiment E4.4. may indicate that we should reconsider the function of health labels. Instead of considering them solely as ways to highlight the benefits of healthier options, it may also be useful to explore how they can be used to highlight the ways in which less healthy options are lacking.

In experiment E4.4., using health labels to highlight positive healthy features of healthy options caused consumers to rate less healthy options as even more unhealthy. These unhealthy products were of course left unlabelled. We know from the study of language that people possess the ability to identify when the absence of information is information in and of itself (Garcés-Báez & López-López, 2020; Grice, 1989). Choosing to omit information can imply that there was no sufficient reason for providing it. As such, omitting comparable information for unhealthy options creates contrast, highlighting the absence of the healthy features referred to on the health labels. In study E4.4., this resulted in unhealthy products being viewed as even more unhealthy.

We propose that the absence of health information may hold greater potential to influence evaluations than its presence. We are hardwired to give negative information greater weight than comparable positive information (Baumeister et al., 2001; Ito et al., 1998; Kanouse & Hanson, 1972). Omitting health information for some products, while including it for others, highlights the ways in which the unlabelled product is lacking. The contrast created between healthy and unhealthy products as a result of this effect might help give healthy options a competitive edge within consumer choices. That being said, the label absence effect was unique to unhealthy

products within our studies, and we only tested it within an environment where the unhealthy, unlabelled options were within the minority in the choice set. Future work could expand on these findings to explore when label absence effects might occur, and the ways in which they could be harnessed to promote healthier choices.

6.3.1. Implications for policy and practice

We suggest that health labels may be most valuable as a means of introducing unfamiliar healthy products to the market. We consistently found that health labels were ineffective as a means of influencing evaluations and the purchasing of familiar healthy products. Much of prior work has shown that their effects in such scenarios are limited (Grech & Allman-Farinelli, 2015; van't Riet, 2013). Yet our participants used health labels to shape their evaluations of unfamiliar products (e.g. experiment 4.E1.).

Guidance could be prepared by policymakers and practitioners alike to suggest best practice when introducing new healthy products. This could include signposting consumers to novel healthy products with health labels, but also tackling some of the negative preconceptions that bias consumers against healthier options (e.g. that they are more expensive, less tasty, and less satiating (Haws et al., 2017; Raghunathan et al., 2006; Suher et al., 2016)). Introducing healthy products at discounted prices, and providing opportunities to taste new products could be effective. Furthermore, based on our findings on label absence, we propose that labels might be most powerful when they create contrasts between healthy and less healthy options. Using positive labels that counter negative preconceptions about healthy options could make less healthy options less attractive in comparison.

There is a growing body of work suggesting this may be the way forward for health labelling. Describing healthy options as one would describe more indulgent options has proven to be an effective way of increasing the proportion of healthy sales made (Turnwald et al., 2017, 2019). When marketed using the same methods as are used for less healthy options, healthier foods may gain the upper hand. If described using exciting language that highlights how tasty and filling these options are, perceptions of tastiness and potential for satiation could reach a balance across healthy and unhealthy options. If this were the case, it is possible that the healthiness of more nutritious options could eventually become the trump card that makes them the more attractive offering.

6.4. Broader considerations for future work

6.4.1. A healthy and sustainable food system

While developing more effective methods of influencing our dietary behaviours so that they become better for our health is urgently needed, there is growing recognition of the fact that our dietary behaviours must also become better for the environment (Bhunnoo & Poppy, 2020). Future dietary interventions may need to be evaluated not just for their health impacts, but for their environmental impacts too. While the findings from this thesis add to our knowledge base of interventions that aim to improve health, their impacts might be evaluated differently if we were also to consider the ways in which they affected the environment.

For example, while our complete replacement vending study made sales healthier, we had no measure of food waste. Achieving a healthier more sustainable food system will demand evaluations that encompass both kinds of impacts. The dual goal of achieving healthier, more sustainable diets might also cause a shift in the kinds of messages we present alongside foods. In future, it is possible that health labels will be presented alongside environmental impact labels that provide consumers with information about a product's food miles, or the carbon, water and nitrogen footprints of their choices (Caputo, Nayga, & Scarpa, 2013; Leach et al., 2016). Exploring what messages consumers prioritise, and the ways in which these two goals and message types interact and differentially impact choices will be of particular importance.

In the same way that we borrowed knowledge from the field of environmental psychology to explore spillover effects in Chapter 5, efforts to produce a healthier and more sustainable food system may require a collaborative approach which combines knowledge from both fields.

6.4.2. Food security

Both the healthiness and sustainability of diets hold influence over food security (Friel, 2010). Food insecurity is characterised by having inconsistent access to sufficient, nutritious food to maintain an active and healthy lifestyle (Brown et al., 2019; FAO, IFAD, UNICEF, WFP, & WHO, 2019), and it is a problem of growing concern within the UK and beyond (Taylor & Loopstra, 2016).

While the interventions described within this thesis attempt to increase the opportunity and motivation for individuals to make healthier dietary choices, they only scratch the surface of the

improvements in capability, opportunity and motivation needed to achieve real dietary behaviour change at a societal and food system level. Obtaining any food is a challenge for large segments of society who are food insecure (Taylor & Loopstra, 2016).

We have mentioned the preconception that healthy choices are more expensive choices several times within this thesis. These perceptions are not unsubstantiated. Across the globe, diets providing adequate energy can be much more affordably obtained than diets providing adequate nutrition (Bai, Alemu, Block, Headey, & Masters, 2021). Cost is a key determinant of food choice within those experiencing food insecurity (Puddephatt et al., 2020). Healthier diets are less affordable, and in turn less accessible for those experiencing insecurity.

While our work provides valuable insights for developing interventions that make healthy choices easier within the specific environments where we make our food choices (like supermarkets, cafes or vending machines), there is a need for much wider system level reform to ensure that everyone making choices within these environments can approach them on an equitable level.

6.5. Conclusion

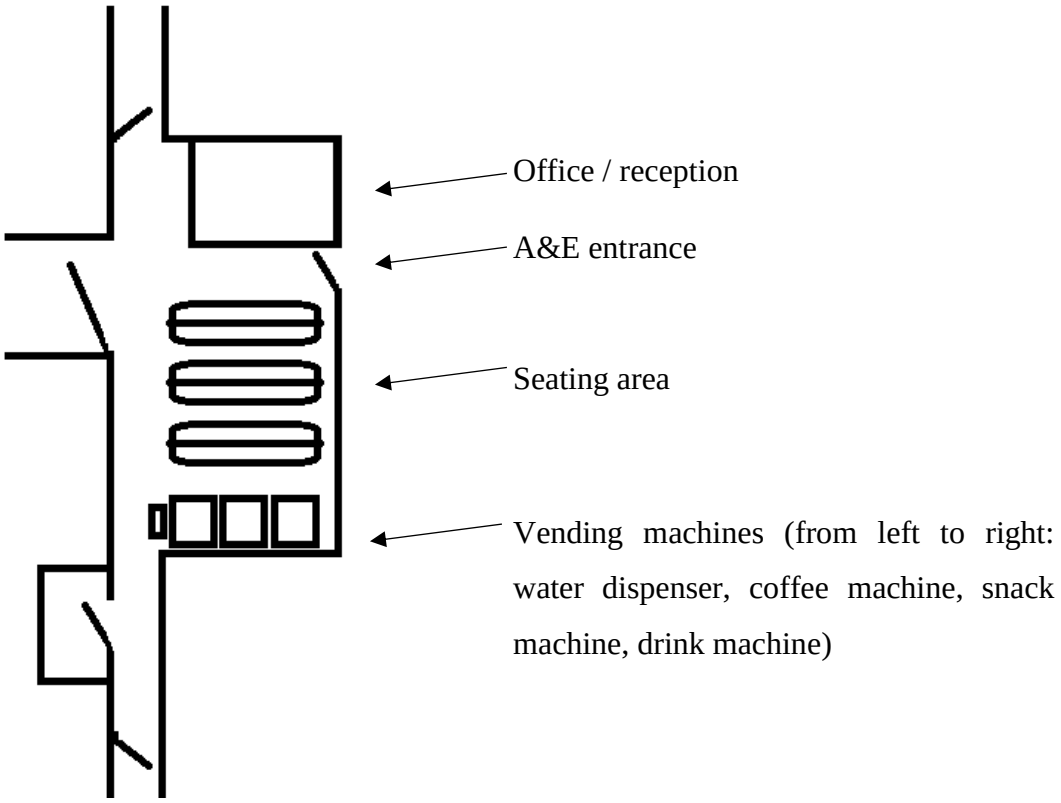
Throughout this thesis, we aimed to use knowledge from psychology to inform interventions that try to make healthier choices easier choices for consumers with an obesogenic food environment. While systemic change is needed to transform our food environment for the better, ensuring that interventions are designed with psychology in mind will help boost their effectiveness. We have provided novel insights into potential interventions and means of evaluating them (e.g. Chapter 2), shed further light on the circumstances in which health labels may be most effective in influencing choice (Chapters 3 & 4), and brought attention to several potential unintended behavioural consequences of interventions that shape dietary behaviours (Chapters 2, 3 & 5). Healthy, nutritious diets should be accessible to all. Within a food environment that makes this more and more difficult to achieve, it is vital that we give people a helping hand in making healthier choices wherever we can. We hope that the findings reported within this thesis can play a small role in contributing to achieve this goal.

7. Appendices

Appendix 1. Experiments 2.E1. & 3.E1. Hospital floor plan

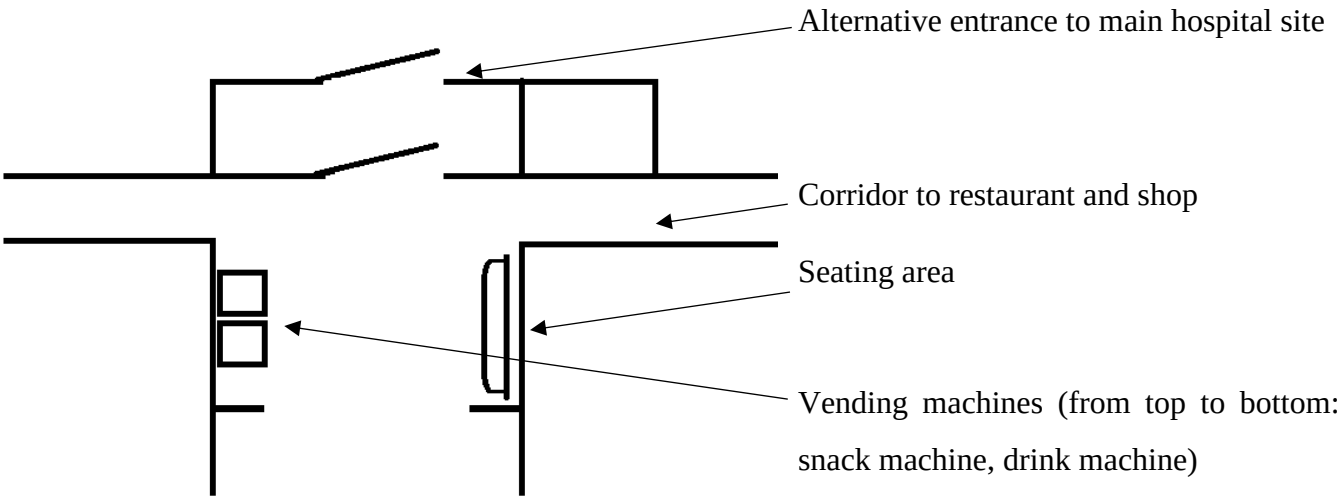
The A&E unit was isolated from all other sections of the hospital, with its own unique entrance. An alternative entrance nearby could be used to enter the main hospital site.

Floor plan within A&E:



The reception was the main entrance to the maternity area of the hospital, but also provided alternative access to the main hospital site. A restaurant and shop could be accessed within approximately 25 metres of the vending machines.

Floor plan within reception:



Appendix 2. Experiment 2.E1. Vending machine layout.

Healthy Vending Layout:

#11 Walkers Baked Cheese + Onion		#13 Walkers Baked Cheese + Onion		#15 Walkers Baked Salt + Vinegar		#17 Walkers Baked Ready Salted	
#21 French Fries Salt + Vinegar		#23 French Fries Worcester Sauce		#25 French Fries Ready Salted		#27 French Fries Ready Salted	
#31 Popchips Sour Cream+ Onion		#33 Popchips Sour Cream+ Onion		#35 Popchips Sea Salt + Vinegar		#37 Popchips Sea Salt + Vinegar	
#41 Popchips Ridges Smoky Bacon		#43 Popchips Ridges Smoky Bacon		#45 Popchips BBQ		#47 Popchips BBQ	
#50 Polo S/F	#51 Polo S/F	#52 Nakd Peanut Delight	#53 Nakd Bakewell Tart	#54 Nakd Berry Delight	#55 Nakd Berry Delight	#56 Go Ahead Crispy Slices	#57 Go Ahead Crispy Slices
#60 Nakd Cashew Cookie	#61 Nakd Cashew Cookie	#62 Nakd Cocoa + Orange	#63 Nakd Cocoa + Orange	#64 Fruit + Nut Grab Bag	#65 Fruit + Nut Grab Bag	#66 Go Ahead Yogurt Breaks	#67 Go Ahead Yogurt Breaks

Unhealthy Vending Layout

#11 Tyrrell's Sea Salted		#13 Tyrrell's Sea Salted		#15 Tyrrell's Sea Salt+Vinegar		#17 Tyrrell's Sea Salt+Vinegar	
#21 Mini Cheddars BBQ		#23 Mini Cheddars Original		#25 Quavers Cheese		#27 Quavers Cheese	
#31 Hula Hoops BBQ Beef		#33 Hula Hoops BBQ Beef		#35 McCoy's Flame Grilled Steak		#37 McCoy's Flame Grilled Steak	
#41 Tyrrell's Mature Cheddar		#43 Tyrrell's Mature Cheddar		#45 Tyrrell's Roast Chicken		#47 Tyrrell's Roast Chicken	
#50 Galaxy Caramel	#51 Galaxy Smooth Milk	#52 Kit Kat	#53 Kit Kat	#50 Twix	#51 Twix	#52 Maltesers	#53 Polo Mints
#60 Bounty	#61 Dairy Milk	#62 M&Ms Chocolate	#63 M&Ms Peanut	#60 Snickers	#61 Mars	#62 Bakewell Flapjack	#63 Chocolate Flapjack

Appendix 3. Experiments 2.E1. & 3.E1. Nutritional guidelines for vending.

Welsh Government's healthy vending directive guidelines were used to determine which products were to be classified as healthy or unhealthy. All criteria discussed below come from the Welsh Government document detailing these guidelines (Welsh Government, 2012). The guidelines indicate that all vending snacks sold in Welsh hospitals must be the healthier option within its product range. This appendix serves as a summary of key components of the guidelines that have relevance to our study.

Products were assessed against specific criteria detailed in the guidelines. Products were determined to have high levels of a nutrient if its value was greater than those listed in the table below:

Highest level of each nutrient allowed by the guidelines per product.

Nutrient	Highest level allowed per 100g (g)	Highest level allowed per portion (g)
Fat	20	21
Saturated Fat	5	6
Added sugars	12.5	15
Salt	1.5	2.4

The guidelines note that high levels of one or more of the nutrients are permitted for certain food categories, to allow more flexibility in sourcing healthier alternatives. Details of the product categories sold in the experiment with specific exemptions are available below:

- *Biscuits and crackers e*.g. Plain biscuits, crackers, rice cakes, oatcakes. Criteria: Can be vended even if one of the four nutrients is classed as high.
- *Crisps and savoury snacks e*.g. Fried potato products, baked crisps, pretzels. Criteria: High for salt permitted.
- *Nuts and seeds e*.g. Coated/roasted nut and seed snacks, and those without added salt/sugar. Criteria: High for fat and/or saturated fat.

Appendix 4. Experiment 2.E1. & 3.E1. Nutritional information

Tables show totals per item for fat, saturated fat, carbohydrates, sugars and sodium.

Healthy Range:

Product number	Product	Kcals	Fat (g)	Saturated fat (g)	Carbohydrate (g)	Sugars (g)	Sodium (g)
1	French Fries Ready Salted	91	3.4	0.3	13.7	0.2	0.53
2	French Fries Salt & Vinegar	92	3.4	0.3	13.9	0.3	0.48
3	French Fries Worcester Sauce	93	3.5	0.4	13.5	0.3	0.42
4	Fruit Nut Grab Bag	242	17.9	3.0	16.9	12.1	0.03
5	Go Ahead Crispy Slice Apple	165	3.0	-	32.7	13.8	0.27
6	GoAhead Yogurt Breaks Forest Fruit	142	3.6	1.6	25.8	12.4	0.18
7	Nakd Berry Delight	135	5.2	1.0	18.2	16.6	0.10
8	Nakd Bakewell Tart	137	5.9	1.2	17.6	16	0.10
9	Nakd Cashew Cookie	143	8.2	1.6	16.1	13.7	0.10
10	Nakd Cocoa Orange	145	7.0	1.5	15.8	13.6	0.10
11	Nakd Peanut Delight	149	7.5	1.4	14.6	13.6	0.20
12	Polo Sugar Free	78	0	0	32.9	0.1	< 0.01
13	Popchips Smoky Bacon	99	3.5	0.3	15.0	0.8	0.34
14	Popchips BBQ	97	3.6	0.3	14.0	2.1	0.49
15	Popchips Sour Cream & Onion	95	3.4	0.4	15.0	1	0.45
16	Popchips Salt & Vinegar	95	3.3	0.3	15.0	0.6	0.50
17	Walkers Baked Cheese & Onion	163	5.1	0.5	25.7	2.8	0.35
18	Walkers Baked Ready Salted	163	5.1	0.5	25.9	2.2	0.44
19	Walkers Baked Salt & Vinegar	162	5.0	0.5	25.5	2.4	0.30

Unhealthy range:

Product number	Product	Kcals	Fat (g)	Saturated fat (g)	Carbohydrate (g)	Sugars (g)	Sodium (g)
20	Bakewell Flapjack	450	21.6	12.0	57.5	28.9	0.45
21	Bounty	278	14.6	12.1	33.6	27.5	0.14
22	Chocolate Flapjack	438	20.8	9.5	56.4	18.2	0.03
23	Cadbury Dairy Milk	240	14.0	8.3	25.7	25.2	0.06
24	Galaxy Caramel	232	11.0	7.0	30.0	27.0	0.08
25	Galaxy Smooth Milk	229	14.0	8.0	23.0	23.0	0.05
26	Hula Hoops BBQ Beef	172	8.8	0.9	21.0	0.5	0.80
27	Kit Kat	209	10.2	5.7	26.1	21.3	0.10
28	Maltesers	186	9.1	5.6	23.0	19.0	0.17
29	Mars	230	8.6	4.2	35.3	30.5	0.20
30	McCoy's Flame Grilled Steak	250	15.0	1.3	25.0	1.1	0.71
31	Mini Cheddars BBQ	262	15.0	6.0	26.0	2.0	0.32
32	Mini Cheddars Original	256	14.6	5.8	25.0	2.6	1.20
33	M&M's Milk Chocolate	218	9.2	5.7	31.0	30.0	0.05
34	M&M's Peanut	230	11.4	4.6	26.6	24.1	0.04
35	Polo	137	-	-	33.4	32.5	<0.01
36	Quavers	182	10.0	0.9	21.0	0.9	0.73
37	Snickers	245	13.4	4.7	26.2	21.7	0.21
38	Twix	248	12	7.0	32.2	24.4	0.22
39	Tyrrells Mature Cheddar & Chives	179	9.2	1.1	21.5	1.2	0.50
40	Tyrrells Roast Chicken	180	9.2	1.1	21.0	2.3	0.40
41	Tyrrells Sea Salt	196	10.9	1.2	20.7	0.2	0.32
42	Tyrrells Sea Salt & Cider Vinegar	195	10.4	1.1	22.4	0.7	0.70

Appendix 5. Experiments 2.E1. & 3.E1. Product cost and profitability

Tables show wholesale cost and profit margins for each product on offer. All prices are in British Pound Sterling (GBP). The purchase price for each product was 80p in Study 1, and £1.00 in Study 2.

Healthy Range:

Product number	Product	Wholesale cost per item (£) Both studies	Profit margin per item (£) Study 1	Profit margin per item (£) Study 2
1	French Fries Ready Salted	0.40	0.40	0.60
2	French Fries Salt & Vinegar	0.40	0.40	0.60
3	French Fries Worcester Sauce	0.40	0.40	0.60
4	Fruit Nut Grab Bag	0.42	0.38	0.58
5	Go Ahead Crispy Slice Apple	0.44	0.36	0.56
6	GoAhead Yogurt Breaks Forest Fruit	0.44	0.36	0.56
7	Nakd Berry Delight	0.45	0.35	0.55
8	Nakd Bakewell Tart	0.45	0.35	0.55
9	Nakd Cashew Cookie	0.45	0.35	0.55
10	Nakd Cocoa Orange	0.45	0.35	0.55
11	Nakd Peanut Delight	0.45	0.35	0.55
12	Polo Sugar Free	0.38	0.42	0.62
13	Popchips Smoky Bacon	0.47	0.33	0.53
14	Popchips BBQ	0.47	0.33	0.53
15	Popchips Sour Cream & Onion	0.47	0.33	0.53
16	Popchips Salt & Vinegar	0.47	0.33	0.53
17	Walkers Baked Cheese & Onion	0.45	0.35	0.55
18	Walkers Baked Ready Salted	0.45	0.35	0.55
19	Walkers Baked Salt & Vinegar	0.45	0.35	0.55

Unhealthy range

Product number	Product	Wholesale cost per item (£) Both studies	Profit margin per item (£) Study 1	Profit margin per item (£) Study 2
20	Bakewell Flapjack	0.42	0.38	0.58
21	Bounty	0.46	0.34	0.54
22	Chocolate Flapjack	0.42	0.38	0.58
23	Cadbury Dairy Milk	0.48	0.32	0.53
24	Galaxy Caramel	0.50	0.30	0.50
25	Galaxy Smooth Milk	0.50	0.30	0.50
26	Hula Hoops BBQ Beef	0.30	0.50	0.70
27	Kit Kat	0.44	0.36	0.56
28	Maltesers	0.48	0.32	0.52
29	Mars	0.43	0.37	0.57
30	McCoy's Flame Grilled Steak	0.44	0.36	0.56
31	Mini Cheddars BBQ	0.40	0.40	0.60
32	Mini Cheddars Original	0.40	0.40	0.60
33	M&M's Milk Chocolate	0.51	0.29	0.49
34	M&M's Peanut	0.51	0.29	0.49
35	Polo	0.35	0.45	0.65
36	Quavers	0.42	0.38	0.58
37	Snickers	0.43	0.37	0.57
38	Twix	0.41	0.39	0.59
39	Tyrrells Mature Cheddar & Chives	0.43	0.37	0.57
40	Tyrrells Roast Chicken	0.43	0.37	0.57
41	Tyrrells Sea Salt	0.43	0.37	0.57
42	Tyrrells Sea Salt & Cider Vinegar	0.43	0.37	0.57

Appendix 6. Experiment 3.E1. Vending machine layout

#11 Walkers Baked Cheese + Onion		#13 Walkers Baked Cheese + Onion		#15 French Fries Ready Salted		#17 French Fries Ready Salted	
#21 Popchips Ridges Smoky Bacon		#23 Popchips Ridges Smoky Bacon		#25 Popchips Sour Cream+ Onion		#27 Popchips BBQ	
#31 McCoy's Flame Grilled Steak		#33 McCoy's Flame Grilled Steak		#35 Hula Hoops BBQ Beef		#37 Hula Hoops BBQ Beef	
#41 Quavers		#43 Quavers		#45 Tyrrells Roast Chicken		#47 Tyrrells Sea Salt & Cider Vinegar	
#50 Polo S/F	#51 Nakd Berry Delight	#52 Nakd Peanut Delight	#53 Nakd Cocoa Orange	#54 Go Ahead Yogurt Breaks	#55 Go Ahead Yogurt Breaks	#56 Go Ahead Crispy Slices	#57 Go Ahead Crispy Slices
#60 KitKat	#61 KitKat	#62 Twix	#63 Twix	#64 Galaxy Smooth Milk	#65 Galaxy Caramel	#66 Bakewell Flapjack	#67 Chocolate Flapjack

Appendix 7. Experiment 3.E1. Health labels

Low source credibility label:

High source credibility label:

Appendix 8. Experiment 3.E1. Further analysis

Table 1. Outputs from omnibus mixed model analysis

Effect	**β**	**SE**	**t**	***p***
Health value	-4.321	0.968	-4.462	< .0001
Machine	2.552	0.896	2.849	.009
Labelling:				
No label v Low credibility label	0.574	0.662	0.868	.403
No label v High credibility label	1.453	0.774	1.878	.078
Low credibility label v High credibility label	-0.879	0.775	-1.134	.273
Health value x Machine	-0.814	1.091	-0.746	.463
Health value x Labelling:				
No label v Low credibility label	0.044	0.823	0.053	.958
No label v High credibility label	-1.423	0.984	-1.447	.161
Low credibility label v High credibility label	1.467	0.98	1.498	.147
Machine x Labelling:				
No label v Low credibility label	-0.692	1.183	-0.585	.564
No label v High credibility label	-3.639	1.078	-3.376	.003
Low credibility label v High credibility label	2.948	1.305	2.26	.032
Health value x Machine x Labelling:				
No label v Low credibility label	-0.196	1.392	-0.141	.889
No label v High credibility label	3.465	1.303	2.659	.013
Low credibility label v High credibility label	-3.661	1.518	-2.412	.023

As a further check on the analysis we ran separate analyses on each machine (Tables 2 & 3). Consistent with the omnibus analysis, effects of the high credibility label were visible in the A&E machine but not in the reception machine. In the A&E machine, the pairwise interaction between health value and the low credibility label and the high credibility label was significant, β = 2.24, SE = 1.01, t = -2.22, p = .039, and that between the high credibility label and no label marginally so, β = 1.79, SE = 0.98, t = 1.84, p = .081, but there was no significant difference between the low credibility label and no label conditions, β = -0.44, SE = 1.06, t = -0.42, p = .68 (see Table 2). In the reception machine, no significant pairwise interactions were observed, ps > .12 (see Table 3).

Table 2. Outputs from A&E machine mixed model analysis.

Effect	**β**	**SE**	**t**	***p***
Health value	-5.050	1.252	-4.033	< .0001
Labelling:				
No label v Low credibility label	0.127	0.930	0.137	.893
No label v High credibility label	-1.964	0.881	-2.228	.044
Low credibility label v High credibility label	2.091	0.910	2.298	.037
Health value x Labelling:				
No label v Low credibility label	-0.442	1.064	-0.415	.683
No label v High credibility label	1.794	0.976	1.839	.081
Low credibility label v High credibility label	-2.235	1.008	-2.218	.039

Table 3. Outputs from reception machine mixed model analysis.

Effect	**β**	**SE**	**t**	***p***
Health value	-4.344	0.960	-4.525	.0001
Labelling:				
No label v Low credibility label	0.212	0.734	0.289	.778
No label v High credibility label	1.256	0.835	1.505	.152
Low credibility label v High credibility label	-1.044	0.808	-1.292	.216
Health value x Labelling:				
No label v Low credibility label	0.324	0.824	0.393	.699
No label v High credibility label	-1.233	0.996	-1.239	.230
Low credibility label v High credibility label	1.557	0.961	1.621	.121

Appendix 9. Experiments 4.E1-6. Products

Healthy Crisps:

Healthy Bars:

Healthy Nibbles:

Unhealthy Crisps:

Unhealthy Bars:

Unhealthy Nibbles:

Ambiguous Crisps:

Ambiguous Bars:

Ambiguous Nibbles:

Price Control

Low cost

High cost

Health control (Experiments 4.E4-6)

Least unhealthy

Least healthy

Appendix 10. Experiments 4.E1-6. Labels, settings and contexts

Example of healthy label:

Example of unhealthy label:

Example of no label:

Examples from healthy vending machine setting and context.

Other settings & contexts:

Healthy shop

Unhealthy shop

Unhealthy vending machine

Appendix 11. Experiments 4.E1-6. Naturalistic labels

Appendix 12. Experiments 5.E1-3. Healthy and unhealthy shop products

Healthy shop

Healthier products:

Apple Crisps

Orange

Carrot Sticks

Dried Mango Slices

Fruit, Nut and Seed Mix

Blueberry Oatmeal Bar

Apple and Strawberry Bar

Planters Nut Mix

Apple Cinnamon Chia Bar

Less healthy products:

Galaxy Caramel Bar

KitKat Bar

Mars Bar

Unhealthy shop

Less healthy products:

Galaxy Caramel Bar

KitKat Bar

Mars Bar

McCoys Crisps

Doritos Crisps

Hula Hoops Crisps

Maltesers

Rowntrees Randoms

McVities Chocolate Biscuit Nibbles

Healthier products:

Apple Crisps

Dried Mango Slices

Fruit, Nut and Seed Mix

Appendix 13. Experiment 5.E1. Products available at checkout

Popchips Mature Cheddar & Onion

(95 calories)

Popchips Sea Salt & Vinegar

(95 calories)

Walkers Oven Baked Cheese & Onion

(163 calories)

Walkers Baked Salt & Vinegar

(163 calories)

Walkers Cheese & Onion

(247 calories)

Walkers Salt & Vinegar

(260 calories)

Appendix 14. Experiment 5.E1. Questionnaire

Manipulation check questions:

Think back to when you were choosing your initial 9 items.

1. How healthy were these products?

(1 Unhealthy – 7 Healthy)

2. How satisfied were you with the selection of products available to choose from?

(1 Very dissatisfied – 7 Very satisfied)

Health consciousness:

1. When shopping for food, how much emphasis do you place on health?

(1 None at all – 7 A great deal)

2. It is important to be mindful of what you eat

(1 Strongly disagree – 7 Strongly Agree)

3. I intend to have a healthy diet

(1 Strongly disagree – 7 Strongly Agree)

4. Making healthy choices is important to me

(1 Strongly disagree – 7 Strongly Agree)

Questionnaire findings:

Health rating for initial choice set

In line with the findings of the manipulation check, those in the healthy shop condition rated the initial product range as significantly healthier than those in the regular shop condition, $F(1,54) = 25.25$, $p < .001$, $\eta_p^2 = .32$. There was however no main effect of second snack selection, $F(2,54) = 1.25$, $p = .29$, $\eta_p^2 = .04$, nor was there a significant interaction between shop condition and second snack choice, $F(2,54) = 2.21$, $p = .12$, $\eta_p^2 = .08$.

Healthiness rating for initial choice set across conditions and second snack choices

Shop condition	Second snack choice		
	Low calorie	Medium calorie	High calorie
Healthy	M = 4.15; SD = 1.46	M = 4.08; SD = 1.31	M = 2.80; SD = .84
Regular	M = 2.15; SD = .80	M = 1.89; SD = .78	M = 2.25; SD = 1.28

Satisfaction with initial choice set

Satisfaction with initial choice set did not differ based on shop condition or second snack choice. No significant differences were documented between the healthy and unhealthy shop conditions, $F(1,54) = .22$, $p = .64$, $\eta_p^2 = .004$, nor between the second snack choices, $F(2,54) = .56$, $p = .58$, $\eta_p^2 = .02$. Likewise, there was no significant interaction between shop condition and second snack choice, $F(2,54) = .06$, $p = .94$, $\eta_p^2 = .002$.

Satisfaction with initial choice set across conditions and second snack choices

Shop condition	Second snack choice		
	Low calorie	Medium calorie	High calorie
Healthy	M = 3.00; SD = 1.47	M = 2.67; SD = 1.37	M = 2.80; SD = 1.48
Unhealthy	M = 3.23; SD = 1.30	M = 2.67; SD = 1.58	M = 3.13; SD = 1.55

Emphasis placed on health when shopping

Participants were asked how much emphasis they placed on health when shopping (none at all – a great deal). Emphasis on health did not differ based on shop condition or second snack choice. No significant differences were documented between the healthy and unhealthy shop conditions, $F(1,54) = 1.02$, $p = .32$, $\eta_p^2 = .02$, nor between the second snack choices, $F(2,54) = .03$, $p = .97$, $\eta_p^2 = .001$. Likewise, there was no significant interaction between shop condition and second snack choice, $F(2,54) = .54$, $p = .58$, $\eta_p^2 = .02$.

Emphasis placed on health when shopping, across conditions and second snack choices

Shop condition	Second snack choice		
	Low calorie	Medium calorie	High calorie
Healthy	M = 4.85; SD = 1.82	M = 4.50; SD = 1.57	M = 4.20; SD = 2.28
Unhealthy	M = 4.69; SD = 1.65	M = 5.11; SD = 1.83	M = 5.13; SD = .64

Importance of being mindful of what you eat

Participants were asked to rate their agreement with the statement "It is important to be mindful of what you eat" (strongly disagree – strongly agree). Rated importance of mindful eating did not differ based on shop condition or second snack choice. No significant differences were found across shop conditions, $F(1,54) = .63$, $p = .43$, $\eta_p^2 = .01$, nor between the second snack choices, $F(2,54) = .33$, $p = .72$, $\eta_p^2 = .01$. Likewise, there was no significant interaction between shop condition and second snack choice, $F(2,54) = .09$, $p = .91$, $\eta_p^2 = .003$.

Importance of being mindful of what you eat across condition and second snack choice

Shop condition	Second snack choice		
	Low calorie	Medium calorie	High calorie
Healthy	M = 5.69; SD = .95	M = 5.33; SD = 1.23	M = 5.60; SD = .89
Unhealthy	M = 5.77; SD = .73	M = 5.67; SD = 1.00	M = 5.88; SD = 1.46

Intention to have a healthy diet

Participants were asked to rate their agreement with the statement "I intend to have a healthy diet" (strongly disagree – strongly agree). Healthy diet intention did not differ based on shop condition or second snack choice. No significant differences were documented between the healthy and unhealthy shop conditions, $F(1,54) = 2.55$, $p = .12$, $\eta_p^2 = .05$, nor between the second snack choices, $F(2,54) = .04$, $p = .96$, $\eta_p^2 = .002$. Likewise, there was no significant interaction between shop condition and second snack choice, $F(2,54) = 2.18$, $p = .12$, $\eta_p^2 = .08$.

Intention to have a healthy diet across conditions and second snack choice

Shop condition	Second snack choice		
	Low calorie	Medium calorie	High calorie
Healthy	M = 5.46; SD = 1.33	M = 4.58; SD = 1.38	M = 5.00; SD = .71
Unhealthy	M = 5.15; SD = 1.77	M = 5.89; SD = .93	M = 5.75; SD = 1.04

Importance of making healthy choices

Participants were asked to rate their agreement with the statement "Making healthy choices is important to me" (strongly disagree – strongly agree). No significant differences were documented between the healthy and unhealthy shop conditions, $F(1,54) = 3.19$, $p = .08$, $\eta_p^2 = .06$, nor across the second snack choices, $F(2,54) = .26$, $p = .77$, $\eta_p^2 = .01$. Likewise, there was no significant interaction between shop condition and second snack choice, $F(2,54) = 1.28$, $p = .29$, $\eta_p^2 = .05$.

Importance of making healthy choices, across conditions and second snack choices

Shop condition	Second snack choice		
	Low calorie	Medium calorie	High calorie
Healthy	M = 5.15; SD = 1.77	M = 4.33; SD = 1.50	M = 4.20; SD = 2.49
Unhealthy	M = 5.08; SD = 1.61	M = 5.67; SD = .87	M = 5.25; SD = 1.17

Appendix 15. Experiments 5.E2. & 5.E3. Options for second product selection task

Healthier products:

Less healthy products:

Appendix 16. Experiment 5.E2. Questionnaire

Manipulation check questions:

Think back to browsing the store and choosing your first 9 items.

1. How satisfied were you with the selection of products available to choose from?
(1 Very dissatisfied – 7 Very satisfied)

2. How healthy were these products?
(1 Unhealthy – 7 Healthy)

3. Were the options available mostly healthy or mostly unhealthy?
Mostly Healthy / Mostly Unhealthy

Experimental measures:

Participants were asked to rate the extent to which they agreed with the following statements. Their agreement was measured on seven point Likert scales ranging from Strongly Disagree (1) to Strongly Agree (7).

1. I'm usually mindful of what I eat
2. I intend to have a healthy diet
3. Making healthy choices is important to me
4. I always try to have healthy snacks
5. I find it hard to maintain a healthy diet
6. I'm a health conscious person
7. The next snack I buy is likely to be healthy
8. I like to treat myself when snacking
9. I deserve to indulge in treats sometimes

Appendix 17. Experiments 5.E2. & 5.E3. Scale development

Health consciousness:

- I'm a health conscious person
- I'm usually mindful of what I eat
- I intend to have a healthy diet
- Making healthy choices is important to me
- I always try to have healthy snacks
- I find it hard to maintain a healthy diet (Reverse coded)

Scores (from 1 to 7) for each question were added and multiplied by the number of questions (6) to give an average health consciousness score between 1 and 7.

Indulgence:

- I like to treat myself when snacking
- I deserve to indulge in treats sometimes

Scores (from 1 to 7) for each question were added and multiplied by the number of questions (2) to give an average health consciousness score between 1 and 7.

Appendix 18. Experiment 5.E3. Forced and free choice manipulation

Free choice condition introductory text:

> Imagine you're visiting a nearby store. You'd like to buy some snacks, and have space for about 9 items in your bag. You walk through the shop and browse what's on offer.

Forced choice condition introductory text:[1]

> Imagine you're visiting a nearby store.
>
> There is a noticeboard by the door drawing your attention to the fact that they are trialing a new health promoting policy. They have reduced the number of high-calorie products available at the store, and have capped the number of high-calorie products any one person can buy to 3. Store staff will be monitoring the implementation of the policy.
>
> You'd like to buy some snacks, and have space for about 9 items in your bag. You walk through the shop and browse what's on offer.

[1] Original image accessible from: https://www.inquirer.com/resizer/a8l7cuo8Atwh_4k9qn9rOu6ICd8=/1400x0/center/middle/arc-anglerfish-arc2-prod-pmn.s3.amazonaws.com/public/QLNDBNN3RRDR7PDNPNU2SHIIHI.jpg

Free choice condition reinforcement following initial choice:[2]

Please read the text below:

Well done. You chose mostly healthy products. Most people tend to choose mostly unhealthy products when shopping for food. You decided to make healthier choices. Actively choosing healthy snacks more often than less healthy alternatives has been proven to improve diet quality and overall health.

People who choose healthy snacking options can expect to have a healthier weight.

Making healthier choices more often than not decreases the risk of becoming overweight or obese (which are associated with an increased risk of developing some cancers, cardiovascular disease and type 2 diabetes). While many factors influence people's weight, dietary habits play a key role, and many of these habits begin at our local store. The choices we make at the supermarket determine what foods we have available in the home. Once food is stored in people's food cupboards and is readily available, it is more than likely to be eaten.

You made a series of healthy choices at the store.

[2] Original image accessible from: https://i2-prod.glasgowlive.co.uk/incoming/article18294824.ece/ALTERNATES/s615/2_GettyImages-1214300376.jpg

Forced choice condition reinforcement following initial choice:[2]

Please read the text below:

As you may remember, the store is taking part in a trial that enforces healthier choices (through reducing the availability of less healthy products, and limiting the number of high-calorie products customers can select). As a result of the restrictions put in place by the store, there were limitations on the snack choices you could make. Your basket contains no more than three high-calorie products - well done, you successfully followed the store's policy.

Governments are increasingly trying to restrict the snacking options available in stores, like this one, so people are forced to have a healthier weight.

Overweight and obesity are associated with an increased risk of developing some cancers, cardiovascular disease and type 2 diabetes. With increasing numbers of the population being overweight or obese, the government is adopting more and more policies that regulate what kinds of products are available to customers, and are setting restrictions on the choices people can make when shopping for food. While many factors influence people's weight, dietary habits play a key role, and many of these habits begin at our local store. The choices we make at the supermarket determine what foods we have available in the home. Once food is stored in people's food cupboards and is readily available, it is more than likely to be eaten.

Most people tend to choose mostly unhealthy products when shopping for food. The government is therefore keen to shape what choices people make in the supermarket, to influence what foods people eventually end up consuming. Those working in public health are keeping a close eye on the ways in which food is sold in the UK, and are trialing many different methods of influencing people's food choices.

Your basket contains no more than three high-calorie products, so you successfully followed the store's policy.

Appendix 19. Experiment 5.E3. Questionnaire

Manipulation check questions:

Think back to browsing the store and choosing your first 9 items.

1. How satisfied were you with the selection of products available to choose from?
   (1 Very dissatisfied – 7 Very satisfied)
2. Who had the biggest influence on your choice of products?
   (1 Myself – 7 The store)
3. Please rate the healthiness of the products that were available for you to choose.
   (1 Unhealthy – 7 Healthy)
4. Were the options available mostly healthy or mostly unhealthy?
   Mostly Healthy / Mostly Unhealthy

Experimental measures:

Participants were asked to rate the extent to which they agreed with the following statements. Their agreement was measured on seven point Likert scales ranging from Strongly Disagree (1) to Strongly Agree (7).

1. I'm usually mindful of what I eat
2. I intend to have a healthy diet
3. Making healthy choices is important to me
4. I always try to have healthy snacks
5. I find it hard to maintain a healthy diet
6. I'm a health conscious person
7. The next snack I buy is likely to be healthy
8. I like to treat myself when snacking
9. I deserve to indulge in treats sometimes
10. I don't like when others try to influence my actions
11. I believe that the government should regulate people's diets

Comparisons producing non-significant results:

"I deserve to indulge in treats sometimes" (compared across conditions)

Participants' scores were compared across conditions, and across second snack choice groups. There was no main effect of freedom of choice, $F(1,73) = .03$, $p = .85$, $\eta_p^2 = <.001$, nor a main effect of second snack choice, $F(1,73) = .17$, $p = .68$, $\eta_p^2 = .002$. In addition, there was no interaction between freedom of choice and second snack choice, $F(1,73) = .61$, $p = .44$, $\eta_p^2 = .01$.

"I deserve to indulge in treats sometimes"

Freedom of choice	Second snack choice	
	Healthy	Regular
Free	M = 5.50; SD = 1.29	M = 5.41; SD = .96
Forced	M = 5.26; SD = .93	M = 5.56; SD = 1.10

"I don't like when others try to influence my actions" (comparison across conditions)

Participants' scores were compared across conditions, and across second snack choice groups. No significant effects were found, for freedom of choice, $F(1,73) = 1.03$, $p = .31$, $\eta_p^2 = .01$, for second snack choice, $F(1,73) = .22$, $p = .64$, $\eta_p^2 = .003$, nor any interaction between freedom of choice and snack choice, $F(1,73) = .32$, $p = .57$, $\eta_p^2 = .004$.

"I don't like when others try to influence my actions"

Freedom of choice	Second snack choice	
	Healthy	Regular
Free	M = 4.83; SD = .99	M = 4.86; SD = 1.55
Forced	M = 5.32; SD = 1.20	M = 5.00; SD = 1.46

Appendix 20. Experiment 5.E4. Product preference survey & final product list

Please select the top 3 items from each category which you would like to eat the most.

Healthy snacks

- Apple
- Banana
- Satsuma
- Granola bar
- Dried fruits
- Raisins
- Rice crackers

Unhealthy snacks

- Gummy bears
- Mars bar
- Snickers
- Milkyway
- Galaxy
- Maltesers
- Kitkat
- Twix
- Lollipop
- Sweets
- Pretzels

Unhealthy drinks

- Coke
- Sprite
- Fanta
- Apple Juice
- Orange Juice
- Lemonade
- Squash

Final selection of drinks: Evian water, Coca Cola, Fanta Orange, Simply Lemonade, Naturis Orange Juice. Naturis Apple Juice

Final selection of snacks: Apple, banana, Alesto mini raisin snack pack, Crownfield Muesli Apple Cereal bar, Haribo treat bag, pretzel snack pack, KitKat, Malteser Teaser chocolate piece.

Appendix 21. Experiment 5.E4. Questionnaire

1. Rate the drink that you consumed:

   Strongly dislike Dislike Neutral Like Strongly like

2. To what extent do you agree with the following statements?

   (1 Strongly Disagree – 5 Strongly Agree)

   It is important to be mindful of what you eat

   1 2 3 4 5

   The government should control what we eat e.g. sugar tax

   1 2 3 4 5

   I intend to have a healthy diet

   1 2 3 4 5

ANOVA results for the effects of freedom of choice and snack chosen on questionnaire measures

Full sample:

It is important to be mindful of what you eat

Factor	df	F	Significance	Partial eta squared
Freedom of choice	1	.109	.74	.002
Snack healthiness	1	.286	.60	.006
Freedom of choice x Snack healthiness	1	NA	NA	NA
Error	51			

The government should control what we eat e.g. sugar tax

Factor	df	F	Significance	Partial eta squared
Freedom of choice	1	.002	.97	<.001
Snack healthiness	1	.802	.38	.015
Freedom of choice x Snack healthiness	1	NA	NA	NA
Error	51			

I intend to have a healthy diet

Factor	df	F	Significance	Partial eta squared
Freedom of choice	1	.122	.73	.002
Snack healthiness	1	1.764	.19	.033
Freedom of choice x Snack healthiness	1	NA	NA	NA
Error	51			

Subset selecting the two most popular snacks:

It is important to be mindful of what you eat

Factor	df	F	Significance	Partial eta squared
Freedom of choice	1	.003	.96	< .001
Snack chosen	1	.021	.89	.001
Freedom of choice x Snack chosen	1	.084	.77	.003
Error	32			

The government should control what we eat e.g. sugar tax

Factor	df	F	Significance	Partial eta squared
Freedom of choice	1	.420	.52	.013
Snack chosen	1	.829	.37	.025
Freedom of choice x Snack chosen	1	.113	.74	.004
Error	32			

I intend to have a healthy diet

Factor	df	F	Significance	Partial eta squared
Freedom of choice	1	.053	.82	.002
Snack chosen	1	<.001	.99	< .001
Freedom of choice x Snack chosen	1	.241	.63	.007
Error	32			

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