Biases of memory and cognition as contributors to, and consequences of, people's inferences about healthiness

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Thesis Summary

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Because 'healthiness' cannot be directly experienced, people primarily understand their own healthiness—and that of the foods they consume—by making inferences. But such inferences are rarely based on the totality of information available. For example, regardless of accuracy, information that *feels* intuitively familiar or is retrieved from memory more easily is typically appraised more positively. Through six pre-registered experiments, this thesis examines how people's inferences about healthiness inform what they (mis)remember about food products, as well as what people infer about their own healthiness from their recollections of eating.

Experiments 1 and 2 demonstrate that health-related package images increased participants' tendency to falsely remember reading health claims about those products, even when the products were labelled as an 'unhealthy' food. In Experiment 3, the inclusion of a health-related image on a dietary supplement's packaging increased its perceived health benefits, and *decreased* the perceived risks, but only when the image was related to the product's supposed function. The data fit with the interpretation that package images afforded people a quick and easy sense of comprehension, which led to more positive product evaluations.

Experiments 4-6 found—counter to initial predictions—participants formed more favourable impressions of their own diets having recalled *many* instances of eating healthily, rather than few instances (and vice-versa for eating unhealthily), which in turn effected the healthiness of their future eating preferences and motivations. Exploratory mediation analyses nevertheless suggested the subjective difficulty of recall may have functioned as a suppressor variable, insomuch as it appeared to partially counteract this numerosity effect.

Collectively, these findings demonstrate that people's health-related inferences can be influenced by the ease with which information is processed and/or retrieved from memory. These data have important implications for the way in which health imagery is used in food marketing, in addition to how memory retrieval could be used to encourage healthier food choices.

Keywords: processing fluency; food; imagery; front-of-pack labelling; memory

Dedication

This thesis is dedicated to the memory of my uncle, Peter Delivett, whose unwavering optimism and courage in the face of much adversity was a continued source of strength during my PhD. His aspiration to one day study for a PhD himself was sadly never realised, but I hope to in some small way honour his memory through my own work presented here. Regrettably, I did not share his aptitude for microbiology, though the irony of submitting my thesis during a global pandemic that would have undoubtedly fascinated him is not lost on me! Though our time together was all too brief, the example you set has helped me to overcome many of life's challenges.

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To my family, who for the most part have only seen fleeting glimpses of me for the past three years, thank you for your unconditional love and support. I would like to thank Dad, Helen, Lesley and Martin for our weekly ‘meetings’ over FaceTime that served as a reminder that there was life beyond writing. I cannot even begin to express my gratitude to my Mum for everything she has done to make this dream a reality. For the spontaneous care packages, home-cooked meals and words of encouragement when I was at my wits’ end – thank you.

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List of Abbreviations

BMI – Body Mass Index

DEBQ – Dutch Eating Behaviour Questionnaire

EC – European Commission

EU – European Union

FBDG – Food-Based Dietary Guidelines

FCQ – Food Choice Questionnaire

FDA – Food and Drug Administration

FoP – Front-of-Pack

FOSHU – Foods for Specified Health Uses

GDA – Guideline Daily Amounts

GM – Genetically Modified

HED – High Energy-Dense

LED – Low Energy-Dense

MTL – Multiple Traffic Light

NCDs – Noncommunicable Diseases

PBQ – Party Behaviour Questionnaire

R/K/G – Remember/Know/Guess

RRV – Relative Reinforcement Value

VAS – Visual Analogue Scale

VPCT – Virtual Portion Creation Task

WHO – World Health Organization

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Chapter 1

General Introduction

Healthy eating is increasingly recognised as an important determinant of health. The advent of functional foods, which offer additional health-benefits beyond that of their basic nutritional value, is just one way in which the global market has sought to capitalise on an increasingly health-conscious consumer base. But whereas a person can directly experience a product's taste, they cannot experience a sense of 'healthiness' in the same way. Though limiting one's salt intake may yield a perceivable decrease in blood pressure over time, other health-related benefits of consuming a balanced, nutritious diet are more abstract (Grunert, 2006). Much of people's understanding about health—and specifically, the healthiness of their food choices—is therefore inferred from the information they have available to them. However, such inferences are rarely based on the entirety of information available. Consider the question, "What was the famous line uttered by Louis Armstrong when he first set foot on the moon?" If you instinctively remembered something akin to "That's one small step for man, one giant leap for mankind", without questioning that *Louis* Armstrong was in fact a jazz musician who never visited the moon, then you are not alone. Oftentimes people overlook the apparent implausibility of such questions, even when they possess contradictory knowledge about Louis Armstrong's storied career as a musician (Shafto & MacKay, 2000). Though unrelated to health, this illustrative example neatly demonstrates that people's cognitive processes are often driven by familiarity-based rules of thumb, or *heuristics* (Park & Reder, 2003). Consequently, when information *feels* intuitively familiar to a person, it typically receives less scrutiny than unfamiliar material (Song & Schwarz, 2008a).

If then, people's health-related inferences are similarly prone to distortions then this may in turn impede their ability to objectively assess a product's healthiness. Consumers may for instance conclude that a product sporting a health-related image on its packaging is 'healthier' than a plain-package alternative. Similarly, people may presume that if they find it easy to recall examples of eating healthily that they are a 'healthy' eater. These two scenarios ultimately represent the two central research questions of this thesis. Before delving into the specifics of my research questions it helps to better contextualise why people's inferences about healthiness are so important. To this end, I begin with a brief overview of what constitutes a 'healthy' diet, and possible health consequences of eating unhealthily.

Defining a 'healthy' diet

According to the World Health Organization (WHO, 2020), a healthy diet is one rich in fruit, vegetables, nuts and whole grains, whilst limiting the amounts of saturated and trans fats, free sugars and salt. More specifically, a healthy diet should guard against malnutrition and noncommunicable diseases (NCDs; e.g., heart disease). The way in which this information is communicated to the general populace varies considerably between different countries. Some offer precise guidelines regarding the quantities and frequency with which particular food groups should be consumed, even offering bespoke guidance for specific subgroups (e.g., the elderly). Others provide broader, more concise health recommendations such as the need to eat five portions of fruits and vegetables a day (De Ridder et al., 2017). The purpose of these food-based dietary guidelines (FBDG) then, is to summarise a vast evidence base regarding foods and their associated health benefits into simple, actionable consumer recommendations to encourage healthier eating (Herforth et al., 2019). Indeed, most FBDGs make similar recommendations concerning limiting salt intake, increasing fruit and vegetable consumption, and prioritising the consumption of healthier, unsaturated fats over trans and saturated fats (Fischer & Garnett, 2016). To assist consumers, most FBDGs use some form of visual representation (e.g., a pyramid) to depict how much of each food group they should aim to consume as part of a balanced diet (Erve et al., 2017). In the UK for instance, the Eatwell Guide divides an image of a plate into five categories (fruits and vegetables; starchy carbohydrates; oils and spreads; dairy and alternatives; proteins) relative to the amounts of each food group a person should aim to consume (Public Health England, 2018). Most countries then, offer consumers comprehensive guidance on how best to follow a healthy diet.

However, the proliferation of fast-food outlets on the high-street and the rise in convenience foods has shifted the way in which people purchase and consume foods. Average food consumption has increased significantly in the past 50 years, with beverages alone adding an estimated 278 kcal/day to the average American diet during this period (Nielsen & Popkin, 2004), and snack-based foods a further 145 kcal/day (Zimmerman, 2011). Comparable shifts in consumers' eating habits have also been observed in parts of Asia, Latin America and Northern Africa (Popkin, 2001). In Japan for instance, average daily fat intake increased by 341% between 1946 and 1987, driven in part by younger consumers adopting a Western-influenced diet (Popkin, 1994). Likewise, in the Middle East and Northern Africa the proportion of energy derived from high-quality cereals has declined significantly since 1961, whilst energy sourced from less healthy animal-based products and vegetable oils has increased (Golzarand et al., 2012). Sustained economic growth and increased urbanisation in these countries result in different societal pressures, which in turn effect the healthiness of people's eating behaviours. Indeed, a cross-sectional analysis of American consumers eating habits found that the percentage of energy consumed from home-prepared sources decreased by nearly a quarter for both males and females from 1965 to 2008 (Smith et al., 2013). Whereas the proportion of males who cook rose slightly, it is theorised that the establishment of gender equality rights contributed to a 24% decline in the proportion of females who cook. Perceived lack of time, inadequate cooking utensils and a lack of cookery knowhow have all been cited as reasons for an increasing number of people choosing to dine away from home (Asp, 1999; Larson et al., 2006). Crucially, foods consumed away from home typically contain fewer fruits, vegetables and whole grains (Todd et al., 2010), as well as higher levels of saturated fats, cholesterol and sodium (Guthrie et al., 2002). By the WHO's standards, this shift away from home-prepared meals has evidently led to a decline in the healthiness of people's diets.

Further contributing to the problem is the manner in which unhealthy foods are favourably marketed to consumers. Indeed, the vast amounts of money manufacturers spend advertising less healthy products—such as convenience foods and confectionary items—

dwarfs that spent on healthier alternatives like fruits and vegetables (Gallo, 1999). Whereas the number of advertisements featuring foods high in saturated fats and sugars fell slightly from 2003 to 2009, the number of high-sodium products and fast-food commercials rose sharply during this time (Powel et al., 2011), with an estimated 35,000 branded food, beverage or restaurant adverts appearing during prime-time television in 2008 (Speers et al., 2011). The scale of this problem was neatly illustrated by O'Dowd (2017), who reported that the top 18 UK food brands collectively spent 27.5 times the amount that the government spent on their Change4Life, healthy eating campaign. Such advertisements invariably entice consumers to eat unhealthily and so it is perhaps unsurprising to learn that increased viewing of commercial television is associated with greater consumption of fast food, sugar-sweetened beverages and sweet and salty snacks (Scully et al., 2009; Scully et al., 2012). In recognition of this fact, the UK government recently proposed plans to ban online advertisements and pre-watershed TV commercials of unhealthy foods from 2023, as part of efforts to promote a healthier lifestyle (Sweney, 2021).

Indeed, people's increasingly poor eating habits have widely contributed to a rise in the number of NCDs, which account for approximately 71% of deaths worldwide (WHO, 2021). To give one example, elevated body mass index (BMI) is considered a major risk factor for developing NCDs such as musculoskeletal disorders (e.g., osteoarthritis), cardiovascular disease (e.g., heart disease), diabetes, as well as some forms of cancer (Bray, 2004). In the UK alone, it is estimated that the costs associated with treating obesity-related illnesses exceeds £5.1 billion per year (O'Dowd, 2017). Likewise, global levels of sodium are almost double that of the WHO's recommended 2.0g per day (Mozaffarian et al., 2014), with an estimated 75% of sodium intake in European and North American diets coming from processed or restaurant-prepared foods (Brown et al., 2009). Much like obesity, a high-sodium diet has been linked to several NCDs including cardiovascular disease, which accounted for approximately 30% of deaths worldwide in 2005 (WHO, 2014a). Evidently, consumers' dietary behaviours deviate considerably from the WHO's definition of a healthy diet. But for the purpose of my thesis, what matters is the average consumers' understanding of what constitutes a healthy diet.

Consumers' understanding of a 'healthy' diet

At a superficial level, people's definition of what constitutes a healthy diet typically conforms with existing WHO guidelines. Consumers typically recognise the importance of increasing fruit and vegetable consumption while simultaneously reducing their intake of dietary fats, sugars and salt (Lake et al., 2007; Paquette, 2005; van der Hijden et al., 2021). Many consumers even demonstrate an awareness of less established FBDGs, such as restricting the consumption of red and processed meats in favour of leaner alternatives like chicken and fish (Paquette, 2005; van der Heijden et al., 2021). But consumers' definitions do vary in their level of specificity, insofar as some people describe detailed nutritional advice, whereas others rely on more abstract concepts such as eating a "balanced" or "varied" diet. In addition, consumers often report feeling confused about specific FBDGs, particularly those regarding serving suggestions, the different types of dietary fats, and the purpose of certain nutrients in promoting health (Boylan et al., 2012). Perceived information overload, as well as confusing and often contradictory advice has led to an element of distrust and scepticism regarding dietary guidelines (Dibsdall et al., 2002; Grunert & Wills, 2007). To give an example, fish is widely recommended as part of a healthy diet for being a good source of protein and essential fatty acids. But recent guidance advises women who are pregnant or breastfeeding to limit their intake of certain varieties of fish because of potentially harmful levels of mercury and other pollutants present in these species (Food and Drug Administration [FDA], 2020a). Likewise, foods considered wholly beneficial to health—such as those high in fibre—may be damaging to someone living with a particular medical condition (e.g., Crohn's disease; Plasek et al., 2020).

Perhaps unsurprisingly then, an increasing number of people are turning to other mediums, such as self-proclaimed "diet gurus" or healthy living blogs for advice on eating healthily (De Ridder, et al., 2017). Healthy living bloggers, in particular, typically use a blog as a means of sharing their 'healthy' eating habits with others and documenting their weight loss. But it is important to acknowledge that these individuals are rarely qualified to offer such advice in a formal capacity. The wholly unregulated nature of these forums means that these bloggers may be unwittingly endorsing dysfunctional—and potentially harmful—eating practices. Indeed, a content analysis of 21 healthy living blogs, each receiving a minimum of 1,100 unique visitors per day, found that five bloggers reported they were recovering from an eating disorder, and a further seven experienced menstruation difficulties or infertility (Boepple & Thompson, 2013). Several bloggers expressed negative messages about food (e.g., concerns about weight gain after excessive eating) and over half used fat stigmatising language to describe themselves. These blogs then typify a changing relationship with food whereby people's interpretation of 'healthy' eating now encompasses the idea of eating to lose, or maintain weight (Buckton et al., 2015), often to the detriment of people's wellbeing. Likewise, health and fitness magazines typically focus on improving readers' body aesthetics rather than their health and/or performance (Labre, 2005; Wasylkiw et al., 2009). Contrary to the WHO's definition of a healthy diet being one that protects against malnutrition then, such content seemingly encourages people to actively deprive themselves of essential nutrients—such as dietary fats—in pursuit of the 'perfect' body. The issue being that when there is a perceived general consensus for something that deviates from one's own perception, people are more likely to alter their viewpoint to match the status quo (Festinger, 1954). That is to say, the 'thin is healthy' mantra that is so often the subject of these conversations about health may actually promote less healthful eating behaviours.

In addition to these broader considerations, consumers may also possess more specific misconceptions about individual foodstuffs. Take for instance, the mistaken belief that consuming eggs elevates blood cholesterol, and are therefore bad for heart health. This myth was ultimately predicated on a series of the studies that were confounded by the presence of large amounts of saturates in the participants' diets (Gray & Griffin, 2009). Indeed, the combined results from two prospective cohort studies suggested instead that people who consume more than one egg per day were no more at risk from coronary heart disease or stroke, than those eating less than one egg per week (Hu et al., 1999). Similarly, there is little evidence to suggest that people need to ingest protein immediately after their workouts to maximise their ‘gains’ (Aragon & Schoenfeld, 2013), as previously observed differences in muscle mass have since been attributed to increases in overall protein consumption rather than an effect of *when* protein is consumed (Schoenfeld et al., 2013). Likewise, whereas consumers are right to think bananas are radioactive—by way of containing trace amounts of potassium—the average person would need to consume 274 bananas a day for seven years to feel the ill-effects from radiation poisoning (Amri, n.d.). These misconceptions may seem relatively trivial, they are nevertheless illustrative of a broader problem; that people’s beliefs about what is healthy, are based on outdated—and often incorrect—information that persists even in the face of newer, more credible evidence to the contrary. Take for instance, the purported link between the MMR vaccine and autism (Wakefield et al., 1998). In spite of evidence refuting this relationship (e.g., Taylor et al., 2014), an estimated 20% of surveyed respondents still believe that some vaccinations are responsible for causing autism in children, and a further 38% of people were unsure whether or not this claim was true (Duffy, 2018). Though unrelated to food, this example nevertheless illustrates that such health fallacies are hard to extinguish in the general populace. Part of the reason that these maladaptive beliefs persist is because they undermine people’s confidence in more accurate information when it is heard in the future (Lewandowsky et al., 2012).

New and emerging evidence means that amendments to FBDGs are certainly not uncommon. By definition, the American FDA characterises a ‘healthy’ food as one that provides an excellent source of nutrients, which offer a potential health benefit for a present health concern (FDA, 2016). That is to say the FDA’s definition of what constitutes a healthy food depends on the most-recently identified risks to health. To give an example, vitamin A and vitamin C deficiencies were previously recognised as a risk to American consumers, and thus, ‘healthy’ foods were considered as those high in these key nutrients. But consumers diets have changed substantially to the point where these nutritional deficits are no longer a health concern. Instead, the reported link between increased potassium consumption and a reduction in heart disease (WHO, 2014b) has prompted a change in FBDG, whereby nutrition facts labels are now required to display the products' potassium content. Dietary advice, is therefore constantly evolving in light of newly emerging evidence. But crucially, such changes are not always well communicated to consumers. A recent review of the 50 most-shared academic studies with a health outcome, found that the media's coverage tended to not only overstate the strength of the findings, but omit key aspects of the studies' design (Haber et al., 2018). Take for instance, the dismissal of genetically modified (GM) foods in the 1990's based on a preliminary—and at the time, unpublished—report, claiming to find evidence of the possible negative health outcomes of consuming such foods (Ewen & Pusztai, 1999). Though a latter rebuttal criticised Ewan and Pusztai's findings as baseless, there was nevertheless a sharp rise in the number of media outlets reporting on the potentially harmful effects of GM agriculture (Frewer et al., 2002). The ensuing consumer panic led to the removal of GM foods from school canteens, restaurants and bars, as well as the destruction of several GM crops sites across the UK. Thus, the media's misrepresentation of the totality of publicly available information evidently has real and lasting consequences for people's beliefs. Captivating headlines like "Frosted flakes are healthier than avocados" (Acuesta, 2016) may have a grain of truth to them—in the sense that American FDA guidelines could be interpreted as suggesting that some sugary cereals are 'healthier' than foods high in healthy fats—but such assertions act as a further source of consumer confusion.

This issue is further exacerbated by people's tendency to categorise foods as either universally "good/healthy" or "bad/unhealthy" (Oakes, 2004, 2005a; Oakes & Slotterback, 2005; Rozin et al., 1996). This "monotonic" way of thinking is characterised by a reluctance to accept that foods can have contrasting effects on health depending on whether they are consumed in small or large amounts (Rozin et al., 1996). In this way, foods *perceived* to be inherently unhealthy (e.g., eggs) may be avoided altogether, whereas other foods with a healthier reputation may be consumed with little regard for their actual nutrient profile. In one study for instance, Mötteli et al.'s (2016) participants were instructed to either serve themselves foods that they would consume on a typical day, or as part of a healthy diet.

Whereas healthy-instruction participants chose foods with significantly less saturated fats and higher amounts of protein than the control group, both conditions served themselves foods containing almost double the recommended daily allowance of sugar and salt. Importantly, participants in the healthy-instruction group chose foods that they *perceived* to be healthier—such as fruits and fruit juices—that nevertheless contained equivalent amounts of sugar as those sourced from ‘unhealthy’ sugar-sweetened beverages and sweets. In another study, foods considered less healthy (e.g., bacon) were thought to promote greater weight gain than higher caloric alternatives with healthier reputations (e.g., raisin bran muffin), even when the food’s calorie content was displayed alongside the product’s name (Oakes 2005a; Oakes & Slotterback, 2005). Similarly, the addition of a disreputable ingredient—such as caramel—to an otherwise considered healthy food (i.e., *caramel* apple) leads to significantly lower appraisals of the product’s vitamin and mineral content compared to when the food is presented in their original, untainted format (Oakes, 2004; 2005b). The reverse is also true, in that products perceived to be healthier are thought to possess additional health-related benefits to the consumer. In one study for example, products whose name contained a nutritive term (e.g., *protein* bar) were thought to contain higher levels of other, unrelated nutrients, such as fibre and iron (Fernan et al., 2018). More recently, Stoltze et al. (2021) reported that products featuring a fibre-related nutrient claim on their packaging received higher ratings of perceived healthiness, naturalness, quality, vitamin content and purchasing intentions than those products without such a claim. Collectively, the results of these studies show that merely categorising foods as either ‘healthy’ or ‘unhealthy’ can lead people to make more general inferences about the products’ overall healthiness.

Importantly, given consumers’ inability to directly assess the relative healthiness of the foods they consume, their food choices ultimately depend on their ability to *infer* a product’s healthiness based on the information they have at their disposal. But as demonstrated by the Armstrong illusion (Shafto & MacKay, 2000), people’s cognitive processes—and particularly those pertaining to reasoning and decision making—rarely encompass the totality of information available. People instead favour the use of simplified heuristics, which exploit their prior knowledge and expectations. Indeed, when information is perceived as *familiar* it often prompts less effortful, top-down processing (Schwarz, 2002). In the case of the Armstrong illusion, the name Louis *feels* familiar in relation to the question and thus people respond intuitively without recognising the apparent infeasibility of the question. However, if this name were substituted for a semantically and phonologically dissimilar name, then the resulting disfluency would lead people to engage in more deliberate, conscious processing of the question (Shafto & MacKay, 2000). People's feelings therefore function as an important source of information in guiding human reasoning (Schwarz, 2011). But if people's beliefs about what constitutes a healthy diet are ultimately flawed, then an increased sense of familiarity could lead them to make quick, intuitive judgments on the basis of erroneous information. For instance, the common belief that dietary fats are 'always' bad for health (Dickson-Spillmann & Siegrist, 2011) might lead some consumers to infer that products signalling "low fat" are good for health. But consider that current European Union (EU) regulations mandate that for a product to qualify for a "reduced fat" claim, the product in question must contain at least 30% less fat "…compared to a similar product" (European Commission [EC], 2006, Article 8.1). Thus, a product belonging to a food category that is inherently high in fat might be eligible to possess such a claim by virtue of being the *least* bad option available. Absent this context, a person may wrongfully deduce that such a product represents a 'healthy' food choice.

Not only can such inferences create false impressions about a product's nutritional quality, but they can also create beliefs about the *appropriateness* of these foods. It has been theorised that when people experience a conflict between immediate self-gratification (e.g., eating a piece of cake) and a long-term goal (e.g., losing weight), they form justifications to make the goal-discrepant behaviour (i.e., eating the cake) seem more acceptable (De Witt Huberts et al., 2012). These licensing effects afford people the opportunity to consume foods that they perceive to be healthier in greater quantities in an act of so-called *guiltless* eating (Spence et al., 2013). For instance, female undergraduates consumed 35% more cookies if they were labelled as a "healthy snack", rather than as a "gourmet cookie" (Provencher et al., 2009). Likewise, restrained eaters consumed significantly more cookies when they were attributed to a healthful brand (Cavanagh & Forestell, 2013), and prospective dieters consumed significantly more sweets when they were labelled as “fruit chews” (Irmak et al., 2011). Furthermore, people’s tendency to think of foods as either universally ‘good’ or ‘bad’ can not only affect perceptions of individual food items, but also people’s overall impression of a meal’s healthiness. Therefore, meals comprised of both a ‘healthy’ and ‘unhealthy’ food are thought to contain fewer calories than the unhealthy food alone (Chernev, 2011). In one study for instance, the addition of a salad to a hamburger reduced participants’ caloric estimations of the meal by 12.6% relative to when the hamburger was shown on its own (Chernev & Gal, 2010; Experiment 1). When judging the overall healthiness of a meal, people seemingly make a holistic judgment that encompasses both the “goodness” of the salad, contrasted against the “badness” of the hamburger, which results in an underestimation of the meal’s calorie content. In support of this rationale, a follow-up experiment found that participants gave higher calorie estimates when judging the individual food items separately than when they appraised the meal as a whole (Chernev & Gal, 2010). These results show that people’s health inferences can not only encourage people to consume foods that they *perceive* to be healthier in greater quantities, but also make a *less* healthy food choice seem more acceptable when paired with a ‘healthy’ food.

Chapter summary

People’s judgments about healthiness depend on their ability to *infer* meaning from information at their disposal. Such inferences are rarely based on the totality of information, but rather, their metacognitive experiences of how information *feels* (Schwarz, 2011). In this way, information that feels intuitively familiar or information that is retrieved from memory more easily might be judged more favourably. However, if this implicit sense of ‘knowing’ pertains to something that is ultimately untrue, then such inferences might lead consumers to make less healthy food choices. Whereas consumers seemingly possess a general understanding of what constitutes a ‘healthy’ diet (Lake et al., 2007; Paquette, 2005; van der Heijden et al., 2021), confusing and oftentimes contradictory advice has led to growing scepticism of FBDGs (Dibsdall et al., 2002; Grunert & Wills, 2007). Increased digital media content has changed the way in which the average consumer engages with health information. But crucially, such sources often misrepresent or even misinterpret the empirical evidence on which they are predicated (Haber et al., 2018), thereby undermining consumers' understanding of healthiness. The purpose of this thesis is therefore to investigate how people's inferences about healthiness inform their memories and cognitions about food products, in addition to what people infer about their own healthiness from their recollections of eating (un)healthily. The exact reasoning for studying people's memories will become apparent in the forthcoming theoretical chapters. Suffice to say that whilst explicitly asking consumers to report their inferences about health is certainly informative, doing so might be what in fact prompts them to make those inferences. Alternatively, testing people's recollections of stored information offers valuable insights into such inferences without relying on direct questioning. Memory is therefore used here as both an instrument to assess people's *implicit* inferences, and as a device to prompt people to make inferences about their own healthiness. Specifically, in the first half of this thesis, I examine whether people's inferences about health-related package imagery informs their memories and beliefs about products' health benefits. I subsequently examine the extent to which the subjective difficulty with which people recall instances of (un)healthy eating influences their self-appraised healthiness.

Research methods: preregistration

It is presumed that most of the scientific literature represents factually correct information about various phenomena, however, this is not necessarily always the case. Indeed, many published findings that exemplify advancements in our shared understanding of the social sciences fail to replicate under certain conditions (Simmons et al., 2021). The Open Science Collaboration (2015) famously attempted to replicate 100 experimental studies published in three established psychological journals, of which just 36% reported a significant effect in the direction of the original study. Despite the use of high-powered designs and materials sourced from the original authors, the majority of studies yielded substantially weaker evidence than the original findings had previously suggested. Naturally, the publication of erroneous findings has important implications, particularly from a health psychology perspective whereby such findings may result in ineffective and potentially damaging policy recommendations (Simmons et al., 2021). Crucially, if consumers perceive that they cannot trust supposedly objective, factually 'correct' health information then they may be more inclined to consult other sources, which—as previously discussed—promote overtly unhealthy eating practices (De Ridder, et al., 2017). Whereas researchers rarely set out to deliberately deceive their readers, they may engage in so-called questionable research practices so as to present a novel, or interesting finding. In one study for instance, responses from 2,155 academic psychologists found a surprisingly high rate of such practices, most common of which were: not reporting all of a study's dependent variables; collecting additional data after seeing whether the study's results were significant; and, selectively reporting studies with significant results for publication (John et al., 2012). These practices exist in a grey area of scientifically acceptable habits that nevertheless undermine researchers' confidence that a true effect actually exists. Perhaps the most telling statistic was that 35% of academics reportedly expressed concerns about the integrity of at least one of their pieces of research.

People's engagement with these dubious practices is arguably a by-product of the 'publish or perish' culture within academia, referring to the pressure on researchers to consistently publish in order to maintain their position as a member of university staff or advance up the hierarchical ladder (Grimes et al., 2018). Efforts to publish are further hindered by the fact that publishers are considerably more likely to publish statistically significant results over statistically insignificant results (Franco et al., 2014). Indeed, Franco and colleagues observed that for this reason, researchers are less likely to even attempt to write-up their null findings for publication. The issue being that should future researchers then find an effect by chance—which then goes on to be published—the published literature in turn misrepresents the true extent of the 'effect' in question. The accepted false-positive rate of 5% in social sciences ultimately means that one in every twenty studies will fall afoul of committing a Type I error (i.e., failure to reject the null hypothesis). Thus, conducting multiple analyses using the same data or conducting several smaller, underpowered studies can increase the likelihood of finding a false-positive (Simmons et al., 2021).

There are, however, precautions that researchers can take to mitigate some of these issues, such as the act of preregistering their study plan *prior* to data collection. The aim of a preregistration is to provide a detailed plan of exactly how the researcher went about obtaining and subsequently analysing their data (Lindsay, 2020), which typically comprises: the research question to be tested; a description of the independent and dependent variables, detailing how these variables will be scored; sample size justification; a thorough explanation of any exclusion criteria; and, an exact account of the key analyses. A pre-registration is not—as some people believe—a binding contract that prevents researchers from conducting additional analyses, but rather, it is perfectly permissible to do so provided these exploratory analyses are explicitly labelled as such. This in turn allows prospective readers to distinguish between those analyses that were confirmatory analyses (i.e., hypothesis testing), and those that are purely exploratory. These practices help safeguard against HARKing, or hypothesising after the results are known, in which researchers may attempt to pass off post-hoc hypotheses as if they were confirmatory (Toth et al., 2021). A second, more obvious, benefit of preregistration is that it reduces reporting bias inasmuch as researchers are obliged to disclose their full analyses rather than selectively reporting those findings with statistically significant results (van't Veer & Giner-Sorolla, 2016). Relatedly, the increased transparency from preregistering one's study plan and analyses deters researchers from *p*-hacking, thus reducing the likelihood of committing a Type I error (Moore, 2016). With all this in mind, I preregistered each of the studies reported in my thesis using the online pre-registration platform, AsPredicted.org. The platform creates a standardised, time-stamped document detailing the methodology and planned analysis, which can be shared anonymously during the review process and later made publicly available at the authors' discretion. For the purpose of my thesis, I have included each of my pre-registrations in my Appendices section.

Chapter 2

Nutritional labelling and health claims

As established in Chapter 1, consumers' inability to experience a sense of 'healthiness' means the accuracy of their health-related judgements relies on their aptitude to *infer* healthiness from the information available (Grunert, 2006). Product packaging for instance, typically contains a wealth of information from which the consumer can deduce a product's relative healthiness. However, the complex—and often contradictory—nature of such information makes it difficult for the average consumer to judge the purported healthiness of a product with any real certainty. As one observer surmises: "As consumers shop for healthier food, they encounter confusion and frustration… The grocery store has become a Tower of Babel and consumers need to be linguists, scientists and mind readers to understand the many labels they see" (HHS, 1990, cited in Boon et al., 2010, p. 21). The purpose of this chapter is to examine how consumers make judgements about the *implied* healthiness of their food choices from product packaging.

When evaluating a product's properties, Olson and Jacoby (1972) distinguished between *intrinsic* cues, referring to the physical characteristics of the product (e.g., taste, colour, texture), and *extrinsic* cues, referring to product-related features that are not a part of the product itself (e.g., price, branding, packaging). Extrinsic cues in particular can generate product expectations (Deliza & MacFie, 1996) that allow consumers to infer a product's quality (Sabri et al., 2020), particularly in instances where they are unfamiliar with the product, or have limited opportunities to assess the product's intrinsic qualities (Zeithaml, 1988). Thus, these extrinsic cues—and particularly product packaging—afford consumers the ability to make inferences about a product's healthiness. However, consumers' perceptions of a product's healthiness are not based on any one extrinsic cue. For instance, dieters rated an identical pasta-salad meal as significantly healthier when it was labelled as a "daily salad special" rather than a "daily pasta special" (Irmak et al., 2011). A product's country of origin may similarly generate expectations about a food's nutritional value, quality, and how safe it is to consume (Juric & Worsely, 1998), with domestically grown produce typically rated healthier than foreign foodstuffs (Gineikiene et al., 2016). Likewise, organic foods are considered healthier than non-organic alternatives (Prada et al., 2016, 2017), with consumers citing the perceived benefits to health as their main reason for choosing to buy organic produce (Hughner et al., 2007; Xie et al., 2015). Packaging colour is another important aspect of a product's design, with some companies (e.g., Cadbury's) going so far as to trademark their unique on-brand colour. Colours signalling artificiality (e.g., celadon) have been shown to negatively impact perceived healthiness (Wąsowicz et al., 2015), whereas paler, more muted tones are typically associated with healthier product appraisals (Mai et al., 2016; Tijssen et al., 2017). Evidently, consumers' perceptions of a product's healthiness can be informed by a variety of different packaging features. But whereas these package attributes may not be deliberately indicative of a product's healthiness, manufacturers often provide more explicit health information regarding their products, such as written claims. Before continuing, it is important to distinguish between the different types of packaging claims and how different countries regulate their use.

What is a health claim?

Products' claiming to offer purported benefits to health existed for decades prior to the advent of legislation restricting their usage. In 1984, Japan's Ministry of Education, Science and Culture launched a nationwide project investigating the different functionalities of foods in anticipation of an increasingly aging population (Yamada et al., 2008). Ultimately, the project was the first to define the term *functional* food, in reference to a food that possesses additional health benefits to the consumer beyond that of its basic nutritional value (Henry, 2010). In response, the Japanese Ministry of Health, Labour and Welfare established the Foods for Specified Health Uses (FOSHU) in 1991, signifying the first attempt to regulate the use of 'health' claims appearing on pre-packaged foods (Shimizu, 2003). By definition, FOSHU claims pertain to foods that are consumed to promote health, or for the purpose of managing a health-related condition (e.g., high blood pressure; Ministry of Health, Labour and Welfare, n.d.). Products seeking FOSHU approval are required to provide detailed documentation concerning the efficacy of the alleged benefit to health, as well as food safety considerations (Lalor & Wall, 2011). Successful applicants are permitted to display the approved claim on the product's packaging, in addition to the FOSHU seal (see Figure 1).

Similarly, in the US, increased demand for pre-packed foods during the 1960's facilitated a rise in the number of written package claims as manufacturers attempted to distinguish themselves from their competitors. But in response to a sharp rise in the number of ambiguous claims appearing on product packages and in advertisements, US Congress passed the Nutritional Labelling and Education Act to impose tighter restrictions on package labelling. Coming into effect in 1993, these new rulings required all packaging claims to adhere to strict FDA guidelines (Lalor & Wall, 2011). Under these regulations a health claim was henceforth defined as any claim "…that expressly or by implication, including "third party" references, written statements (e.g., a brand name including a term such as "heart"), symbols (e.g., a heart symbol), or vignettes, characterizes the relationship of any substance to a disease or health-related condition" (FDA, 2020b). As with FOSHU foods, FDA approval is contingent on there being significant scientific agreement to support the purported relationship that is the subject of the claim (Lalor & Wall, 2011).

By comparison, legislation governing the use of health claims across Europe was only recently enacted by the European Union in 2006, having previously existed in several of its member states independently. Much like the FDA's approach, the European Commission (EC) recognises a claim as "…any message or representation…including pictorial, graphic or symbolic representation" (EC, 2006, Article 2.2.1). Where they differ is that European legislation further distinguishes between *disease reduction* claims—which closely resemble the FDA's definition of a health claim—and *health* claims that are more broadly defined as "…any claim that states, suggests or implies that a relationship exists between a food category, a food or one of its constituents and health" (EC, 2006, Article 2.2.5)[1] Health claims that refer to the role of a nutrient on normal physiological or psychological functioning

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[1] Note that in subsequent chapters, I refer to a *health* claim as defined by the EC (2006) in Article 2.2.5.

Figure 1

Foods for Specified Health Uses (FOSHU) seal (Ministry of Health, Labour and Welfare, n.d.)

(e.g., “calcium is needed for the maintenance of normal bones”) may forgo the review process, provided that they are derived from generally accepted scientific evidence (EC, 2006, Article 13.1). However, claims based on newly established evidence are to be submitted for approval alongside a detailed dossier that includes independent, peer reviewed studies that demonstrate a causal relationship between the food and its purported health benefit (Lalor & Wall, 2011). All three of these examples then, are united by a desire to provide accurate, well-informed information to help consumers make healthier food choices.

Despite the often daunting review process, the prevalence of pre-packaged foods containing health claims has steadily increased since their inception. Hieke et al., (2016) reported that 11% of foods sampled from five EU countries (Germany, Netherlands, Slovenia, Spain, and the UK) carried a health claim, with comparable results found in Australia (Sobierajski et al., 2006) and the US (Colby et al., 2010). Much like other aspects of a package’s design, written claims also affect people’s appraisals of a product’s healthiness. For instance, when a short, written claim is added to a product’s packaging, prospective consumers typically judge the product more favourably (Kozup et al., 2003), awarding higher ratings of its perceived healthiness (Wills et al., 2012), and of their purchasing intentions (Roe et al., 1999). Furthermore, recent initiatives aiming to promote healthier food choices among older adults found that package claims not only increase perceptions of product healthiness (Annunziata et al., 2015), but also adults’ likelihood of consuming such foodstuffs (Farrell et al., 2019). There is at least some evidence to suggest that products carrying a health claim represent healthier food choices. Indeed, a review of 2,043 consumables from five EU countries reported that foods carrying a health claim had significantly lower levels of total sugars (-3.6/100g), total fat (-3.3/100g), saturated fat (-2.5/100g), and sodium (-546.6mg/100g; Kaur et al., 2016). But as a global review of nutritional labelling policy highlights, many countries do not yet have legislation in place to regulate the use of health claims on product packages (Hawkes & WHO, 2004). Whereas it is important to acknowledge that several countries have gone on to introduce such legislation since this report was first published, others have passed new laws that arguably represent a backwards step.

Limitations of existing legislation

Recent years have seen the introduction of new legislation to accelerate the application process for approving packaging claims. In Japan for instance, policymakers introduced the term "*qualified* FOSHU" in reference to foods with a purported health function that is not substantiated by scientific evidence (Grasso et al., 2014). Products carrying a qualified FOSHU claim are required to use the term "possibly" in their description of the health claim, in addition to including a short disclaimer that reads: "evidence has not necessarily been established" (Lalor & Wall, 2011). The FDA made similar concessions to US legislation with the introduction of *qualified* health claims (FDA, 2017), which—much like their Japanese equivalent—relaxed rulings on the quality and strength of scientific evidence needed to bring a functional food to market. These amendments permit products to carry a health claim for which there is "emerging" evidence to support a link between a food and a decreased risk of disease (Lalor & Wall, 2011). Similar to qualified FOSHU foods, the American FDA specifies that qualified health claims must be accompanied by a written disclaimer that explicitly acknowledges the current level of scientific support for the purported claim. An example from the FDA website reads:

> "Scientific evidence suggests, but does not prove, that whole grains (three servings or 48 grams per day), as part of a low saturated fat, low cholesterol diet, may reduce the risk of diabetes mellitus type 2" (FDA, 2017).

Understandably, the uptake of these claims is relatively low. From a manufacturer's perspective, the increased time associated with applying for FDA approval, as well as the additional space required on the package label may not exceed the benefit of making a health-related claim (Bone & France, 2009). Instead, manufacturers—and consumers alike—prefer a third type of package claim, the *structure-function* claim. Such claims are similar to the EC's definition of a health claim, insomuch as they typically refer to the relationship between a named nutrient and supporting normal, health functioning (e.g., "calcium builds strong bones"; FDA, 2002). But crucially, such claims are permitted to appear on a product's packaging without the need for FDA approval. Whereas structure-function claims are prohibited from specifically mentioning *disease* (e.g., "treats Alzheimer's disease"), they are allowed to refer to the characteristic symptoms of the disease (e.g., "improves absentmindedness") from which the consumer may make disease-reduction inferences. This gradual dilution of legislation governing the use of packaging claims means that an increasing number of products now bear written claims that lack adequate scientific support. Indeed, a recent review reported that structure-function claims appeared on nearly twice as many product packages as related qualified health claims (Bone & France, 2009). But crucially, consumers fail to make clear distinctions between structure-function claims, nutrient claims and health claims (Williams, 2005); forming equivalent beliefs about the perceived efficacy and level of scientific support of these claims, irrespective of the claims' classification (France & Bone, 2005). If people are unable to distinguish between these different types of claims, then it stands to reason that these wholly unregulated claims may inflate people's perceptions of a product's healthiness in much the same way as an FDA approved claim. Aside from the problems that arise from these explicit health claims, there is also the consideration that consumers may draw inferences about a product's healthiness based on other package cues, such as a health-related image.

Images as health claims

Though there is no general consensus on what constitutes a health claim, there are undoubtedly some similarities between how different regulatory bodies govern their use. In particular, some regulators recognise a ‘claim’ to be *any* representation, which includes the use of pictures, graphics or symbols (EC, 2006; FDA, 2020b). That is to say that package images are assumed to convey information about the supposed health properties of the products on which they appear (Nathan et al., 2012). Package images are therefore subject to the same regulations as written claims, in that they are not allowed to *imply* that the product reduces the risk of disease (FDA, 2002), or *deliberately* mislead consumers (EC, 2006). But unlike written claims, images can evoke a variety of different interpretations (Smith et al., 2015), and can often suggest unintended meanings (Gil-Pérez et al., 2019). Package imagery then, poses a unique problem to policymakers, in that the consumer may not be certain of the intended message that the manufacturer is trying to convey. According to relevance theory (Wilson & Sperber, 2002), it is assumed that any information that the communicator—in this case being the products’ manufacturer—chooses to convey is expected to be relevant to the message that they are attempting to communicate. In this way, the inclusion of an image on a product’s packaging is therefore interpreted by the consumer as an attempt to communicate something about the product itself. In instances where a message’s relevance is unclear—such as may be the case with an ambiguous package image—people formulate ideas about the message’s meaning by matching contextual cues with previously-held knowledge (Smith et al., 2015).

However, the implied significance of these images may in turn lead consumers to make more optimistic assumptions about the products on which they appear. In one study for instance, participants saw simplistic drawings of three product packages (i.e., bread, cake, yoghurt) featuring either a ‘natural’ symbol of a plant leaf, a ‘medical’ symbol of a cross with a serpent-entwined rod, or no such image. Notably, when the products’ packaging featured either a ‘natural’ or ‘medical’ graphic, participants awarded the product higher healthiness ratings than when there was no graphic present (Saba et al., 2010). Similarly, Carrillo et al., (2014) used a word association task to demonstrate that even ambiguous images--such as an image of a person running, some olives, or a heart and stethoscope—can have health-related connotations that increase the overall appeal and trustworthiness of a product.

Oftentimes more subtle features of an image's subject can also influence people's perceptions of a product's healthiness. In one study for instance, a jar of peanut butter containing an image of peanuts in their raw, unprocessed form was rated significantly healthier—and as containing fewer calories—than an equivalent product featuring an image of peanut butter (Szocs & Lefebvre, 2016). Likewise, people rate images of food products in motion (e.g., cereal being poured into a bowl) as significantly fresher and more appealing than still images (Gvili et al., 2015, 2017).

Though valuable, these studies rely on directly questioning people about their inferences, which may in turn be what actually prompts them to make those inferences. That is to say, by explicitly asking someone to evaluate a product's healthiness, they may be more likely to assume that the package's image is indicative of health and thus make inferences on this basis. Such methods may therefore overestimate the influence that packaging images have on participants' perceptions of product healthiness. Other research examining people's recollections of package information has, however, demonstrated that health imagery can not only enhance the perceived general healthiness of a product, but can lead people to *implicitly* infer specific health benefits (Klepacz et al., 2016). In three experiments, Klepacz et al.'s participants saw images of fictitious product packages that either did or did not feature a health-related image on their packaging, such as a symbol of a heart. Participants later completed a memory test for the information that had appeared on each product's packaging. Notably, when a product's packaging had included a health-related image, participants were more likely to falsely remember that they had read specific health claims about the product. In fact, people made these types of memory errors even when explicitly warned to disregard the health-related images. Taken together, these findings suggest that in response to seeing a health-related package image, participants made spontaneous inferences about how consuming that product would be beneficial to health.

There are at least two reasons to predict that package imagery may lead people to make health-related inferences about a product's contents. Consumers rarely—if ever—make use of all of the package information available to objectively assess a product's healthiness (Grunert et al., 2010; Roe et al., 1999). Consumers instead favour processing as little information as possible to make rational purchasing decisions (Haines, 1974, as cited in Payne, 1976). Thus, traditional dual-process theories (e.g., Chaiken, 1980) that distinguish between two information processing pathways may offer an explanation as to why consumers form health-related inferences from package imagery. Indeed, such theories have more recently been used to explain a variety of phenomena on the topic of reasoning and decision making (Evans, 2006). These dual-process theories assert that human reasoning comprises both rapid, intuitive *heuristic* processes and more in-depth, conscious *analytic* processes (Banks & Hope, 2014). Consumer time constraints (Drichoutis et al., 2006), complex on-pack nutrition information (Boylan et al., 2012), as well as how motivated people are to make healthier food decisions (Guthrie et al., 2015; Miller & Cassady, 2012), all affect the frequency with which people use simplified heuristics when making purchasing decisions. Package claims—and particularly image-based claims—can therefore be thought of as a type of heuristic cue that consumers employ in order to make more generalised inferences about a product's healthiness. Previous research has indeed shown that package images are vivid cues that attract consumer interest (Piqueras-Fiszman et al., 2013; Spence et al., 2016; Varela et al., 2014), which in certain conditions require less effortful processing (Gil-Pérez et al., 2019), and thus generate product expectations more rapidly than related textual information (Smith et al., 2015). Put simply, Alessandri (1982, as cited in Houston et al., 1987) referred to package images as an "advance organiser", insomuch as they generate product expectations on which all subsequent information the consumer learns about the product is judged.

A second, related explanation for why package imagery may inflate consumers' perceptions of a product's healthiness derives from schema theory. A schema can be defined as a cognitive structure, which represents a person's collective knowledge regarding an object or concept (Fiske & Taylor, 1991). Consumer schemata arise from grouping objects into categories based on their shared attributes. Thus, a person may develop a schema for 'healthy' foods that includes items that are low in fat, free from artificial preservatives, and offer some benefit to wellbeing. In instances where information is scarce—such as when consumers are unable to evaluate a product's intrinsic properties (Zeithaml, 1988)—schematic knowledge can generate expectations about the missing product information (Halkias, 2015; Sujan & Bettman, 1989). In one study for instance, consumers expected a soft cheese to taste sweeter when its packaging featured an image of a sweet accompaniment (e.g., quince), rather than an image of a savoury trimming (e.g., cured meat; Rebollar et al., 2016). Likewise, yoghurts whose packaging contained sugar-related imagery (e.g., a sugar cube) were expected to taste significantly sweeter than an equivalent plain-labelled yoghurt (Rebollar et al., 2019). Consumers may therefore make similar predictions about a product's healthiness based on the addition of health-related imagery to a product's packaging.

Crucially, people's prior schematic knowledge can alter their perceptions of new information. Encountering a product that conforms with a person's existing schema elicits a favourable response, because people value things that ultimately match their expectations (Mandler, 1982, as cited in Meyers-Levy & Tybout, 1989). As such, a person may form a favourable impression of a soup possessing the schematic attributes "liquid", "made from a combination of meat and/or vegetables", and "served hot". But information that challenges one's existing schema prompt more in-depth processing so as to attempt to resolve the perceived discrepancy. When a consumer is presented with a product possessing a specific attribute that does not conform to their existing product category schema, they will be forced to re-evaluate their existing schema against this new piece of information. Successful resolution of the perceived discrepancy actually results in a more positive appraisal of the product than that of a congruous schema. For instance, a person may encounter a type of soup typically served cold (i.e., gazpacho), which might be resolved by modifying their existing schema (i.e., soup can be served hot *or* cold). However, if the perceived incongruity is so extreme that resolution would ultimately require displace one's existing schema, then the discrepancy is likely to go unresolved leading to a less favourable target appraisal. Dubbed the schema-congruity effect by Peracchio and Tybout (1996), this theory acknowledges that people's judgments can be influenced by the perceived congruence between a stimulus and an internally held belief. I explore this concept in greater detail in Chapter 5.

Put into context, in 2008 POM Wonderful LLC launched a near eight-year legal dispute with Coca Cola's Minute Maid division after they alleged that Coca-Cola had deliberately misled consumers by marketing a "pomegranate blueberry" juice that contained just 0.5% pomegranate-blueberry juice (POM Wonderful v. Coca-Cola Co., 2014). POM Wonderful LLC argued that the inclusion of an image depicting both a pomegranate and blueberries on the products' labels, as well as the enlarged "pomegranate blueberry" text (see Figure 2) created an illusion that consumers were purchasing a pomegranate-blueberry drink that was in fact 99.4% apple and grape juice (Ikeda & Blackburn, 2016). Taking into consideration that both pomegranates and blueberries are widely recognised "superfoods" (YouGov, 2013) that are consumed for their innumerable health benefits (Proestos, 2018), it stands to reason that the overt use of pomegranate-blueberry imagery may have led some consumers to infer that the product possessed some of those benefits itself. However, the jury eventually ruled in favour of Minute Maid stating that the product's labelling had not *deliberately* misled consumers by way of the fact that the packaging referred not to the beverage's nutritional content, but rather the product's taste. By the American FDA's standards, the package imagery was not seen to imply that the product would reduce the risk of disease and therefore the case was ultimately dismissed.

Front-of-pack nutritional labelling

Evidently, package imagery can inflate consumers' perceptions of a product's healthiness. In most studies that explore how packaging imagery affects consumers' judgments of a product's healthiness though, participants typically study fictional product packages that provide minimal contextual information about the product itself. For example, participants in Saba et al.'s (2010) study saw crude black and white line drawings of a food product (e.g., bread), appearing with or without a health-related image. Likewise, the fictitious product packages used by Klepacz et al. (2016) featured a colourful design that included the

Figure 2

Example of Minute Maid's 'pomegranate blueberry' juice packaging (The Times Editorial Board, 2014)

product's name, in addition to some peripheral text (e.g., the product's weight), yet no explicit indicators of the product's healthiness. Such materials do not therefore mirror the fact that in most Western countries, for instance, regulations mandate that all pre-packaged foods must display a product's nutritional information on the product's packaging (European Union, 2011; FDA, 2020b). In Europe for example, product labels are required by law to include the product's energy value, in addition to the amount of fat, saturates, carbohydrate, sugars, protein and salt the product contains (EU, 2011, Article 30.1). Whereas traditionally such information was found on the back of a product's package, several countries have since developed their own front-of-pack (FoP) devices that offer a snapshot of a product's nutritional information in an easily interpretable format. Nondirective nutritional labels (e.g., Guideline Daily Amounts [GDA]), typically feature detailed numerical information regarding the amounts of each nutrient (listed per serving), but lack any indication as to whether those nutrients are present in 'healthy' quantities (Hodgkins et al., 2009). Though informative, many consumers express difficulty interpreting numerically-based labelling systems (Cowburn &

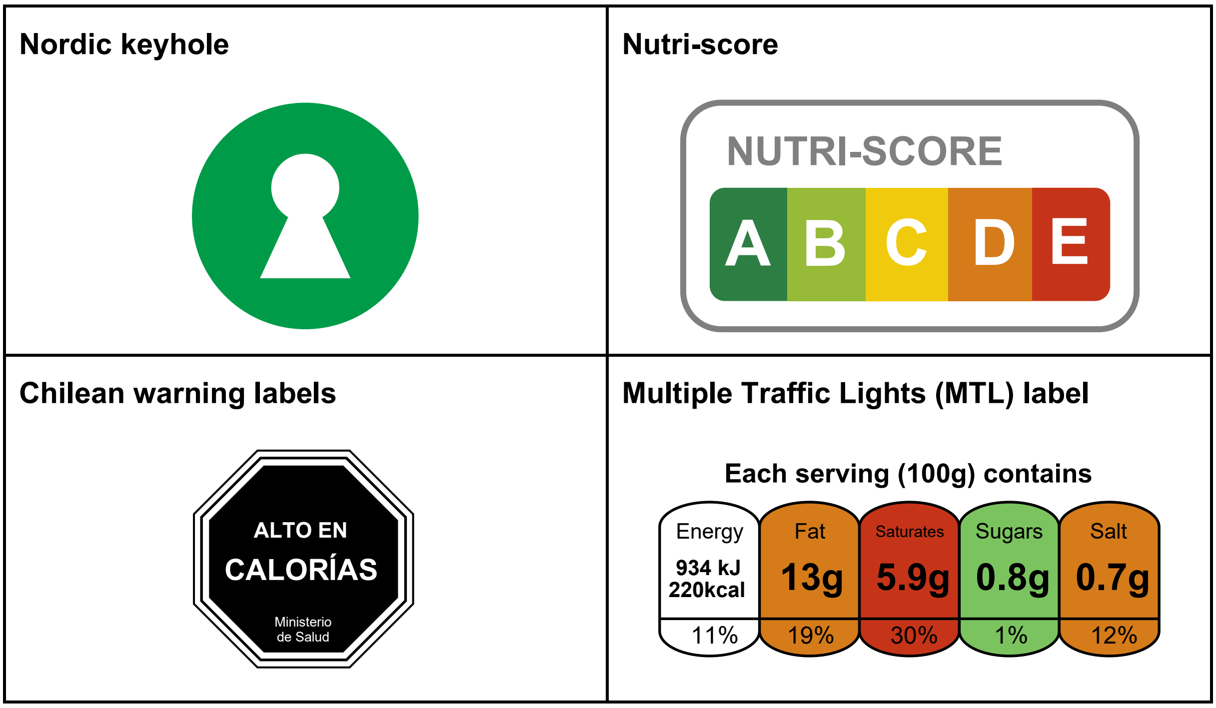
Stockley, 2005), while critics of these labels argue that manufacturers are complicit in misrepresenting serving sizes to make foods appear healthier than they actually are (Lobstein et al., 2007).

At the other end of the spectrum, directive labels provide consumers with a finite decision regarding a product's healthiness relative to other products within the same category (Hodgkins et al., 2009). Initiatives such as the Green Keyhole in Sweden (Swedish Food Agency, 2021), the Nutri-Score in central Europe (Santé publique France, 2021), and Chilean warning labels (Pan American Health Organisation, 2017) identify healthier options through the presence—or absence—of an easily recognisable symbol (see Figure 3 for examples). The Nutri-Score for instance, assigns each product a letter from "A" to "E" based on an algorithm that computes the product's overall healthiness. This formula takes into consideration the relative amounts of less healthful nutrients (i.e., sugars, saturates, sodium) to more favourable nutrients (i.e., fibre, protein, fruits and vegetables; Colruyt Group, n.d.). Conversely, in Chile, recently adopted warning labels require all pre-packaged foods high in calories, sugars, saturates and sodium to feature a health warning alerting consumers to this fact (Corvalán et al., 2018). Products subject to regulation must carry a FoP warning label consisting of a black octagon with the words "alto en…" (i.e., "high in…") followed by the nutrient(s) name (see Figure 3; Taillie et al., 2020). However, it is difficult to objectively measure the efficacy of these warning labels, as their introduction coincided with changes to the law prohibiting the sale of regulated foods in schools, cafeterias, vending machines and kiosks, in addition to banning advertisements of regulated foods to children under the age of 14 (Corvalán et al., 2018).

Lastly, semi-directive labels provide equivalent amounts of numerical information as nondirective labels, but such information is presented in an easily interpretable format so that consumers can tell at a glance whether the products' nutrients are present in 'healthy' quantities (Hodgkins et al., 2009). Here in the UK, for instance, a Multiple Traffic Light (MTL) label assigns each nutrient group (fat, saturates, sugar, salt) a colour code based on whether that nutrient is present in high (red), medium (amber), or low (green) amounts (United

Figure 3

Examples of front-of-pack labelling systems



Kingdom Department of Health, 2016). These labels utilise familiar heuristics, such as the colour green signalling ‘health/go’ and red ‘danger/stop’ (Tham et al., 2020), to provide consumers with an easy-to-process snapshot of a product’s nutritional quality. A predominantly green label therefore indicates a ‘healthy’ food that is suitable for regular consumption, whereas a mainly red label represents a food that should be consumed in moderation (see Figure 3). Notably, the inclusion of a MTL label on a product’s packaging has reliably been shown to improve consumers’ ability to correctly identify healthier food choices (Borgmeier & Westenhoefer, 2009; Hawley et al., 2013; Jones & Richardson, 2007; Shangguan et al., 2019), though it remains unclear how such labels would interact with the effects of health-related package imagery.

There is good reason to predict that these more objective indicators of a product’s healthiness—such as an MTL label—would affect people’s likelihood of drawing inferences from FoP health imagery. First, it has long been suggested that written claims appearing on product packages and the product’s nutritional information have independent effects on people's beliefs (Ford et al., 1996). In one study for instance, participants rated both 'healthy' and 'less healthy' soups as significantly healthier when their packages carried a disease reduction claim than when they did not (Franco-Arellano et al., 2020a). However, for those participants who chose to also consult the products' Nutritional Facts tables—and thus directly assess the products' nutritional information—no such effect of the disease reduction claim was found. Similarly, Franco-Arellano et al. (2020b) reported that the presence of a nutrient claim on a food's packaging led to higher ratings of perceived healthiness, and greater purchasing intentions, but only among participants who did not consult the product's Nutritional Facts table. Notably, there is evidence to suggest that FoP nutritional labels may also affect people's health-related inferences. For instance, Maubach et al. (2014) used a best-worst scaling choice task to show that participants were more likely to select a product with a poor, or moderate, nutrient profile as the 'best' option available to them if that product's packaging featured a health claim. Yet health claims had no such effect on participants' best-worst choices when the products' packaging had also featured a MTL label. These findings imply that whereas written claims—and by extension, health-related images—may shape people's beliefs about a product's healthiness, people tend to instead rely on explicit contextual information to inform their judgments when it is readily available. Taking into consideration that self-reported nutritional label usage is high (Campos, 2011), studies investigating how packaging imagery affects product appraisals may have overestimated the effect of imagery by not proving a frame of reference to judge the plausibility of the products' implied health benefits.

Chapter summary

Package imagery is but one indicator of a product's healthiness that—much like written claims—can shape consumer's inferences about a product's healthiness, and even lead people to falsely remember reading health claims about those products that they never actually saw (Klepacz et al., 2016). But unlike heavily regulated written claims, images can convey subtle and often unintended meanings (Gil-Pérez et al., 2019), insomuch as even ambiguous images—such as a person running—can have health-related connotations

(Carrillo et al., 2014), which may lead consumers to make more optimistic assumptions about the products' contents. Crucially, these health inferences may in turn affect consumers' eating behaviour by way of the fact that people tend to consume foods that they *perceive* to be healthier in greater quantities (Cavanagh & Forestell, 2013; Irmak et al., 2011; Provencher et al., 2009). But studies investigating how packaging imagery influences consumers' judgments of products' healthiness, typically involve having participants study fictional product packages that offer minimal contextual information about those products' *actual* healthiness (e.g., Saba et al, 2010). Such materials overlook that pre-packaged foods are often required to display nutritional information of their packaging, and indeed, several countries use additional visual devices (e.g., MTL label) to communicate information about healthiness. It is reasoned that this missing contextual information may in fact safeguard consumers from making potentially erroneous inferences about a product's healthiness (Franco-Arellano et al., 2020 a, b; Maubach et al., 2014) by way of offering consumers a frame of reference when judging the plausibility of these products possessing additional health benefits. Thus, the overall aims of Experiments 1-3 were to examine whether images appearing on product packaging influenced people's inferences about those products' healthiness, even when they were presented with more purposeful health information.

Experiment 1. The aims of Experiment 1 were twofold. The first aim was to test the replicability of the finding that front-of-pack health imagery can lead people to falsely remember reading health claims that they in fact only inferred (Klepacz et al., 2016). The second aim was to examine the extent to which a FoP label signalling the product's *actual* healthiness influenced the effect of imagery. To this end, participants saw image of fictitious food product packages featuring written nutrient claims. Some of these packages featured a health-related image (e.g., a heart), whereas others did not. The supposed 'healthiness' of each product was manipulated by altering the colour of the products' MTL label. Following a short delay, participants attempted to remember the written claims as they had appeared on each products' packaging.

Experiment 2. The aims of Experiment 2 were first to test the replicability of the findings from Experiment 1, and secondly, to examine whether an explicit statement identifying the products as relatively ‘healthy’ or ‘unhealthy’ attenuated this effect. These statements were used in place of the MTL labels to address concerns that such labels were not sufficiently salient to override the influence of the package imagery. In most other aspects, this study was a direct replication of Experiment 1.

Experiment 3. Experiment 3 sought to more closely examine how package imagery influences consumers’ *beliefs* about a product’s healthiness, in addition to testing two potential mechanisms underpinning the observed effects of imagery. To this end, the first aim of Experiment 3 was to examine the extent to which health-related images on product packaging affected people’s perceptions of the risks and/or benefits of consuming those products. The second aim was to investigate the extent to which this effect was contingent on a perceived consistency between the package image and the product’s supplementary information (i.e., the product’s function and risk-benefit information). Participants initially saw images of fictional dietary supplements, some of which contained a health image on their packaging. They were then instructed to infer the products’ intended purpose. Next, participants received some additional contextual information about the product in the form of the products’ ‘actual’ function, as well as two health risks and two health benefits of consuming each product. Participants were subsequently asked to rate the perceived benefits, risks and extent to which the benefits outweighed the risks of consuming each supplement.

Chapter 3

Experiment 1[2]

The aims of Experiment 1 were twofold. Firstly, I aimed to replicate Klepacz et al.'s (2016; Experiment 3) finding that health-related package images can lead people to falsely remember reading health claims about the products on which they appear. Extending this finding, my second aim was to examine the extent to which an explicit indicator of a product's healthiness—which one would expect to find on the product's packaging—would moderate this effect. To address my research questions, I used Klepacz et al.'s (2016) memory-based experimental method. Participants saw images of fictitious product packages featuring written nutrient claims and were later tested participants' memory of these claims. Some of the product packages featured health-related images (e.g., a heart), whereas others did not. The general 'healthiness' of the product was manipulated by altering the colour of the products' MTL label. I did so on the basis that my participants would be highly familiar with the MTL labelling system given its prevalence in the UK, and because it afforded me a straightforward way to manipulate the products' relative healthiness. Based on Klepacz et al.'s findings, I predicted that health-related package images would lead participants to more often misremember reading health claims about the products. However, based on the above reasoning, I also predicted that this effect would only occur when the MTL label signalled that the product was a relatively healthy food (i.e., a green MTL label), or when the MTL label conveyed no nutritional information (i.e., a white MTL label). Conversely, I predicted that there would be no effect of imagery when the products' MTL label identified the food as being unhealthy (i.e., a red MTL label).

Method: Pilot study

A short pilot study was conducted to identify and subsequently resolve any issues with the procedure, as well as refine the experimental materials. The results from this study

[2] This experiment is currently under review as Experiment 1 in Delivett, C. P., Farrow, C. V., Thomas, J. M., & Nash, R. A. (n.d.). *Front-of-pack health imagery on both 'healthy' and 'unhealthy' foods leads people to misremember seeing health claims*.

were not formally analysed, but rather, the data was used to highlight any potential flaws in the existing methodology.

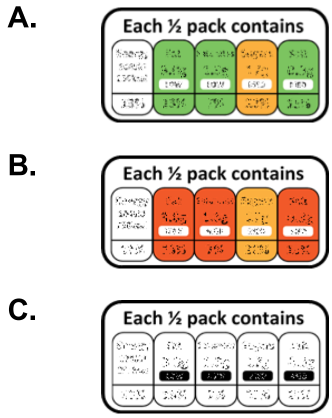
Participants and design. A total of 19 participants completed the pilot experiment in full, either in exchange for course credit or without compensation (17 females, 2 males; M_{age} = 19.37, *SD* = 1.17, range = 18-23). The study used a 2 (image: present vs. absent) x 3 (MTL label: green vs. red vs. white) within-subjects design. The dependent variables were the number of falsely recalled and recognised health claims.

Materials. The Qualtrics Survey Platform was used to present the stimuli and record participant responses. For the purpose of this experiment, I created a new set of critical stimuli adapted from the twelve fictitious product packages used by Klepacz et al. (2016; Experiment 3). Each of Klepacz et al.'s original stimuli depicted a fictional food product, featuring a brand name, a description of the contents (e.g., cereal bar), and some basic information about the product itself (e.g., the product's weight). Crucially, each product package also contained a short—EU approved—written nutrient claim, which referred to a specific nutrient that the product contained (e.g., "An important source of carbohydrates"; see Appendix A for a full list of the claims used). Each package image had a second identical variant, on which a simple health-related image was added to the packaging to represent a specific health function (e.g., an image of a person running was used to symbolise enhanced muscular endurance).

Next, I created a green MTL label (to convey mainly 'healthy' properties), a red MTL label (conveying mainly 'unhealthy' properties), as well as a white, monochrome equivalent of an MTL label (conveying no discernible information about the products' health properties), which was designed to serve as a control condition. No textual nutritional information was visible on the MTL labels and therefore the labels' colour was the only information conveyed to inform participants' judgments about each product's apparent healthiness (see Figure 4 for an example). These labels were then superimposed onto Klepacz et al.'s original 24 food packages (i.e., 12 image-present, 12 image-absent), creating three variants of each package (i.e., green vs. red vs. white), and therefore 72 product stimuli in total. These 72 images were

Figure 4

Examples of MTL labels as they appeared on product packages



Note. Panel A represents the green (healthy) MTL label; Panel B represents the red (unhealthy) MTL label; Panel C represents the white (control) MTL label.

blocked into six stimulus sets so that each participant saw one variant of each product (e.g., they only ever saw the ‘peanuts’ once, appearing either with or without an accompanying health image, with either the green, red, or white MTL; see Figure 5 for examples). I fully counterbalanced the assignment of product to the image and MTL label conditions, so that all participants saw two products, at random, in each of the six conditions. Together, these stimuli served as my *critical* items, for which I was expressly interested in participants’ ability to remember each package’s written nutrient claim.

I then designed three additional food product packages to use as filler stimuli, in the same manner as Klepacz et al.’s stimuli (i.e., each package contained a fictional brand name, product description, in addition to some rudimentary product information). Unlike the critical stimuli described above, each of these filler products featured a health claim chosen from the *EU Register of Nutrition and Health Claims Made on Foods* (EC, 2018), which referred to the health benefits of a particular nutrient (e.g., “Protein contributes to the maintenance of muscle mass”; see Appendix B for a full list of the claims used). These three filler stimuli were not relevant to my analyses, but rather, their inclusion served only to ensure that participants saw some health claims during the study. That is to say that the filler stimuli

Figure 5

Examples of fictional product packages containing EU approved nutrient claims

Note. Exemplars in the left-hand column represent the image-absent condition, whereas those in the right-hand column represent the image-present condition. Row A represents the green (healthy) MTL label conditions; Row B represents the red (unhealthy) MTL label conditions; Row C represents the white (control) MTL label conditions.

were designed to enhance the likelihood that participants would think it possible that they had read health claims on the critical products (see Appendix C for an example). No counterbalancing was used for the filler stimuli.

Procedure. Participants completed the study on individual workstations within a laboratory. Once participants had provided informed consent, the encoding phase began. Initially, participants were told:

> "In a moment you will be shown 15 pictures of fictional food products. These images will appear onscreen one after another for a set period of time. The pictures will automatically appear and disappear. During this time, please try to remember as much information about the pictures as possible. You will be asked about this information later."

Next, participants saw a random exemplar of a fictitious food package for 20 seconds, after which a new random exemplar appeared onscreen for the same duration. This process then repeated until participants had seen one variant of all 15 products (i.e., they saw 12 *critical* foods, featuring nutrient claims, and 3 fillers, featuring health claims). Of the 12 critical food packages, each participant saw six image-present products and six image-absent products, and within each of the two image conditions, they saw two products with a green MTL label, two with a red MTL label, and two with a white MTL label. Once participants had seen all 15 product packages, they completed a 3-minute filler task. The task itself featured a series of logic puzzles that involved selecting the missing shape that best completed a 2x2 grid of three interrelated images. After 3 minutes had elapsed, the memory phase began.

The memory phase comprised both a cued recall task and a recognition task. For the recall task, participants were again shown the same 12 critical product packages they had seen previously in a new random sequential order, only this time the written nutrient claim on each product was obscured by a black panel. For each product, participants were asked to recall what had originally been written in the obscured part of the package, and to type their response into a text box underneath the package image. In the event that participants were unable to remember the claim, they were instructed to type “Don’t know”.

Once participants had submitted their recall responses for all 12 critical packages, the recognition task began. Participants once again saw the same 12 critical products sequentially with the corresponding claim obscured, but this time each product was accompanied by a list of six statements, and participants were asked to select the statement which had originally appeared on the package. Of the six randomly ordered statements; one was always the correct nutrient claim that had appeared during the encoding phase (e.g., “Source of zinc”), one was a health claim associated with the image that had appeared in image-present conditions (e.g., “Zinc contributes to normal cognitive function”), and four were general claims (e.g., “Free from bones”).

Once participants had responded to all 12 critical products, they were asked a few demographic questions. To ensure that we only included data from participants who could correctly interpret the meaning of an MTL label, participants were then shown an example of an actual MTL label—complete with legible nutritional information—alongside a list of six statements (e.g., “This product is LOW in fat”). Participants were simply asked to correctly choose which three of these statements accurately interpreted the information on the label. Finally, participants were fully debriefed and thanked for their time.

Results: Pilot study

The results of the pilot study found that only 1.8% of participants’ responses on the cued recall task were coded as health claims, with just 15.8% of participants falsely recalling at least one health claim. Similarly, when participants were asked to select the claim that they remembered seeing on the products’ packaging, participants incorrectly chose the health claim in just 6.6% of instances. This may, however, not be all that surprising given that participants saw four times as many products containing nutrient claims, as they did products containing health claims. It is therefore conceivable that by presenting a disproportionate number of stimuli featuring nutrient and health claims, participants were only ever likely to recall seeing shorter, nutrient claims. Consequently, in preparation for the main experiment I created an additional 9 filler stimuli, each with a new EU approved health claim. I subsequently added a health-related image to half of the filler packages that complemented the products' health claim (e.g., the health claim "Protein contributes to the maintenance of muscle mass", was accompanied by an image of a flexed arm). To account for the increased experiment duration associated with viewing that many more stimuli, I reduced the exposure time of each package stimuli from twenty to ten seconds.

A second notable oversight of the pilot study was that the written nutrient claims—as they appeared on the products' packaging (e.g., "Contains vitamin D")—were significantly shorter in length than the related health claims that participants saw during the recognition task (e.g., "Contains vitamin D for the maintenance of healthy teeth"). Given that the black panels obscuring the products' nutrient claims were only just large enough to cover the claim itself, participants may have rejected the longer, health claims on the grounds that a claim of that length could not possibly fit behind such a small panel. For this reason, I opted to increase the size of the black panels on each of the package stimuli for the main experiment.

Furthermore, I added one additional element to the recognition task that was not preregistered, to test whether participants' responses were merely the result of educated guesswork. That is, after making each recognition response, participants were asked to qualify their decision by selecting either; (1) "I *remember* seeing it on the packaging", (2) "I *know* I saw it on the packaging, although I don't explicitly remember it", or (3) "It was just a *guess*".

Lastly, 4 participants failed the MTL comprehension test—and thus would have been excluded from my main analysis as per my preregistered criteria—despite indicating that they were familiar with the MTL labelling system. Closer inspection of participants' responses found that people repeatedly failed to correctly identify that the example MTL label depicted a product with "*moderate* levels of salt", and therefore the decision was made to replace the word "moderate" with "medium" to limit any further confusion.

Method

This study received full ethical approval from Aston University Research Ethics Committee. The procedure and planned analysis were preregistered prior to data collection through AsPredicted.org, and the preregistration can be found in Appendix D.

Participants and design. Per my preregistered plan, I intended to recruit participants using conservative inclusion criteria, until a total of 60 people had met these criteria. The planned sample size was based on Klepacz et al. (2016, Experiment 1), whose 36 participants provided high statistical power to detect medium-sized effects of imagery on participants' false recognition of health claims, using their within-subjects design. In the present research we also used a within-subjects design, and so my target sample of 64 was based on a decision to recruit approximately 50% more participants than Klepacz et al. (2016, Experiment 1). Ultimately, this meant that 156 undergraduate students completed the study in full, either in exchange for course credit or without compensation. Data from 96 participants were removed from the analysis based on my preregistered exclusion criteria. Specifically, 74 gave invalid responses to more than 25% of trials during the recall task (see *Coding of recall data* below); 4 reported that they, or someone in their immediate family, had been diagnosed as colour blind; 3 said that they were unfamiliar with the MTL labelling system; and 15 failed the MTL comprehension test, as described in the pilot study. These removals left a final sample of 60 UK residents whose data were included in the preregistered analysis (50 females, 9 males, and 1 other; mean age = 20.32, *SD* = 3.01, range = 18-34). In hindsight, my inclusion criteria were unduly conservative and led to a greater than expected exclusion rate, however, I followed my preregistered research plan regardless. For completeness, I also report the findings of the full dataset, absent any exclusion criteria. As before, the study used a 2 (image: present vs. absent) x 3 (MTL label: green vs. red vs. white) within-subjects design, with the number of falsely recalled and recognised health claims as dependent variables.

Procedure. Participants completed the study individually, within a laboratory. The findings of the pilot study highlighted a few limitations of the experimental procedure that were subsequently addressed for the main experiment. Specifically, participants now saw a total of 24 images of fictional food product packages; 12 *critical* packages, featuring only nutrient claims, and 12 *fillers*, featuring only health claims. To account for the additional time associated with viewing that many more stimuli, each product package was viewed for 10 seconds as opposed to the original 20 seconds. Finally, as an additional measure, participants were now asked to make a remember/know/guess (R/K/G) judgment for each recognition response. All other aspects of the procedure remained unchanged from the pilot study.

Results: Preregistered analysis

Coding of recall data. As per Klepacz et al. (2016), responses to the recall task were coded as either; (1) a *health* claim, whereby the participant referred to a health function of the product (e.g., helps build strong bones), (2) a *non-health* claim, whereby the participant referred to either a specific nutrient without mentioning its related health properties (e.g., enriched with calcium), or referred to another product characteristic (e.g., easy to cook), or (3) an *omission*, whereby the participant either gave no meaningful response, said “Don’t know”, or referred to another detail that remained visible on the packaging during the recall phase (e.g., the product’s weight). Responses were coded as valid if they fell into the first of these two categories, and thus, to meet the preregistered inclusion criteria, participants were expected to provide no more than three omissions. The large proportion of excluded data was therefore primarily a consequence of my unrealistic expectation about how much participants would remember. In my final dataset after exclusions, 12.9% of all responses were coded as health claims, with 71.6% of participants falsely recalling at least one health claim. Note that the percentage of falsely remembered health claims was substantially higher than in the pilot study, suggesting that the revised package stimuli and amended procedure were effective. Non-health claims accounted for 71.5% of all responses, with the remaining 15.6% of answers coded as omissions.

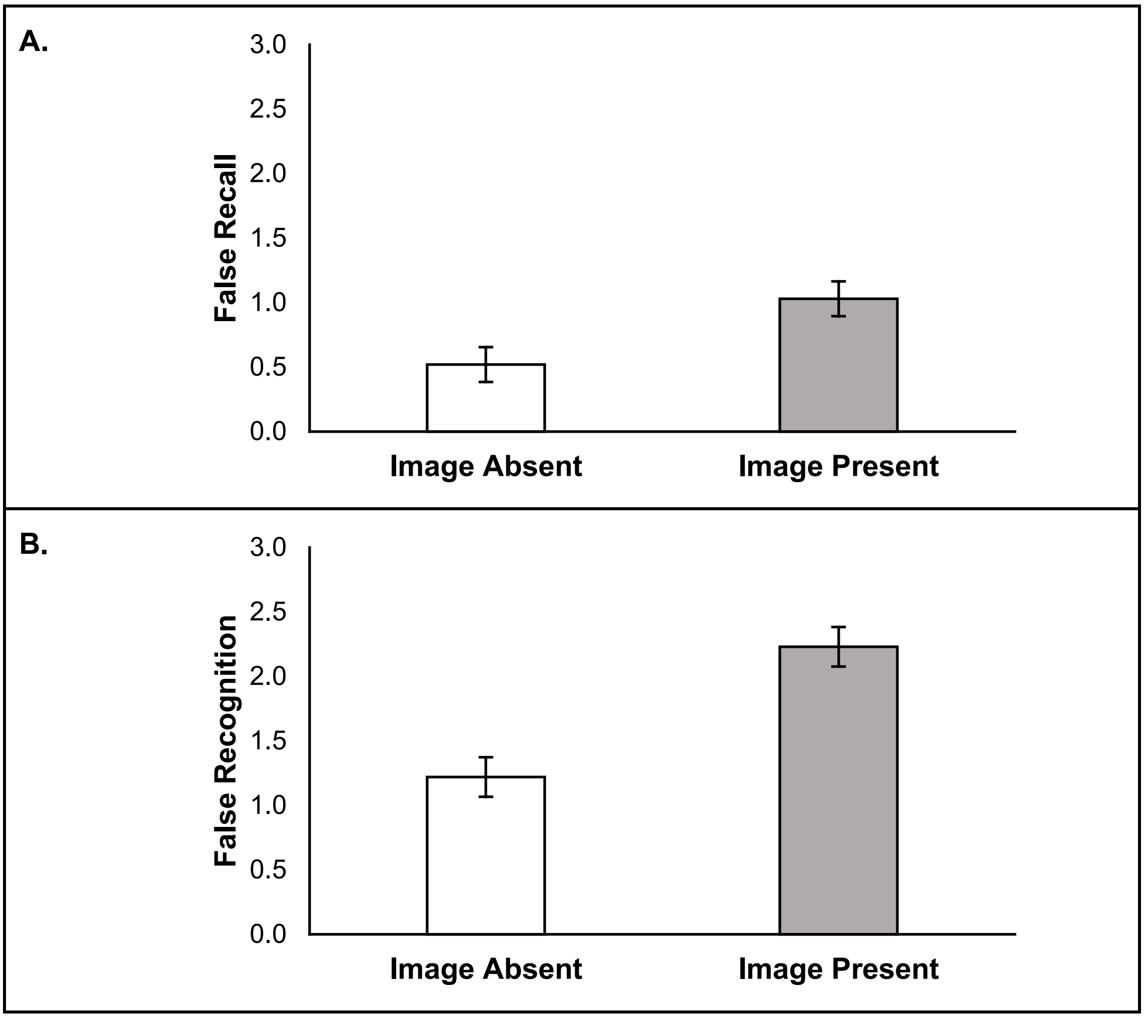
False Recall. To begin, I was interested in whether the addition of a health-related image to a product’s packaging would lead people to falsely recall nutrient claims as health claims. A 2 (image: absent vs. present) x 3 (MTL label: green vs. red vs. white) repeated-measures ANOVA revealed a significant effect of image, $F(1, 58) = 13.75$, $p < .001$, $\eta^2_p = .19$, with participants falsely claiming to have seen almost twice as many health claims about products whose packaging featured a health image, than for comparable image-absent products (see Panel A of Figure 6). Contrary to my hypothesis though, an MTL label depicting the general 'healthiness' of a product had no meaningful effect on the number of falsely recalled health claims, $F(2, 116) = 0.21$, $p = .81$, $\eta^2_p < .01$, and there was no significant image x MTL label interaction $F(2, 116) = 1.13$, $p = .33$, $\eta^2_p = .02$.

False recognition. Next, I was interested in whether a health-related package image would increase the likelihood of participants incorrectly selecting the *health* claim from the list of six options during the recognition task. In total, participants recognised the correct nutrient claim for 65.3% of products. However, participants incorrectly chose the health claim for 28.8% of products, with 98.3% of people falsely recognising at least one health claim. A 2 (image: absent vs. present) x 3 (MTL label: green vs. red vs. white) repeated-measures ANOVA on the number of instances in which participants incorrectly chose the health claim, revealed a significant main effect of image, $F(1, 59) = 31.28$, $p < .001$, $\eta^2_p = .35$, with participants more likely to falsely select the health claim when a health-related image was present on the packaging, than when it was absent (see Panel B of Figure 6). There was however no significant effect of an MTL label on the number of falsely recognised health claims, $F(2, 118) = 0.56$, $p = .57$, $\eta^2_p = .01$, nor was the image x MTL label interaction significant, $F(2, 118) = 0.15$, $p = .86$, $\eta^2_p < .01$.

Exploratory analysis of subjective recognition judgments. At face value it is perhaps unsurprising that health images increased the false recognition of health claims, after all, even if participants recalled nothing about each product, then it would make sense to choose the recognition option most related to a visible cue on the product's packaging. If this educated guessing were the sole explanation of my findings, then we would expect the effect to disappear after excluding those recognition responses that participants described as 'guesses'. To address this matter, I conducted additional analyses to those I preregistered

Figure 6

Average number of falsely remembered and recognised health claims for the image-absent and image-present conditions in Experiment 1



Note. Panel A represents the number of falsely *recalled* health claims for the image-absent and image-present conditions; Panel B represents the number of falsely *recognised* health claims for the image-absent and image-present conditions. Error bars represent 95% within-subjects confidence intervals.

(see Table 1). Of the falsely recognised health claims, 39.1% of responses were reportedly 'remembered', 41.5% were 'known', and 19.3% were 'guesses'. The presence of a health-related image did significantly increase the number of guess responses, $F(1, 59) = 15.56$, $p < .001$, $\eta^2_p = .21$. However, the main effect of image remained significant even after excluding these guess responses (i.e., leaving only 'remember' and 'know' responses), $F(1, 59) = 9.47$, $p < .01$, $\eta^2_p = .13$.

Table 1

Mean (SDs) number of recognition errors made by participants for remember, know and guess responses in Experiment 1

Response	Image-absent	Image-present
Remember	0.57 (0.81)	0.78 (0.88)
Know	0.52 (0.77)	0.92 (1.11)
Guess	0.13 (0.34)	0.53 (0.68)

Results: Exploratory analysis of full sample

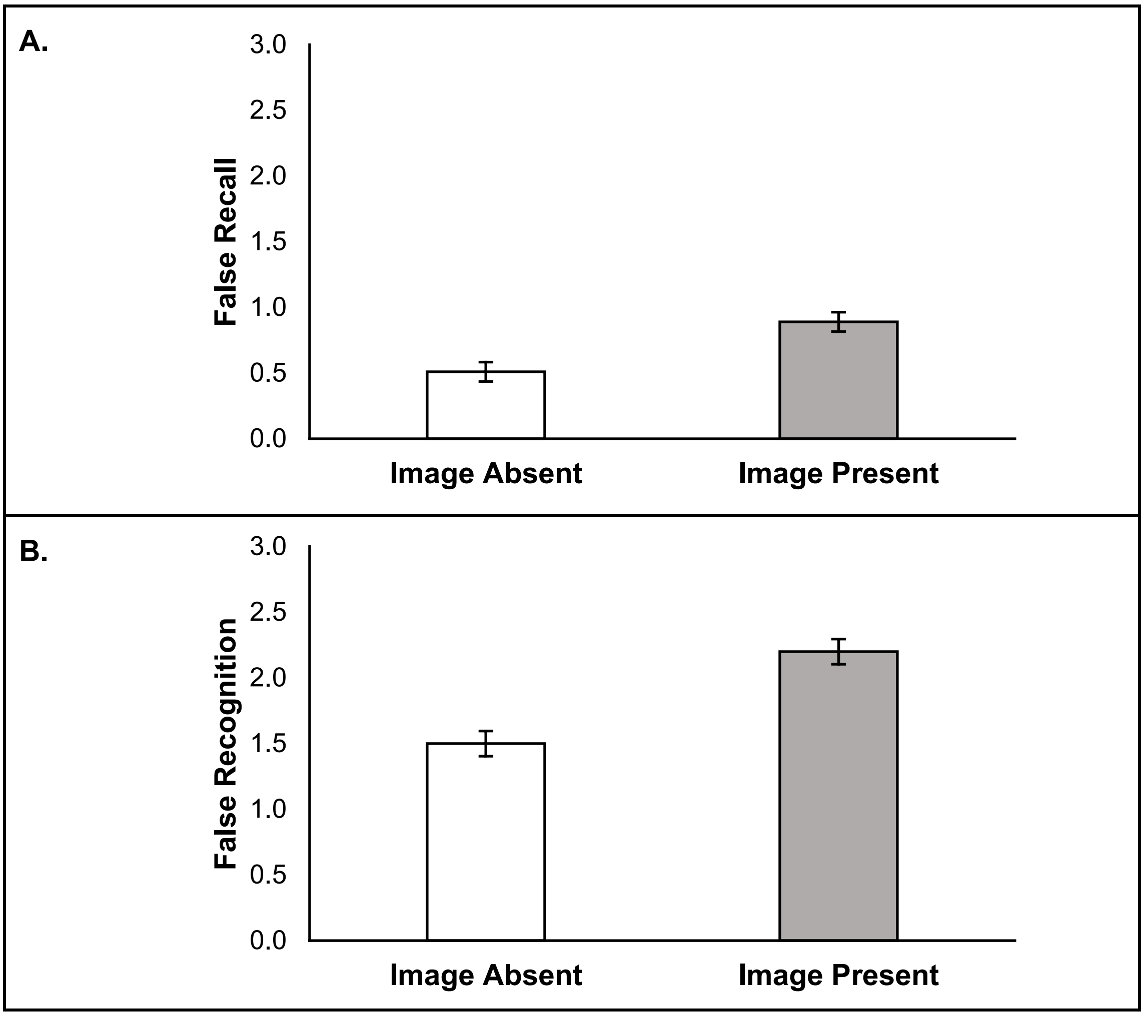
As previously mentioned, the conservative inclusion criteria led to a large number of participants' data being excluded from the main analysis. Most notably, 74 participants' data was excluded from the main analysis for providing at least four responses that were subsequently coded as omissions. However, this data is nevertheless valuable for testing the robustness of the observed effect of image. To this end, I repeated all of the analyses using the full sample of 156 participants, minus any exclusion criteria.

False Recall. Notably, the number of falsely recalled health claims were comparatively similar for both the preregistered (12.9%) and total (11.6%) samples, respectively. By comparison, omissions now accounted for 35.6% of total responses. Importantly, the main effect of image remained significant, $F(1, 154) = 19.57$, $p = <.001$, $\eta^2_p = .11$, with participants more likely to falsely recall having seen a health claim when the products' packaging featured a health-related image compared to when there was no image (see Panel A of Figure 7). Again, a MTL label had no significant effect on the number of falsely recalled health claims, $F(2, 308) = .85$, $p = .43$, $\eta^2_p < .01$, and the image x MTL label interaction was also not significant, $F(2, 308) = .41$, $p = .66$, $\eta^2_p < .01$.

False recognition. Recognition responses were also comparable to the preregistered sample, with participants selecting the incorrect health claim for 30.8% (vs. 28.8%) of products. The main effect of image was again significant, $F(1, 155) = 35.90$, $p <$

Figure 7

Average number of falsely remembered and recognised health claims for the image-absent and image-present conditions for the full sample of Experiment 1



Note. Panel A represents the number of falsely *recalled* health claims for the image-absent and image-present conditions; Panel B represents the number of falsely *recognised* health claims for the image-absent and image-present conditions. Error bars represent 95% within-subjects confidence intervals.

.001, $\eta^2_p = .19$, with participants more likely to select the health claim when a health-related image was present on the packaging, than when it was absent (see Panel B of Figure 7). A MTL label once again had no meaningful effect on the number of falsely recognised health claims, $F(2, 310) = .66$, $p = .52$, $\eta^2_p < .01$, nor was the image x MTL label interaction significant , $F(2, 310) = 1.77$, $p = .17$, $\eta^2_p = .01$.

Subjective recognition judgments for critical claims. As a final consideration, I once again repeated the analyses of participants' R/K/G responses to ensure that the observed effect of imagery was not resultant of an increase in the number of “guess” responses. The addition of a health claim again increased the number of ‘guess’ responses, $F(1, 155) = 20.13$, $p < .001$, $\eta^2_p = .12$, but crucially, the main effect of image remained significant after these responses had been removed, $F(1, 155) = 11.68$, $p = .001$, $\eta^2_p = .07$ (see Table 2).

Table 2

Mean (SDs) number of recognition errors made by participants for remember, know and guess responses for the full sample of Experiment 1

Response	Image-absent	Image-present
Remember	0.56 (0.77)	0.74 (0.90)
Know	0.61 (0.87)	0.84 (0.99)
Guess	0.33 (0.64)	0.62 (0.78)

Discussion

The results from Experiment 1 replicate Klepacz et al.’s (2016; Experiment 3) finding that the inclusion of a health-related image on a product’s packaging led participants to falsely remember reading more health claims, which they never actually saw. The occurrence of these false memories suggests that as a result of seeing a health image on a product’s packaging, participants inferred that the product possessed additional benefits to health. Contrary to my hypothesis though, these memory errors were just as frequent when the product’s MTL label signalled a mostly ‘healthy’ product, as when the MTL label signalled a mostly ‘unhealthy’ product. Thus, participants seemingly formed these inferences without considering the overall healthiness of the products on which these images appeared. Furthermore, participants’ R/K/G responses suggest that these inferences were not the result of mere deductive reasoning, but rather, that participants explicitly ‘remembered’ or ‘knew’ that they had previously seen the inferred health claim.

These findings contribute to a growing body of empirical research, which illustrates that health-related package imagery can inflate the perceived healthiness of a product (Carrillo et al., 2014; Delivett et al., 2020; Saba et al., 2010). But contrary to previous research that suggests additional contextual information could protect consumers from potentially misleading health claims (e.g., Franco-Arellano, 2020a, b), the data herein found that a product's 'actual' healthiness did little to deter people from drawing inferences about that product's health properties on the basis of the package's imagery. Specifically, changing the colour of a product's MTL label to denote a mostly healthy, or unhealthy, foodstuff had no meaningful effect on the number of falsely remembered and recognised health claims. These findings therefore suggest that people's health-related inferences persist even when people have access to more purposeful information about the products' healthiness.

Thus, legislation governing the use of packaging imagery is warranted. Whereas existing regulations in some countries already govern the use of pictorial claims in the same manner as written claims, it is often difficult to objectively measure what 'claim' any particular image is trying to make. This concern is particularly pertinent given that images can evoke a variety of different interpretations (Smith et al., 2015), and even ambiguous images can have health-related connotations (Carrillo et al., 2014) that may lead consumers to make inferences about a product's healthiness. In the aforementioned case of POM Wonderful LLC vs. Coca-Cola Co. for instance, Coca-Cola's pomegranate-blueberry juice was ruled not to have *deliberately* misled consumers as the package imagery referred only to the product's taste and not its hypothetical health benefits (Ikeda & Blackburn, 2016). I discuss the implications of these findings in greater detail in Chapter 9.

It was reasoned that consumers make inferences based on package imagery because they lack the necessary time (Drichoutis et al., 2006), motivation (Guthrie et al., 2015; Silayoi & Speece, 2004), and knowledge (Sanjari et al., 2017) to systematically process all of the information available to them. But equally, package MTL labels should have drawn upon familiar heuristics (i.e., the colour green signalling "health/go") to provide participants with a snapshot of a product's nutrient profile. Evidently, it was not the case that participants simply misunderstood the MTL labelling system, as I explicitly tested, and subsequently excluded those participants who failed to correctly interpret a MTL label. Participants instead made these inferences in spite of more purposeful information about the products' healthiness being present. But just because participants knew how to correctly interpret a package MTL label, this does not necessarily mean that they were *aware* of this information on the package stimuli. That is to say, the MTL labels may have lacked sufficient saliency to override participants' imagery-based inferences. Thus, the purpose of Experiment 2 was to test this possibility by providing participants with an unambiguous and salient statement about each product's relative healthiness. To all intents and purposes, Experiment 2 was otherwise a direct replication of the preceding experiment.

Chapter 4

Experiment 2[3]

The key finding from Experiment 1 was that people were more likely to attribute additional health properties to a product whose packaging had featured a health-related image than an equivalent plain-labelled alternative, even when the product was identified as an 'unhealthy' food. Nevertheless, people's inferences are shaped by both the *relevance* and the *saliency* of the information they receive (Nisbett & Ross, 1980). One possible explanation for Experiment 1's findings therefore, is that the MTL labels were not sufficiently salient to over-ride the influence of the health imagery. Despite efforts by regulators to improve the overall visual saliency of on-pack nutritional information, a recent review of the labelling literature highlighted several factors that may impede their effectiveness at capturing consumer interest (Ma & Zhuang, 2021). For instance, consumers typically pay less attention to a product's nutrition information when it is embedded in a complex package design that—much like my own stimuli—features a brand name, product image, nutritional label, and a health-related symbol (Bartels et al., 2018; Bialkova et al., 2013). Conversely, more simplistic product packages with fewer visual elements more effectively direct consumers' attention towards the products' nutritional information (Visschers et al., 2010). Indeed, a second literature review advocated making nutritional labels more salient as a means of helping consumers make healthier food choices (Graham et al., 2012). By comparison, prominent package imagery—from which people evidently make health-related inferences—has reliably been shown to be a good method of capturing consumer interest (Varela et al., 2014; Piqueras-Fiszman et al., 2013). The possibility that participants in Experiment 1 paid little attention to the MTL labels is therefore not necessarily a limitation of the materials, but rather, an accurate reflection of consumer behaviour. Nevertheless, it is important to rule out the possibility that the MTL labels failed to moderate the effect of health imagery because they lacked the visual saliency to capture participants' attention. I therefore reasoned that if

[3] This experiment is currently under review as Experiment 2 in Delivett, C. P., Farrow, C. V., Thomas, J. M., & Nash, R. A. (n.d.). *Front-of-pack health imagery on both 'healthy' and 'unhealthy' foods leads people to misremember seeing health claims.*

this were the case, then a more salient indicator of a product's healthiness (i.e., an explicit healthiness statement) would attenuate the previously observed effect of imagery.

The aims of Experiment 2 were therefore twofold. The first aim was to replicate the observed effect of health imagery on false memories from Experiment 1. The second aim was to determine the extent to which an explicit statement—identifying each product as either relatively 'healthy' or 'unhealthy'—would moderate the frequency of these memory errors. As in Experiment 1, I predicted that the inclusion of a health-related image on a product's package would increase the frequency with which people mistakenly remembered having read health claims about the product. However, this effect would only occur for reportedly 'healthy' foods, not 'unhealthy' foods.

Method

This study received full ethical approval from Aston University Research Ethics Committee. The procedure and planned analysis were preregistered prior to data collection through AsPredicted.org, and can be found in Appendix E.

Participants and design. Per my preregistered plan, I intended to recruit participants using a less conservative inclusion criteria than in Experiment 1, until a total of 64 people had met these criteria. Per Klepacz et al. (2016; Experiment 2) this sample size should provide reasonable power to detect a medium-sized interaction effect (f = .25, given α = .05, power = .80, and a correlation between repeated measures of r = .20). Face-to-face test began in early 2020, after which 41 undergraduate students and members of university staff completed the study in exchange for course credit or a cash voucher. Following the nationwide lockdown that resulted from the Coronavirus (COVID-19) pandemic, in-person testing was halted and recruitment was moved online. A further 58 participants who identified as students, aged 18 and over, were subsequently recruited via Prolific in exchange for a small financial credit. In accordance with my preregistered plan, participants were excluded from the analysis if they provided invalid responses to more than 50% of trials during the recall task (n = 35). This left a final sample of 64 participants (50 females, 14 males; M_{age} =

21.98, *SD* = 5.59, range = 18-50) who were included in the preregistered analysis. Note that the data exclusion rate was still relatively high in spite of the amended inclusion criteria. The study used a 2 (image: present vs. absent) x 2 (statement: healthy vs. unhealthy) within-subjects design. As in Experiment 1, the dependent variables were the number of falsely recalled and recognised health claims.

Materials. The materials were identical to those used in Experiment 1, with two main exceptions. First, participants now saw eight filler product packages as opposed to 12. Second, the MTL labels were removed from each product package and participants instead saw a prominent health message underneath each product that labelled the food as being either relatively 'healthy' or 'unhealthy'. Specifically, participants saw: "This product is recognized as very [healthy/unhealthy] in comparison to other brands" (see Figure 8 for an example). A small pilot study confirmed that these messages were visually salient. A total of 40 participants encoded a single product package in the same manner as in Experiment 1, with one of the two healthiness statements presented at random underneath the package image. Participants then completed the filler task and memory tests from Experiment 1, before being asked to report whether they had been told that the preceding product was relatively 'healthy' or 'unhealthy'. Overall, 95% of respondents selected the correct answer, suggesting that the message had been sufficiently salient for them to encode this information. As in Experiment 1, the assignment of products to conditions was counterbalanced across conditions. Importantly, participants now saw three product packages in each of the four conditions.

Procedure. Participants either completed the study online, or on individual workstations within a laboratory. Participants followed the same procedure as in Experiment 1, viewing 20 images of food product packages accompanied by a statement of the products' relative 'healthiness'. Of these, 12 were *critical* product packages, featuring entirely nutrient claims, and 8 were *filler* packages, all of which featured health claims. Of the 12 critical packages; participants saw six image-absent products and six image-present products, and within each image condition, they saw three relatively 'healthy' products and three relatively

Figure 8

Examples of fictional (image-present) product packages used in Experiment 2, accompanied by a statement of the product's relative healthiness

A.

This product is recognised as very healthy in comparison to other brands.

B.

This product is recognised as very unhealthy in comparison to other brands.

Note. Panel A represents the 'healthy' statement conditions; Panel B represents the 'unhealthy' statement conditions.

'unhealthy' products. The MTL label comprehension check from Experiment 1 was removed and participants instead completed a short attention check at the end of the experiment, in which participants were presented with one of the filler packages they had seen during the experiment, plus three entirely new product packages. To pass the check, participants were required to correctly select the product they had seen previously. Aside from obtaining informed consent via the survey itself, all other aspects of the experimental procedure remained unchanged when the study was transferred online.

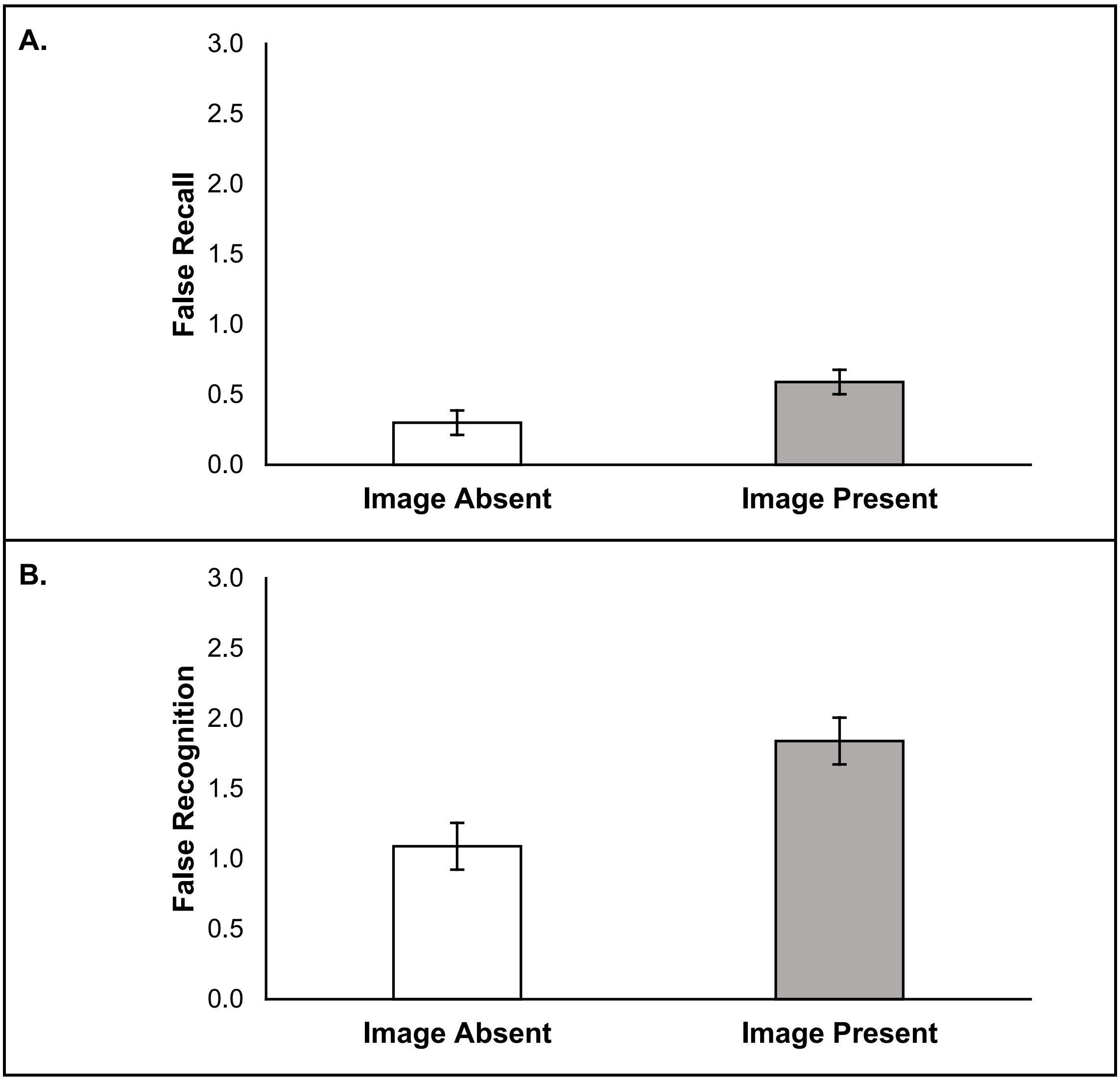
Results: Preregistered analysis

False recall. As in Experiment 1, I was first interested in the extent to which a health-related package image increased the number of falsely recalled health claims. Recall responses were coded in the same manner as Experiment 1. Following exclusions, 64.1% of responses were coded as non-health claims, and 7.4% of responses were coded as health claims. Overall, 37.5% of participants falsely recalled at least one health claim. Omissions accounted for 28.5% of responses. A 2 (image: present vs. absent) x 2 (healthiness: healthy vs. unhealthy) repeated-measures ANOVA revealed that the presence of a health-related image on a product's packaging significantly increased the frequency of falsely recalled health claims, $F(1, 63) = 7.20$, $p < .01$, $\eta^2_p = .10$ (see Panel A of Figure 9). Conversely, the statements about the products' relative 'healthiness' had no meaningful effect on the number of falsely recall health claims, $F(1, 63) = 0.64$, $p = .43$, $\eta^2_p = .01$, and there was no significant image x statement interaction, $F(1, 63) = 0.80$, $p = .37$, $\eta^2_p = .01$.

False recognition. I next looked to participants' recognition responses to determine the extent to which a health-related package image increased the likelihood of people selecting the incorrect, health claim from the list of statements. Overall, participants chose the correct nutrient claim for 63.4% of products, but incorrectly recognised the health claim for 24.5% of products. In total, 85.9% of participants falsely recognised at least one health claim. A 2 (image: present vs. absent) x 2 (statement: healthy vs. unhealthy) repeated-measures ANOVA again revealed a significant effect of image, $F(1, 63) = 14.18$, $p < .001$, $\eta^2_p = .18$. As in Experiment 1, participants were more likely to choose the health claim when a package featured a health-related image than when it was absent (see Panel B of Figure 9). On the other hand, an explicit statement of the products' relative healthiness had no effect on the number of falsely recognised health claims, $F(1, 63) = 0.03$, $p = .86$, $\eta^2_p < .01$, nor was the image x statement interaction significant, $F(1, 63) = 0.04$, $p = .85$, $\eta^2_p < .01$.

Figure 9

Average number of falsely remembered health claims for the image-absent and image-present conditions in Experiment 2



Note. Panel A represents the number of falsely *recalled* health claims for the image-absent and image-present conditions; Panel B represents the number of falsely *recognised* health claims for the image-absent and image-present conditions. Error bars represent 95% within-subjects confidence intervals.

Subjective recognition judgments for critical claims. Finally, I consulted participants' R/K/G responses to rule out the possibility that the observed effect of imagery was resultant of deductive reasoning. Of the falsely recognised health claims; 32.4% of responses were 'remembered', 42.0% were 'known', and the remaining 25.5% were 'guesses'. Unlike Experiment 1, the presence of a health-related image did not significantly increase the number of guess responses, $F(1, 63) = 3.10$, $p = .08$, $\eta^2_p = .05$. The main effect of image remained significant having removed these responses from the analysis as per my preregistered plan for this experiment, $F(1, 63) = 9.00$, $p < .01$, $\eta^2_p = .13$ (see Table 3).

Table 3

Mean (SDs) number of recognition errors made by participants for remember, know and guess responses in Experiment 2

Response	**Image-absent**	**Image-present**
Remember	0.34 (0.57)	0.61 (0.81)
Know	0.47 (0.87)	0.77 (1.05)
Guess	0.28 (0.52)	0.47 (0.78)

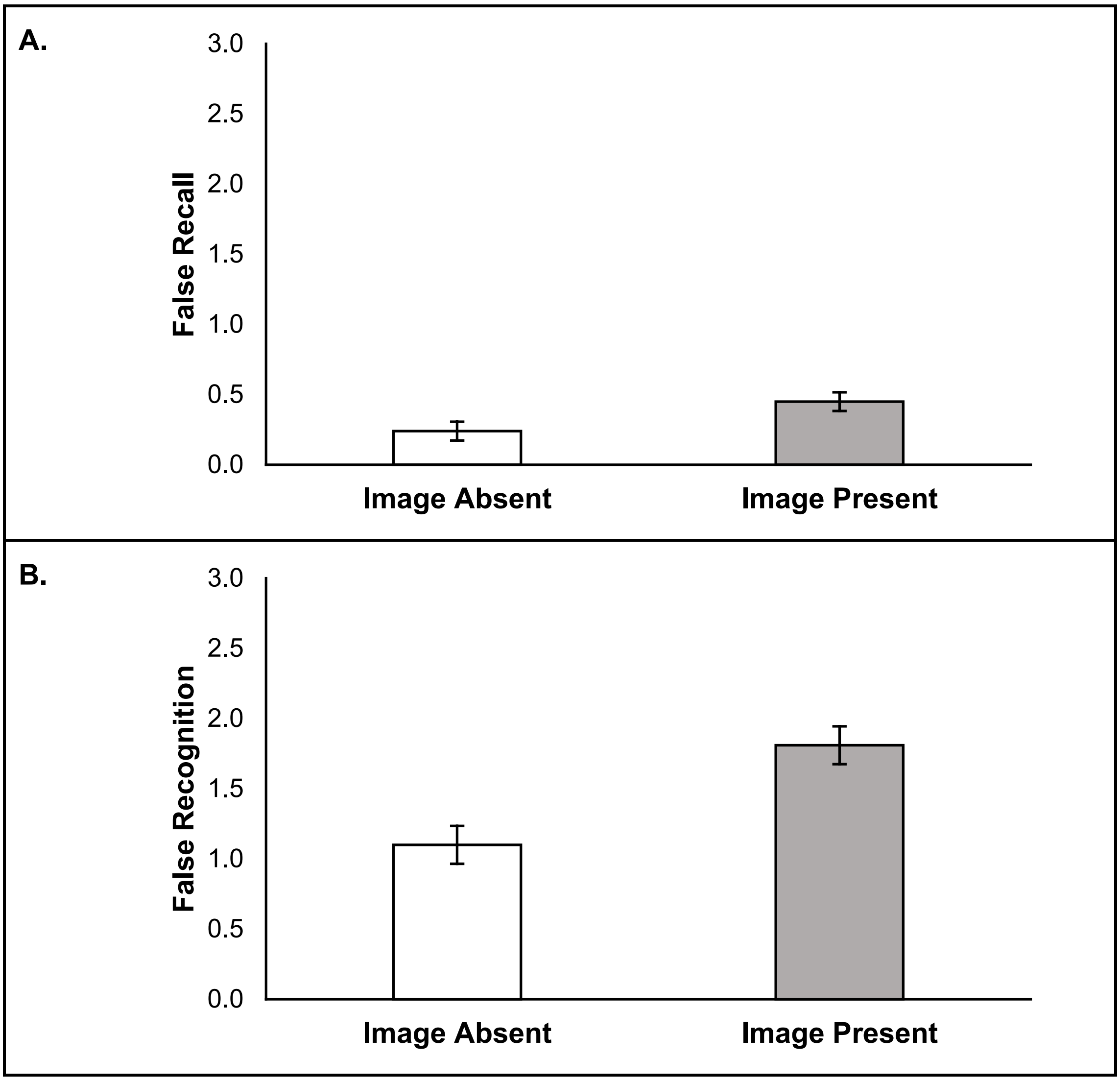
Results: Exploratory analysis of full sample.

Despite using less conservative inclusion criteria, data from 35 participants were excluded from the main analysis due to participants providing fewer than six valid responses on the recall task. For the sake of completeness, I again repeated the preregistered analyses using the full sample ($n = 99$) to test the robustness of the observed effect of imagery.

False recall. The frequency of falsely recalled health claims was comparable to that of the preregistered sample, with 5.8% (vs. 7.4%) of responses coded as health claims, and 33.3% of participants recalling at least one health claim. Omissions now accounted for 45.4% of responses. Notably, the main effect of image remained significant, $F(1, 98) = 7.72$, $p < .01$, $\eta^2_p = .07$, with participants more likely to falsely recall having read a health claim when the products' packaging featured a health-related image than when there was no such image (see Panel A of Figure 10). As in the preregistered analysis, a statement of the products' relative healthiness had no effect on the number of falsely recalled health claims, $F(1, 98) = 0.02$, $p = .89$, $\eta^2_p < .001$, and there was no significant image x statement interaction, $F(1, 98) = 1.81$, $p = .18$, $\eta^2_p = .02$.

Figure 10

Average number of falsely remembered and recognised health claims for the image-absent and image-present conditions for the full sample of Experiment 2



Note. Panel A represents the number of falsely *recalled* health claims for the image-absent and image-present conditions; Panel B represents the number of falsely *recognised* health claims for the image-absent and image-present conditions. Error bars represent 95% within-subjects confidence intervals.

False recognition. In the full dataset, participants incorrectly chose the health claim for 24.2% (vs. 24.5%) of products, with 84.8% of people falsely recognising at least one health claim. Again, the inclusion of a health-related image on a product's packaging significantly increased the likelihood that participants would choose the incorrect, health claim from the list of six statements, $F(1, 98) = 20.00$, $p < .001$, $\eta^2_p = .17$ (see Panel B of

Figure 10). Likewise, statements of the products' relative 'healthiness' had no effect on the number of falsely recognised health claims, $F(1, 98) = 0.02$, $p = .89$, $\eta^2_p < .001$, nor was the image x statement interaction significant, $F(1, 98) = 0.00$, $p = 1.00$, $\eta^2_p < .001$.

Subjective recognition judgements for critical claims. Contrary to the results of the preregistered analysis, the inclusion of a health-related image significantly increased the number of 'guess' responses, $F(1, 98) = 4.83$, $p = .03$, $\eta^2_p = .05$. But crucially, the main effect of image remained significant after these responses were removed $F(1, 98) = 12.45$, $p = .001$, $\eta^2_p = .11$ (see Table 4).

Table 4

Mean (SDs) number of recognition errors made by participants for remember, know and guess responses for the full sample of Experiment 2

Response	Image-absent	Image-present
Remember	0.37 (0.68)	0.58 (0.80)
Know	0.42 (0.80)	0.73 (1.01)
Guess	0.30 (0.56)	0.51 (0.79)

Discussion

The main aims of Experiment 2 were to test the replicability of the previously observed effect of imagery, as well as investigate the extent to which a prominent statement of a product's relative healthiness moderated this effect. As in Experiment 1, the inclusion of a health-related image to a product's package led participants to falsely remember reading health claims about those products. Importantly, the data again show that the effect of imagery occurred even when the product had been explicitly identified as an 'unhealthy' food. That is to say, health imagery on product packaging increased the likelihood of participants reporting to have seen health claims about those products, irrespective of more objective information about the products' healthiness being present. Whereas in Experiment 1 it could be argued that the package MTL labels lacked the necessary visual salience to capture the participants' attention, in Experiment 2 an explicit and salient statement of the products' healthiness also had no effect on the number of falsely remembered and recognised health claims. I can therefore more confidently conclude that the observed effect of imagery occurs even when more diagnostic health information is available.

A strength of the preceding two experiments is that by using a memory-based task I was able to assess people's tendency to form these health-related inferences, without relying on direct questioning. Previous research has shown that package imagery can affect people's inferences about a product's healthiness when participants are explicitly asked to make such judgments (e.g., Saba et al., 2010). But as previously discussed, the act of asking someone to reflect upon their beliefs about a product may in itself be what prompts them to make inferences about the product's healthiness. Importantly then, Experiments 1 and 2 replicate Klepacz et al.'s (2016) finding that these inferences often occur automatically and without effortful processing. Indeed, in both experiments I have shown that these memory errors were not the product of educated guesswork, but rather that participants explicitly 'remembered' or 'knew' that they saw the claim previously.

One limitation of the Experiments 1 and 2 is that my samples comprised mostly undergraduate students who are perhaps less preoccupied with the healthiness of their food choices, and therefore less attentive to on-pack nutritional information. Indeed, Chalamon and Nabec (2016) found that younger consumers typically employed heuristics that favoured cheaper, convenience foods over more health-orientated search strategies. The authors reasoned that these consumers have yet to experience specific health problems associated with less healthy eating and so they may instead prioritise more applicable product features, such as its cost. Consumers who are more aware of the disease-diet relationship may be more inclined to scrutinise on-pack nutritional information in favour of making more healthful food selections, and thus be less susceptible to forming inferences on the basis of packaging imagery alone (Drichoutis et al., 2006).

A second limitation of the preceding two experiments relates to the fact that the critical lures (i.e., the health claims) were typically longer in length that their associated nutrient claims. As such, participants may have in some cases rejected the critical lure on the grounds that it could not have reasonably fit on the products' packaging. Though efforts were made to negate this limitation (e.g., increasing the size of the black panels obscuring the written claims), it would nevertheless have been better to match the claims in terms of length where possible. The present findings may therefore underrepresent the effect of imagery by way of the fact that some participants were assumedly able to discount the critical lures for this reason.

The findings from Experiments 1 and 2 suggest that images on product packages can lead consumers to attribute additional health properties to those products. People's propensity to make these inferences even when the product is explicitly identified as being 'unhealthy' implies that such an effect is not simply due to a lack of understanding. It is therefore important to better understand the possible mechanisms that underpin the observed effect of imagery. To this end, the following chapter examines how FoP health imagery influences people's beliefs about the products on which they feature, as well as testing two potential explanations as to why these effects occur.

Chapter 5

Experiment 3[4]

Experiments 1 and 2 replicate Klepacz et al.'s (2016) findings that images on food product packages can lead people to infer additional health properties about those products' contents. Extending those prior findings, my first two experiments demonstrate that people make these inferences even when the products are—indirectly or directly—identified as being 'unhealthy'. However, these data cannot tell us whether participants actually *believed* their inferences to be true. That is to say, a person may infer that a product has been marketed as being beneficial to heart health, without necessarily believing that the product actually possesses this health benefit. From a legislative and health psychology perspective, this is an important issue to address, as frameworks such as the Theory of Planned Behaviour predict that people's behavioural intentions are governed not by their inferences per se, but by their *beliefs* in those inferences (Ajzen, 1991). To this end, Delivett et al.'s (2020; Experiment 1) participants saw images of fictitious dietary supplements that sometimes featured a health-related symbol (e.g., a heart) on their packaging. Participants were subsequently told each product's supposed function, as well as two health benefits and two health risks of consuming the product. They were then instructed to judge the likelihood that someone with the specified health concern could benefit, and be at risk from consuming the product. Notably, when the products' packaging had contained a health-related image, participants appraised the health benefits of the product more likely, but not the health risks. These initial findings suggest that health-related images can indeed shape people's beliefs about how beneficial a product is to health, even when they receive more diagnostic, written information (i.e., the products' risks and benefits).

There are at least two reasons why health-related images might shape people's appraisals of products' risk-benefits, even when they receive more objective written

[4] This experiment is published as Experiment 3 in Delivett, C. P., Klepacz, N. A., Farrow, C. V., Thomas, J. M., Raats, M. M., & Nash, R. A. (2020). Front-of-pack images can boost the perceived health benefits of dietary products. *Appetite*, *155*, 104831. Both Experiments 1 and 2 were conducted by my co-authors prior to starting my doctorate program.

information. The first reason is that imagery may simply make the product more aesthetically appealing, leading people to think more positively in general about the products' other attributes. These so called 'health halos' have shown that people assume that a product carrying an 'organic' claim will contain fewer calories than an equivalent product without the claim (Schuldt & Schwarz, 2010); that products marketed by socially responsible corporations are perceived to be healthier (Peloza et al., 2015); and that products whose names contain a nutritive term (e.g., protein bar) will contain higher levels of other, unrelated nutrients, such as fibre and iron (Fernan et al., 2018). It is therefore reasonable to assume that people would judge a dietary supplement featuring an image on its packaging as more visually appealing, which may in turn lead them to make more optimistic assumptions about the product's other qualities (e.g., how beneficial the product is to health).

A second, related reason to make this same prediction derives from the literature on processing fluency, which suggests that when an individual processes information in ways that they perceive to be quick and easy, they often experience an inflated sense of comprehending the information. The resultant positive affect from this perceived understanding in turn leads people to make more favourable appraisals of risks (i.e., lower risks) and benefits (Slovic et al., 2004). In one study for instance, participants rated food additives with hard-to-pronounce, disfluent names (e.g., Hnegripitrom), as significantly more harmful than those with easy-to-pronounce, fluent names (e.g., Magnalroxate; Song & Schwarz, 2009). Likewise, participants were willing to administer higher doses of imaginary drugs with more easily pronounceable names than drugs whose names were more difficult to pronounce (Dohle & Montoya, 2017). Furthermore, there is evidence to suggest that images—just like easily processed text—can evoke a false sense of understanding that can in turn bias people's judgments of information. For instance, Cardwell et al. (2017) asked participants to rate their understanding of various natural and mechanical processes (e.g., how a rainbow forms). Some of these processes were preceded by a related but ultimately uninformative photo (e.g., an image of a rainbow), whereas others were not. Across six experiments, viewing an uninformative picture beforehand led participants to believe that they had a greater understanding of the process. Similarly, a simple nonprobative photo (i.e., one that provides no relevant information) can increase people's confidence that a related trivia claim is true (Newman et al., 2015), or lead people to believe that a lesser-known celebrity is either 'dead' or 'alive' (Newman et al., 2012). Crucially, these imagery-based fluency effects also seem to influence the way in which people evaluate health-related information. In one study for instance, parents who were asked to evaluate two fictitious pain relief medications demonstrated superior gist (i.e., general comprehension) and verbatim (i.e., factual accuracy) understanding of the products' risk-benefit information when it had been presented as a pictograph rather than as text, or appearing in a table. Notably, parents rated the perceived risks of the two drugs lower—and the benefits higher—when the information was presented in this easily-interpretable format (Tait et al., 2010). Based on this reasoning, I would predict that the addition of a health-related image to a product's packaging could provide a sense of fluency that would affect people's judgments on that product's health properties.

In short, both the health halo and processing fluency accounts could explain Delivett et al.'s (2020) finding that participants appraise the health benefits of consuming a functional dietary supplement more likely when the packaging features a health-related image. How they differ is that a halo effect would predict that the addition of an image would lead to more positive product appraisals irrespective of what participants subsequently learned of the products' function (i.e., a picture should make a product more appealing regardless of additional contextual cues), whereas a fluency effect would be contingent on there being a perceived congruity between the image and the products' supposed function (Newman et al., 2014; Song & Schwarz, 2009). Recent research has indeed shown that package imagery can hasten people's product appraisals, but only when the image is conceptually related to the judgment in question. For instance, when judging whether 'tabasco sauce' is spicy, participants made quicker judgments if a picture of fire appeared next to the name of the product. But when judging whether 'ice cream' is spicy, the addition of a picture of fire actually slowed down participants' judgments (Gil-Pérez et al., 2019). If then—as this study suggests—package imagery can indeed create a fluency effect, then such an effect should disappear when people discover that their initial intuition about the products' function was incorrect.

To test these assumptions, Delivett et al. (2020; Experiment 2) conducted a follow-up experiment whereby participants' product expectations—as informed by the packaging image, when present—were later confirmed, or disconfirmed to be true. Specifically, sometimes participants received information that matched their expectations of the product's function, in the sense that the package image (e.g., a heart) 'matched' the product's intended function (i.e., "aids in the maintenance of a healthy heart"). However, other times participants instead learned that the product was intended for a different health function to the one suggested by the products' image (e.g., a package with a picture of a heart was accompanied by the statement "improves bowel function"). As before, participants rated the perceived benefits of consuming the product more likely when the package featured a health-related image, but crucially, this only occurred when the image matched their expectations of the products' function. These findings therefore provide initial support for a fluency-based account, in that people's appraisals of the products' health benefits were dependent on their original expectation about the product being proven correct.

The purpose of this study then, was to test the replicability of Delivett et al.'s (2020; Experiment 2) findings using a pre-registered study design, whilst also addressing some of the methodological limitations of their research. Whereas the previous study achieved a modest sample size (*N* = 164), it was nevertheless not sufficiently powered to detect small effect sizes. Thus, by explicitly specifying the methodology, target sample, and planned analysis prior to data collection, the aim was to determine the reliability of Delivett et al.'s findings while controlling for researcher degrees of freedom that can contribute to Type I error and inflated estimates of effect sizes.

One limitation of Delivett et al.'s prior studies was that their samples comprised participants from EU member states only. Despite replicating the effect of imagery in all three countries tested (Italy, Romania, UK), these countries are nevertheless all governed by the same legislation and therefore these findings are not necessarily generalisable outside of Europe. There is good reason to predict that consumers from the US for instance, whereby the American FDA mandates that all medicinal product advertisements must explicitly state the products' health risks (FDA, 1999), may appraise a product's risks and benefits differently. Though the decision to recruit US participants for my own research had not originally been intended to test this assumption, it nevertheless became apparent that it would be useful to examine whether participants' risk-benefit judgments varied as a function of their country of residence.

As a final consideration, in the preceding two experiments by Delivett et al. (2020) the scale anchors for both the perceived benefits and risks questions were framed such that higher ratings were indicative of a more favourable appraisals (i.e., higher scores reflected greater benefits and *lesser* risks). Though both experiments reported no effect of image on participants' risk perceptions, it is important to rule out the possibility that this outcome was not an artefact of some participants being confused by the counterintuitive ordering of the risk response scale. To this end, in the present experiment participants were randomly assigned to see the risk scale in either the same format as the previous experiments, or in a reversed format, whereby a higher score was indicative of greater risks (i.e., 1 = definitely not at risk; 10 = definitely at risk).

Collectively, the aim of the present research was to test the replicability of the previous studies conducted by Delivett et al. (2020), using a large sample consisting of both UK and US participants, and a preregistered design plan. To this end, I used Delivett et al.'s (2020; Experiment 2) procedure, whereby participants made risk-benefit judgments about fictious dietary supplement packages – some of which featured a health-related image. Based on the findings of Delivett et al. (2020), I anticipated that participants would appraise the health benefits of consuming the fictional dietary supplements more likely when the products' packaging had contained a health image. However, this should only be the case when participants' expectations about the product were confirmed to be true.

Method

This study received full approval from Aston University Research Ethics Committee. The procedure and analysis plan for this study were preregistered prior to data collection through AsPredicted.org, and can be found in Appendix F.

Participants and design. A priori power analysis indicated that a minimum of 265 participants would be needed to detect a small effect (d = 0.2, given α = .05, power = .90) with a two-tailed t-test. I therefore aimed to exceed this sample size, by collecting valid data from 300 participants. Ultimately, a total of 324 participants were recruited via an online panel provider, Qualtrics. All participants completed the study in full and were subsequently awarded points that could be accrued and exchanged for money and/or vouchers. Per my preregistered plan, I excluded people from participating if they reported having a comprehensive understanding of the Dutch or German language due to the characteristics of my stimuli, described below. In keeping with Delivett et al. (2020; Experiment 1), I also excluded people from participating if they indicated that they worked professionally as a nutritionist or dietician, however, I neglected to mention this particular exclusion criteria in the pre-registration. Participants that did not meet these criteria were automatically exited from the survey, and replaced with another participant. Data from a further 18 participants were subsequently removed for either providing identical responses to every item, or for failing an attention check described below. This left a final sample of 306 participants (222 females and 84 males; M_{age} = 42.93, SD = 14.73, range = 18-77) from the UK (n = 152) and USA (n = 154) respectively, slightly above my preregistered target of 300. The study used a 2 (image: present vs. absent) x 2 (expectation: confirmed vs. disconfirmed) within-subjects design.

Materials. Package labels were identical to those used by Delivett et al. (2020; Experiment 2), with each product package representing one of four health function categories (heart health, joints and muscles, memory, weight management). Each package comprised a fictional brand name, the name of the active ingredient (e.g., Camellia Sinensis), the amount of this ingredient contained in the supplement (e.g., 300mg), some peripheral text (e.g., the number of capsules in the packet), and one written health claim from the EU's

Register of nutrition and health claims made on food (EC, 2013). All of the peripheral text and written health claims appeared on the packaging in Dutch, and therefore imitated dietary supplements that might hypothetically be available for sale on the Dutch market. By showing participants products in their non-native language, the aim was to simulate a scenario whereby a consumer may attempt to scour difficult-to-understand text for information about the product. As opposed to using plain-labelled packaged appearing with or without health-related imagery—as was the case in some prior studies—the aim was to include textual elements that were minimally informative, but would nevertheless make the health image seem more incidental. For each package there existed a second identical variant, onto which a health-related image representing the supposed function of the product had been digitally added. As an example, the 'weight management' supplement had an image of a tape measure wrapped around the silhouette of a female torso (see Figure 11 for examples).

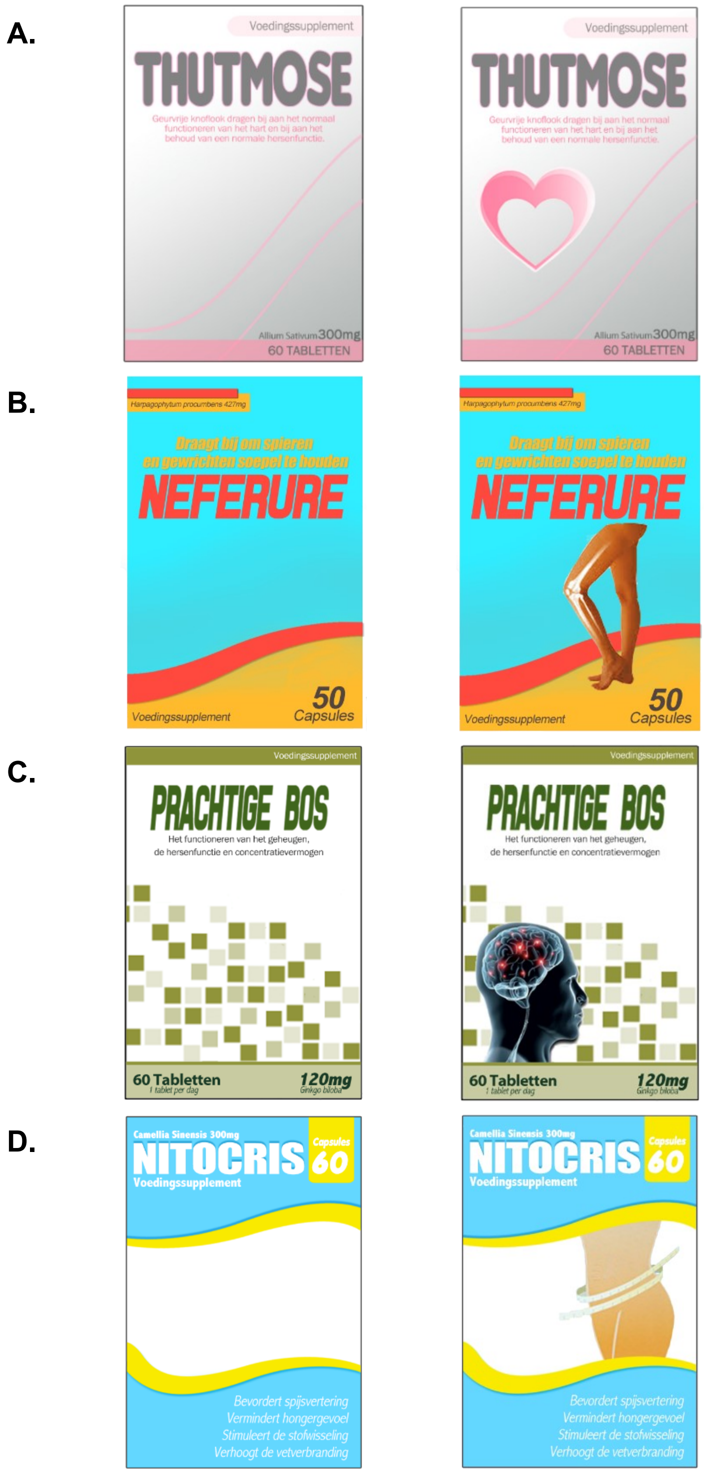
Each of the four fictional dietary supplements used by Delivett et al. (2020) also had a set of four written claims, signalling two risks and two benefits associated with consuming that product's active ingredient. For instance, the active ingredient in the 'weight management' supplement was *Camellia Sinensis* (Green Tea), of which the benefit claims were 'Contributes to fat oxidation' and 'Helps to reduce the appetite', and the risk claims were 'Cases of liver damage have been reported' and 'May cause sleep disturbances' (see Appendix G for a complete list of the benefits and risks for each dietary supplement).

Procedure. Participants completed the study online, under the premise that they would be evaluating some fictional dietary supplement packages. After providing consent, participants first reported their age, gender and country of residence, as well as indicating whether they had a working understanding of Dutch and/or German, or had ever worked as a dietician/nutritionist. Non-eligible participants were thanked for their time and exited the survey.

To begin, a random exemplar of the four dietary supplement packages appeared on the screen accompanied by the question: "Based on the packaging shown above, what do you think this product might be used for?" Participants were instructed to rate, on 8-point

Figure 11

Examples of fictional dietary supplement labels



Note. Examples of fictitious dietary supplement labels for the image-absent (left) and image-present (right) conditions. Row A represents the 'heart health' supplement; Row B represents 'joints and muscles' supplement; Row C represents the 'memory' supplement; and Row D represents the 'weight management' supplement.

Likert scales (i.e., 1 = very unlikely; 8 = very likely), the likelihood that each of eight, randomly ordered, statements about the product were true. Each statement started “This product…”, and ended: (1) “aids in the maintenance of a healthy heart”, (2) “supports weight loss”, (3) “helps improve memory”, (4) “aids in the maintenance of healthy joints and muscles”, (5) “improves bowel function”, (6) “aids sleep and promotes restfulness”, (7) “relieves the symptoms associated with colds and flu”, and (8) “relieves the symptoms of low mood and anxiety”. For each of the four products, one of these statements represented the ‘correct’ answer, insofar as it described the product’s *actual* supposed function. For the purpose of interpreting the results, I hereafter refer to the ‘correct’ response as the *critical* statement, and I refer to the remaining seven ‘incorrect’ statements collectively as *noncritical* statements.

After rating all eight statements, a new screen appeared, displaying the same product package as before in addition to a text-box that explicitly stated the health concern that the product supposedly remedied (i.e., the products’ corresponding critical statement). To the right of the package appeared a table listing two health benefits and two health risks associated with consuming the product (see Figure 12 for an example). Importantly, in the expectation-confirmed conditions, this supplementary information directly related to the products’ supposed health function. For example, participants may see a supplement package bearing an image of a heart accompanied by the statement “…aids in the maintenance of a health heart”. In the expectation-disconfirmed conditions, however, participants instead saw information relating to ‘bowel function’ or ‘cold and flu’ supplements from Delivett et al. (2020; Experiment 1). For instance, participants might see a package featuring an image of a heart, but subsequently learn that the product is actually a remedy for bowel disturbances, and see benefits and risks relating to bowel function. Participants were instructed to read this information carefully before responding to three further questions on 10-point Likert scales. Specifically, participants were asked to rate the degree to which: (1) somebody with the specified health concern might benefit from taking this product (1 = definitely will not benefit; 10 = definitely will benefit); (2) somebody with the specified health

Figure 12

Example of how fictional dietary supplement labels were shown with benefit and risk information

concern might be at risk from taking the product, which was either presented in the same form as the previous experiments in Delivett et al. (2020; i.e., 1 = definitely at risk; 10 = definitely not at risk), or in the new, reversed format (1 = definitely not at risk; 10 = definitely at risk), and; (3) the benefits of taking the product outweigh the risks (1 = the risks outweigh the benefits; 10 = the benefits outweigh the risks). These three questions were always presented in the same order. After responding, a new product package appeared and the procedure repeated until participants had appraised all four products. The allocation of products to image and expectation conditions was randomly counterbalanced across participants.

Once participants had rated all four dietary supplement packages, they were asked to complete a short attention check. Participants were shown a screen depicting two previously seen stimuli and two entirely new fictional product packages. To pass the attention check, participants were simply asked to select the two packages that they recalled seeing during the experiment. To conclude, participants were fully debriefed and thanked for their time.

Results

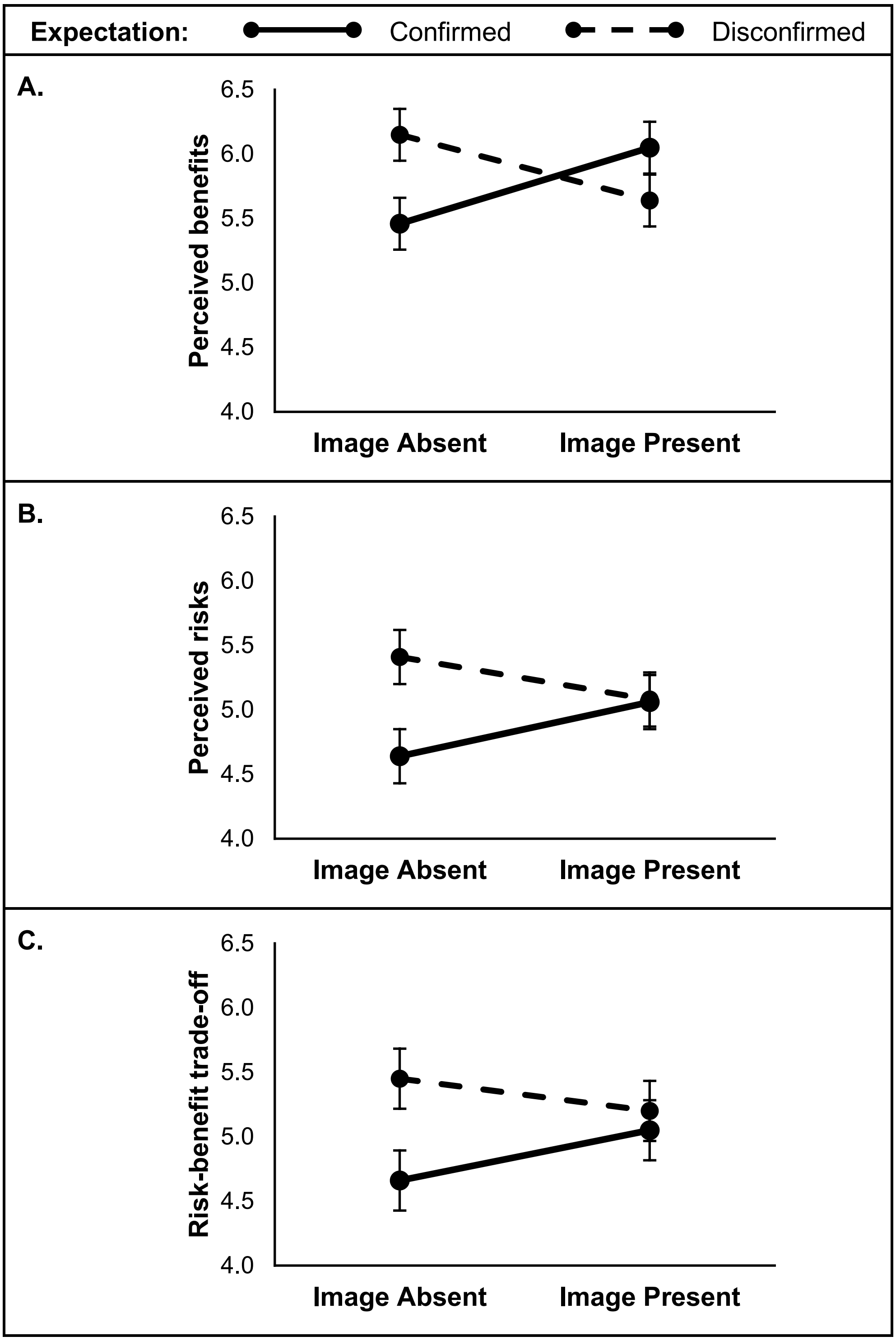
Manipulation check. To begin, it was important to confirm that the health images led participants to form systematic expectations about the products' intended functions. This was indeed the case. When the supplements' packaging included a health-related image, participants rated the critical statements as significantly more likely (M = 6.54, SD = 1.60) than they did when the health-related image was absent (M = 3.71, SD = 1.71), $t(305)$ = 24.77, $p < .001$, d_z = 1.42. In contrast, people rated the noncritical statements as significantly less likely when the images were present (M = 2.33, SD = 1.09) than when they were absent (M = 3.20, SD = 1.20), $t(305)$ = 14.22, $p < .001$, d_z = .81.

Interestingly, people gave higher ratings to the critical statements than to the noncritical statements even in the image-absent condition, $t(305)$, = 6.04, $p < .001$, d_z = 0.35, suggesting that the image-absent packages still conveyed some clues to the products' intended functions.

Perceptions of benefits. Next, I examined whether a health-related package image affected participants' appraisals of the *benefits* of consuming the dietary supplements. A 2 (image: present vs. absent) x 2 (expectation: confirmed vs. disconfirmed) repeated-measures ANOVA of these ratings revealed no significant main effect of image, $F(1, 305) = 0.13$, p = .72, $\eta^2_p < .001$, or expectation, $F(1, 305) = 1.98$, $p = .16$, $\eta^2_p < .001$. Crucially though, the two-way interaction was statistically significant, $F(1, 305) = 28.97$, $p < .001$, $\eta^2_p = .09$ (see Panel A of Figure 13). Post-hoc *t*-tests showed that when participants' expectations of the products' function were confirmed to be true (i.e., the image matched the products' reported function and risk-benefit information), the inclusion of a health-related image on a product's packaging increased the perceived benefits of consuming the product, relative to when the image was absent, $t(305)$ = 4.26, $p < .001$, d_z = 0.24. Conversely, when participants'

Figure 13

Interaction between image and expectation for perceived supplement benefits, risks, and risk-benefit trade-off



Note. Panel A shows average ratings for the perceived benefits; Panel B shows average ratings for the perceived risks; Panel C shows average ratings for the extent to which the benefits outweighed the risks. Higher ratings represent more positive appraisals, namely greater benefits, lesser risks, and a greater advantage of the benefits relative to the risks. Error bars represent 95% within-subjects confidence intervals.

expectations were disconfirmed, the function image actually *decreased* the perceived benefits of consuming the product, $t(305) = -3.49$, $p = .001$, $d_z = 0.20$.

Perceptions of risks. I then tested the extent to which a health-related package image influenced participants' perceptions of the *risks* of consuming the dietary supplements. Prior to conducting the analysis, I reverse-scored all of the responses from those participants who saw the risk scale in its new, negatively-framed format (i.e., 1 = definitely not at risk; 10 = definitely at risk). This transformation meant that for all participants, higher scores were indicative of *lower* perceived risk of consuming the product. A 2 (image: present vs. absent) x 2 (expectation: confirmed vs. disconfirmed) x 2 (risk scale order: positive vs. negative) mixed-factor ANOVA of the risk ratings revealed no statistically significant interactions of scale order with any of the other independent variables. There was, however, a significant main effect of scale order, $F(1, 304) = 9.14$, $p < .01$, $\eta^2_p = .03$, with participants indicating greater risks when the question had been framed in its original, positive format ($M = 4.76$, $SD = 1.58$), than when the response scale was reversed ($M = 5.33$, $SD = 1.70$). However, because this main effect was independent of any of the effects of interest, it was not considered further, and I conducted the main analysis absent the scale order factor.

A 2 (image: present vs. absent) x 2 (expectation: confirmed vs. disconfirmed) repeated-measures ANOVA of these ratings revealed no significant main effect of image, $F(1, 305) = 0.16$, $p = .69$, $\eta^2_p = .001$. The main effect of expectation was significant, with risks rated more severe in the confirmed condition compared to the disconfirmed condition, $F(1, 305) = 14.36$, $p < .001$, $\eta^2_p = .05$. It is, however, important to note that to create a perceived mismatch between participants' expectations and that of the products' *actual* function, participants appraised different risk-benefit information (i.e., the two health risks and two health benefits) in the confirmed and disconfirmed conditions. As such, the observed effect in the image-absent conditions is likely the result of baseline differences in the perceived risk to health of consuming those products. That is to say, the health risks associated with the products in the confirmed conditions (e.g., "gastrointestinal disorders; diarrhoea, nausea, vomiting, abdominal pain") were rated as more extreme than in the disconfirmed conditions (e.g., "electrolyte disturbances"). Notably, the two-way interaction was significant, $F(1, 305) = 12.30$, $p = .001$, $\eta^2_p = .04$ (see Panel B of Figure 13). Post-hoc *t*-tests showed that when participants' expectations about the product were confirmed to be true, the inclusion of a health-related image decreased the perceived risks of consuming the product, relative to when the image was absent, $t(305) = 2.95$, $p < .01$, $d_z = 0.17$. But when participants' expectations about the product were disconfirmed, the presence of a health-related image had no significant effect on the perceived risks, $t(305) = 1.93$, $p = .054$, $d_z = -0.11$.

Risk-benefit trade-off. Lastly, I examined whether a health-related package image influenced participants' ratings of the extent to which the supplements' benefits outweighed the risks. A 2 (image: present vs. absent) x 2 (expectation: confirmed vs. disconfirmed) repeated-measures ANOVA of these ratings revealed no significant effect of image, $F(1, 305) = .46$, $p = .50$, $\eta^2_p = .001$. As with participants' risk appraisals, the main effect of expectation was significant, with the benefits seemingly outweighing the risks to a greater extent in the disconfirmed condition than in the confirmed condition, $F(1, 305) = 21.03$, $p = < .001$, $\eta^2_p = .065$. Again, this finding should be interpreted with a degree of caution for the reason outlined above. Notably, however, the predicted two-way interaction was significant, $F(1, 305) = 7.47$, $p < .01$, $\eta^2_p = .02$ (see Panel C of Figure 13). Post-hoc *t*-tests showed that when participants' expectations about the product were confirmed to be true, the addition of a health-related image exaggerated the extent to which the benefits outweighed the risks, relative to when the image was absent, $t(305) = 2.85$, $p = .005$, $d_z = 0.16$. Conversely, when participants' expectations about the product were disconfirmed, the presence of a health-related image had no significant effect on participants' ratings, $t(305) = -1.46$, $p = .15$, $d_z = -0.08$.

Exploratory analysis. In hindsight, it was informative to examine whether participants' appraisals of the dietary supplements' risk-benefits differed by country, given that these countries are governed by different legislation regarding the way in which risk-benefit information is marketed to consumers. I therefore conducted additional analyses to those that I had preregistered to examine whether participants' ratings varied as a function of their country of residence. Specifically, I conducted separate 2 (image: present vs. absent) x 2 (expectation: confirmed vs. disconfirmed) x 2 (country: UK vs. USA) mixed-factor ANOVAs for each of the dependent variables. There were no statistically significant interactions between country of residence and any of the other independent variables for participants' ratings of the benefits, risks, or risk-benefit trade-off.

Discussion

The results of Experiment 3 replicate Delivett et al.'s (2020; Experiment 1 and 2) finding that FoP health imagery can in fact shape how people appraise the health benefits of fictitious dietary supplements. Specifically, the data show that the addition of a health-related image to a product's packaging significantly increased participants' perceptions that someone with the specified health concern would benefit from consuming the dietary supplement. Likewise, health-related imagery also led participants to inflate the extent to which the products' benefits outweighed the risks. But, contrary to Delivett et al.'s findings, the present research suggests that health-related imagery may actually *decrease* the perceived risks of consuming those products.

Of course, the images used in this experiment contained no meaningful information that would logically influence people's appraisals of the products' risk-benefit information. The key finding here then, is that the effect of health imagery depended on whether or not people's imagery-based inferences about the product's function were confirmed to be true. When participants' product expectations were confirmed (i.e., the health image matched the product's function and related risk-benefit information), they judged the products' health benefits and risks more favourably. But when people's expectations were later disconfirmed (i.e., the product's function was at odds with the package's health image), the inclusion of a health-related image either had no effect or actually *reversed* the effect. In this way, a person may evaluate a product with an image of a heart on its packaging more favourably if they subsequently learn that product aids heart health, but not if the product is later revealed as a cold remedy.

These findings do not therefore fit the rationale that such effects are caused by a health ‘halo’. If this were the case, then people’s perceptions of the products’ benefits and risks should have been similarly affected, irrespective of whether the information that people later received was consistent or inconsistent with their expectations. Instead, the present findings are more consistent with a fluency-based explanation (e.g., Schwarz 1998). According to this account, the addition of a health-related image to a product’s package gave participants an easy, fluent feeling of understanding that in turn led them to make more generalised positive assumptions about the product’s other characteristics (Slovic et al., 2004). However, when participants received contradictory product information, this in turn disrupted their sense of fluency resulting in a less favourable appraisal of the product itself.

A strength of the present research, is that I was able to reproduce Delivett et al.’s (2020) findings—which did not involve *a priori* sample justifications—using a preregistered study plan, thus increasing confidence in the robustness of the observed effect. Furthermore, the replicability of these findings across the three EU countries originally studied by Delivett et al., (2020), and now the US, lend support to their generalisability. That these effects occur in the US, whereby current FDA regulations mandate that all medicinal product advertisements explicitly reference the probable risks of consuming such commodities (FDA, 1999), is in itself significant. One might have anticipated that US respondents may have judged the products’ risk-benefit information differently given that they are arguably more versed in receiving this kind of overt health information about their commodities, but this was not the case. This finding should, however, be interpreted with a degree of caution given the study was not sufficiently powered to detect a three-way interaction. In addition, whereas there was an overall effect of risk-order—in that participants indicated greater risks when the question was framed so that higher scores were indicative of lesser risks—the fact that this effect was independent of any of my effects of interest lends further support to Delivett et al.’s (2020) original findings.

One limitation of the present research concerns the risk-benefit information that participants saw after making their initial judgments about each product’s intended function.

Whereas the two health risks and two health benefits for each product represented actual risk-benefit information for those product's active ingredient, crucially, this information was not matched in terms of its perceived severity. Consequently, the observed effect of expectation is unlikely to be meaningful given that participants appraised different risk-benefit information in the confirmed and disconfirmed conditions. Future research should therefore equate the products' risk-benefit information across conditions, or alternatively, fully counterbalance this information.

A second, related limitation of the experimental stimuli is that some of the risk-benefit information used complex medical terminology (e.g., "may slow down the development of *atherosclerosis*"), which the average participant would not be expected to understand. Not only does this limit participants' ability to objectively measure the products' benefits and risks to health, but prior research has shown that people's health-related judgments can similarly be affected by the pronounceability of a word (Dohle & Diegrist, 2011; Song & Schwarz, 2009). Assuming that participants did in fact use this information to inform their judgments, the use of medical jargon to describe the products' risk-benefit information may have in itself disrupted participants' sense of fluency, leading to less favourable product appraisals. However, this explanation would not account for the observed effect of health imagery.

Rounding off this trio of studies, images on product packages can capture consumer interest (Varela et al., 2014), and even generate product expectations more rapidly than related textual information (Smith et al. 2015). But the findings from Experiment 3 suggest that health images on product packaging can lead consumers to make more optimistic assumptions about the magnitude of those products' health benefits. The data herein suggests that this effect occurs because images can provide a fluent sense of understanding, which leads people to make more positive judgements about the products' other attributes. But crucially, whereas a person may infer that a product with a fluently designed product package is more beneficial to wellbeing, this may not necessarily be the case.

Chapter 6

How inferences about remembered eating episodes inform food choices and behaviours

As discussed in Chapter 2, consumers' tendency to make spontaneous inferences about product healthiness can be influenced by a variety of factors, not limited to a product's name (Irmak et al., 2011), country of origin (Juric & Worsely, 1998), or package colour (Mai et al., 2016; Tijssen et al., 2017; Wąsowicz et al., 2015). Indeed, here I have shown that health-related package imagery can lead people to infer additional health benefits about the products on which they appear. But to the best of my knowledge, little is known about whether people make these kinds of inferences about their *own* healthiness and how this in turn influences the healthiness of their food choices. Partly inspired by the finding that a sense of quick and easy processing can lead people to make more favourable product appraisals (Experiment 3), people's judgments of their own healthiness may similarly be affected by the subjective 'ease' with which they recall their past eating experiences. Consumers' tendency to categorise foods as ubiquitously 'healthy' or 'unhealthy' (Oakes, 2004, 2005a; Oakes & Slotterback, 2005; Rozin et al., 1996) implies their eating memories may also be constrained by this monotonic way of thinking. In this way, a person who finds it particularly difficult to recall an occasion when they consumed something healthy, may infer that they are an 'unhealthy' eater. The remaining chapters of my thesis are therefore dedicated to answering some of these research questions, beginning with a summary of how people's remembered eating experiences can influence their food choices and consumption.

The functions of autobiographical memories

Empirical research on autobiographical memories has postulated that such memories have three distinct functions: social, directive and self (Bluck, 2003; Cohen & Conway, 2007; Pillemer, 2003). The *social* function—while unrelated to my thesis—emphasises the role of people's autobiographical memories in developing and fostering interpersonal relationships. In this sense, people's memories provide conversational material (Cohen, 1998) that can elicit empathetic responses from others if they themselves have experienced something similar (Pillemer, 1992, as cited in Bluck, 2003). Directly related to my own research questions, the *self* function surmises that knowledge of one's past self helps maintain a consistent sense of self over time (Bluck, 2003). I revisit this concept in greater detail shortly. Lastly, the *directive* function posits that people recall their past experiences to help resolve a current problem, or to guide present and future behaviour (Bluck, 2003; Cohen & Conway, 2007). Indeed, people's ability to retrospectively assess their past experiences in light of new information affords them the capacity to refine their understanding and probable causes for past events (Bluck et al., 2005). Say for instance a person was to become unwell after consuming a particular food; they may—quite reasonably—want to avoid eating that product again in future. But should the person later learn that the product expired prior to consumption, then they may re-evaluate their food aversion as something that is unique to that particular instance rather than the food in general. Extending upon this theory, the constructive episodic simulation hypothesis suggests that people's memories play an integral role in the construction of future imagined events, in that people retrieve past experiences from memory and reassemble them into simulations of potential future outcomes (Schacter & Addis, 2007; Schacter & Madore, 2016). Supporting evidence for this hypothesis stems from research showing that detailed descriptions of imagined future experiences depend upon one's prior experiences. In one study for instance, participants' descriptions of an unusual future event, for which they presumably had no frame of reference (e.g., backpacking through a jungle), contained fewer contextual details than participants' descriptions of more commonplace events (Szpunar & McDermott, 2008). In addition, both recalling episodic memories and imaging future events seemingly rely on similar brain regions (Addis, 2018), to the extent that amnesiac patients who exhibit difficulties in retrieving past memories are similarly unable to imagine future events (Hassabis et al., 2007).

The same then is true of people's eating memories, in that their recollections of past eating help regulate appetite and guide future eating intentions (Higgs, 2008). Whereas rehearsing the positive aspects of a meal can increase remembered enjoyment and subsequent choice of those foods (Robinson et al., 2012), a single negative eating experience can lead a person to avoid the associated foodstuff indefinitely (Bernstein, 1999). Indeed, there is mounting evidence to suggest that people's memories of recent eating play an important role in informing their subsequent eating behaviours. In one study for instance, cueing participants to remember a lunch that they had eaten earlier in the day, decreased snack consumption during a subsequent *ad-libitum* taste test compared to participants who recalled non-food memories (Higgs, 2002). Likewise, recalling a past experience of eating healthily—such as eating vegetables—can encourage healthier future eating behaviours. For instance, prompting participants to retrieve positive memories of eating vegetables (e.g., broccoli) resulted in higher predicted liking (Experiment 2), and selection of a larger portion of vegetable from a buffet (Experiment 3) relative to those participants who recalled either a non-food memory, an unrelated food memory (i.e., crisps), or those who visualised someone else's enjoyment of eating vegetables (Robinson et al., 2011). However, one limitation of this method is that the effect of food intake depends on explicitly asking consumers to recall their past eating experiences, when in reality people may not ruminate on these memories when deciding what next to eat.

An alternative approach is to instead examine the influence of disrupting people's encoding of a mealtime memory using a routine distractor, such as watching television. In one study for instance, "normal" weight females consumed a fixed lunch whilst either watching television or sitting in silence. Participants were later invited to take part in a bogus taste test whereby they were instructed to rate the pleasantness of three varieties of chocolate biscuits, under the guise that they were free to consume as many biscuits as they liked as any leftovers would be disposed of after the experiment. Interestingly, participants who had previously consumed their lunch whilst watching television remembered their meals less vividly, and subsequently ate significantly more biscuits than those who ate their lunch in silence (Higgs & Woodward, 2009). Other studies have since found comparable findings by having participants initially play a computer game whilst eating (Oldham-Cooper et al., 2011; Higgs, 2015). In this way, people's diminished mealtime memory seemingly results in a less satiating experience overall, which in turn leads to later overconsumption. In another study, Brunstrom et al. (2012) examined the effect of mealtime memory on hunger using a covert peristaltic pump affixed to the bottom of a bowl that allowed the research to manipulate the amount of soup participants ate as part of a fixed lunch. Initially, participants saw either 300ml or 500ml of soup, but the amount they subsequently ate was altered by either drawing in or syphoning out some of the liquid. Whereas immediately after eating self-reported hunger ratings were predicted by the amount that participants consumed, following a two-hour delay participants' satiety was instead determined by the amount they thought they had eaten. That is to say, participants who saw 500ml of soup were more satiated than those who saw 300ml, irrespective of how much they had actually eaten. Taken together, the results of these studies suggest that in the absence of an accurate recollection of one's past eating experiences people are unable to appropriately manage their *future* eating intentions.

Whereas an impoverished mealtime memory may encourage further eating, people's recollections of historic eating experiences may similarly affect their future eating intentions. Indeed, evidence from the false-memory literature shows that the mere suggestion that a person became unwell after eating a particular food—such as strawberry ice cream—is enough to deter them from consuming that food in the future (e.g., Bernstein et al., 2005a). In such a study, participants are typically misinformed of a fictional childhood episode whereby they had gotten sick after eating a particular foodstuff. Of the minority that come to believe this claim to be true, participants subsequently express lower hedonic liking for the food in question (Bernstein et al., 2005a). In this way, a single utterance can negatively affect people's liking of a highly specific foodstuff (Scoboria et al., 2012), or entire food categories (Scoboria et al., 2008), and can persist long after the initial suggestion was made (Geraerts et al., 2008; Laney et al., 2008a). The reverse is also true, in that implanting a favourable childhood memory of the first time a person tried a particular food can actually increase people's hedonic liking and willingness to pay more for that food (Laney et al., 2008b). Importantly, these suggested events do not always create a false memory per se, but rather a false autobiographical *belief* that the proposed event occurred (Bernstein et al., 2015). It is people's beliefs in the occurrence of these events that—in accordance with the Theory of Planned Behaviour (Ajzen, 1991)—in turn influences people's eating intentions, and subsequent engagements in those behaviours.

However, people's past experiences need not be artificially manipulated in order to shape their present and future behavioural intentions. In one study for instance, participants who recalled a positive university experience were more likely to make a small donation to a university-affiliated charity than a non-affiliated alternative, compared to participants who recalled no such memory (Kuwabara & Pillemer, 2010). When asked to justify their reasoning, students' justifications made no mention of their prior recollections suggesting that their decisions were largely implicit, occurring outside of conscious awareness. In a second, related study, participants who recalled a positive public speaking experience from childhood were judged to have performed significantly better during a subsequent short oral presentation than were participants who remembered overcoming an unrelated childhood phobia (Pezdek & Salim, 2011). Not only did the experimental group appear less anxious during the presentation, but they also exhibited a significantly smaller rise in post-presentation cortisol levels and self-reported anxiety compared to control participants. Taken together, these studies demonstrate that prompting people to retrieve memories of their past experiences may inform their present and future behavioural intentions.

Likewise, research has shown that simply recalling a positive health-related experience is enough to encourage people to make healthier choices in the future. For instance, participants who recalled an autobiographical memory relating to successfully controlling their diet, or completing an exercise activity, subsequently reported higher intentions to control their food intake over the following two weeks (Merson & Pezdek, 2019). In another study, Biondolillo and Pillemer's (2015) participants remembered a motivational memory in which they felt either satisfied or displeased following exercise. Of those who remembered a satisfactory exercise experience, 61% reportedly increased their self-reported activity levels over the following two weeks, compared to 49% of participants who remembered a negative exercise memory, and 37% of participants who recalled no such memory. The authors explained their findings in reference to the Active-Self account (Wheeler et al., 2007), which theorises that people possess both a *chronic* self-concept and an *active* self-concept. The chronic self-concept encompasses all aspects relating to one's self stored in long-term memory, many of which will be mutually conflicting. Conversely, the active self-concept consists of a temporarily active subset of the chronic self that is said to determine behaviour. According to Biondolillo and Pillemer (2015), remembering a past exercise experience—be it positive or negative—made aspects of the participants' self-identity particularly salient, thereby drawing these aspects into the active self-concept and in turn influencing behaviour. In this way, people's episodic memories not only serve a directive function, but they also inform people's concept of *self*. Whereas the directive function assumes that people's memories *directly* inform their present and future behaviours, the self function surmises that it is people's desire to maintain a consistent sense of self over time—as informed by their memories—that ultimately drives behaviour (Bluck, 2003). In the previous example, a person remembering an example of exercising may infer that being physically active is an important aspect of their self-identity, and therefore aim to increase their engagement with physical activities in the following weeks. In this way, people's memories not only inform their behavioural intentions by way of highlighting what is important to their self-concept, but their engagement in those behaviours (i.e., exercising) in turn provides new confirmatory experiences to support future self-appraisals (Wilson & Ross, 2003).

Retrieval fluency

In attempting to understand the effects of memory on food intake and behavioural intentions, research has tended to focus on the recalled *content* of an experience, such as having participants recall instances of successful or unsuccessful dietary control (Merson & Pezdek, 2019). However, what might also matter is the *number* of memories that are retrieved. According to the availability heuristic (Tversky & Kahneman, 1973) the *subjective ease* with which people recall their past experiences is in itself a source of information. In this way, recalling several events in succession may create a metacognitive experience of difficulty, which may inversely affect people's judgments compared to if they were to rely on the recalled content alone (Schwarz, 1998, 2004). In one study for instance, participants who tried to recall twelve—rather than four—childhood memories, tended to judge their recollections of childhood to be significantly less complete (Winkielman et al., 1998). Despite generating more examples overall, the experienced difficulty associated with recalling more examples led people to *infer* that their childhood memories were incomplete. People's interpretations of this metacognitive experience of difficulty are ultimately informed by naïve theories regarding the way in which they think their memories operate (Alter & Oppenheimer, 2009; Schwarz, 2004). Therefore, in much the same way that enhanced processing fluency led to more positive judgements of fictitious dietary supplements in Experiment 3, people seemingly appraise their memories more favourably when recall is perceived to be easy, but less favourably when recall is perceived to be difficult.

Importantly, there is evidence to suggest that these so-called retrieval fluency effects can also inform people's judgments about health. For instance, healthy participants with no known family history of heart disease considered themselves at greater risk of developing heart-disease after recalling three risk-increasing behaviours as opposed to eight risk-increasing behaviours (Rothman & Schwarz, 1998). In another study, participants rated the perceived severity of two medical conditions as lower after being asked to list few disease consequences rather than many disease consequences, and similarly, participants who listed many treatment options for haemorrhoids expressed less confidence in their ability to remedy the condition than those listing few methods of treatment (Chang, 2010). Crucially, there is also evidence that these fluency-based effects can even bias people's appraisals of what constitutes a healthy diet. In one study, Requero et al.'s (2015) participants listed up to eight positives (or negatives) about the Mediterranean diet before rating how difficult they found it to generate these thoughts and subsequently rating their attitudes towards the Mediterranean diet. The significance here being that the Mediterranean diet—which closely resembles the WHO's definition of what constitutes a 'healthy' diet—is associated with reduced risk of developing cardiovascular disease, diabetes, neurodegenerative diseases (e.g., Alzheimer's disease), and some forms of cancer (Sofi, 2013). Requero et al. theorised that participants' attitudes towards the Mediterranean diet would be a function of the perceived ease with which people were able to generate thoughts about the diet. This was indeed the case, as participants who found it easier to think of positive aspects formed more favourable impressions of the Mediterranean diet than those finding it easy to recall negative thoughts. It therefore stands to reason that if people's appraisals of an exemplary diet can be biased by a metacognitive experience of difficulty, then people's assessment of their *own* healthiness may be similarly affected by the subjective difficult with which they can recall their past eating experiences. In this way, a person who finds it especially difficult to recall instances of eating healthily may infer that they are an 'unhealthy' eater, which may in turn influence their present and future behavioural intentions.

How do judgments about healthiness affect people's food choices and behaviours?

There are at least two reasons to predict that people's appraisals of their dietary healthiness may affect their present and future food choices and/or behaviours. As previously noted, people may behave according to their active-self concept (Wheeler et al., 2007) in efforts to maintain a consistent self-concept over time (Bluck 2003; Bluck et al., 2005). As was surmised in other health-related examples (e.g., Biondolillo & Pillemer, 2015), people's recollections of eating healthily, for instance, may make aspects of their self-identity particularly salient (i.e., "I am a healthy eater"), which may in turn influence their future food choices. A person who recalls instances of eating healthily may therefore—correctly or incorrectly—infer that they are a 'healthy' eater, and thus choose to eat healthily to maintain a consistent self-identity. Indeed, a recent study demonstrated that participants' identity as a healthy eater significantly predicted their healthy eating intentions and overall healthiness of their eating behaviours beyond that of the combined components of the Theory of Planned Behaviour (Brouwer & Mosack, 2015). Whereas collectively participants' attitudes, subjective norms and perceived control over eating healthily explained 30.7% of the variance in intentions to eat healthily, the addition of participants' identity as a healthy eater to the model predicted a further 28.5% of the variance. If then, cuing participants to retrieve memories of eating healthily alters their salient self-identity, this may in turn affect their subsequent food choices and/or behaviours.

Conversely, people's appraisals of their dietary healthiness may actually prompt a change in behaviour to compensate for a perceived imbalance between a person's perception of themselves and their goals (i.e., to stay healthy). According to the Compensatory Health Beliefs model (Rabia et al., 2006), the negative consequences associated with engaging in an 'unhealthy' behaviour (e.g., eating a piece of cake), can be counteracted by subsequently engaging in a comparatively 'healthy' behaviour (e.g., exercising). In this way, people can maintain a consistent self-identity (i.e., one in which they perceive themselves to be 'healthy') by forming justifications for their discrepant behaviours. In one study for instance, female undergraduate students who consumed an 'unhealthy' snack were significantly more likely to partake in a bout of exercise when given the opportunity, than a sedentary activity (Petersen et al., 2019). It is therefore reasonable to assume that a person forming an unfavourable opinion of their recent eating behaviours may look to rectify their past eating choice by opting to receive a healthier snack when prompted. The reverse is also true, insomuch as people can engage in compensatory 'healthy' behaviours in anticipation of a later reward (Knäuper et al., 2004). Therefore, a person may abstain from less healthy foods during the day in anticipation of a decadent meal in the evening. For these reasons, one might therefore anticipate that people's appraisals of their dietary healthiness may indeed bias their future eating choices and/or behaviours.

Chapter summary

In sum, it has long been suggested that people's memories serve a directive function insomuch as people's past experiences guide their present and future behaviours (Bluck, 2003; Cohen & Conway, 2007). In this way, people's memories of what they have eaten play an integral part in regulating appetite and informing future eating intentions (Higgs, 2008). For instance, prompting a person to recall an instance of eating healthily—such as consuming vegetables—can increase predicted liking and subsequent choice of those healthy foods (Robinson et al., 2011). An alternative explanation for these findings is that retrieving specific memories about one's health behaviours can make aspects of their self-identity particularly salient, which in turn drives their behavioural intentions and subsequent engagement in those behaviours (Biondolillo & Pillemer, 2015). Whereas research has explored how memory retrieval might be used to promote healthier behaviours (e.g., Merson & Pezdek, 2019), this research has tended not to consider that the accessibility of people's memories might also inform their self-appraisals and subsequent food choices. That is to say, a person who finds it particularly difficult to recall instances of eating healthily may infer that they are an 'unhealthy' eater, which may in turn lead them to behave according to their active self-concept (i.e., I am an unhealthy eater, so I shall continue to eat unhealthily), or to compensate for a perceived discrepancy between their self and dietary goals (i.e., eating a healthy snack now will neutralise my previous unhealthiness). Therefore, the following three experiments aimed to investigate whether the subjective difficulty with which people recall their past eating experiences can inform their perceptions of their own healthiness, and whether such appraisals would in turn influence the healthiness of their future food choices and motivations.

Experiment 4. The aims of Experiment 4 were firstly to examine whether the subjective difficulty with which people recall instances of eating healthily influences their judgments about the healthiness of their diets, and secondly, to examine the extent to which these appraisals affect people's future food choices and/or behaviours. To this end, participants were asked to recall either few (easy) or many (difficult) examples of instances where they had consumed something healthy, before then rating the healthiness of their diets and completing measures of their food choices and motivations. Owing to the onset of the Coronavirus (COVID-19) pandemic, data collection was halted long before my target sample size was achieved, but I nevertheless report these data in full.

Experiment 5. The main aim of Experiment 5 was to build upon the preliminary findings of Experiment 4 using a larger, online sample, whilst also addressing some of the limitations of the previous experiment. Extending those findings, the second aim of Experiment 5 was to examine the extent to which remembering 'unhealthy' eating experiences may similarly affect people's judgments about the healthiness of their diets. Thus, participants were instead asked to recall few (easy) or many (hard) examples of eating either 'healthily' or 'unhealthily' according to their random allocation to condition.

Experiment 6. The purpose of Experiment 6 was to test the replicability of the findings from the preceding two experiments using an empirically validated measure of people's eating choices and intentions. The ongoing COVID-19 pandemic necessitated that such a measure needed to be administrable online, and thus, I opted to use a modified version of the Virtual Portion Creation Task (VPCT). Elsewise, Experiment 6 was a direct replication of Experiment 5.

Chapter 7

Experiment 4

The aims of Experiment 4 were twofold. The first aim was to investigate whether the subjective difficulty with which people recall instances of eating healthily can inform their perceptions of their own dietary healthiness. The second aim was to examine the extent to which people's self-appraised dietary healthiness influenced their subsequent eating food choices and motivations. Based on the reasons outlined in the previous chapter, I predicted that when participants were instructed to recall a small number of healthy eating experiences, they would form more favourable impressions of their diets. However, the subjective difficulty associated with attempting to recall a large number of healthy eating experiences would be interpreted as evidence that their diets were *less* healthful, leading them to form unfavourable impressions of their dietary healthiness. Because the effects of these appraisals could either lead participants to act according to their salient self-identity *or* counteract their perceived (un)healthiness, I did not make any directional predictions about these outcomes. To test my research questions, I used a variation of Winkielman et al.'s (1998) memory-based experimental method. Participants were instructed to remember either few or many instances of eating healthily, before rating the healthiness of their past diets, and completing measures of their food choices and motivations.

Method: Pilot study

I conducted a small pilot study to determine how many specific eating experiences a person could feasibly be expected to remember when prompted, from which I could estimate the number of experiences necessary to evoke a sense of retrieval difficulty. Initially, 12 participants were randomly assigned to recall as many instances of eating either a 'healthy' or 'unhealthy' *meal* as possible. But owing to the low number of remembered eating experiences (M = 3.33, SD = 1.50), it remained unclear whether this figure was representative of the average number of eating experiences one could be expected to recall. I therefore recruited an additional 21 participants to test a less specific, alternative question. Specifically, participants were asked: "Try to remember an occasion in the recent past, for example within the past month, when you ate *something* [healthy/unhealthy]", and to enter their responses into an onscreen textbox. In addition to the food itself, participants were asked to provide some contextual information about the experience, such as where they were at the time. Once participants had submitted their response, a new screen appeared asking them whether they could recall another instance of eating healthily, or unhealthily. Answering "Yes" would prompt the participant to describe another example in the manner described above, whereas selecting "No" would terminate the survey.

Results: Pilot study

Responses were coded as valid provided they described at least one recognisable foodstuff or beverage, in addition to at least one additional detail about the remembered experience (e.g., where they were at the time). For reasons that will become apparent in Experiments 5 and 6, it was first important to rule out the possibility that participants found it easier to recall one memory type—be them healthy, or unhealthy—over the other. This was not the case (Mdn_{Healthy} = 3.00; $Mdn_{\text{Unhealthy}}$ = 2.00; U = 47.00, z = -0.58, p = *.61*, r = -0.13). Having addressed this concern, the average number of remembered eating experiences across both conditions was 3.52 (SD = 2.35), only marginally higher than that of the prior pilot study. Based on these data, I determined that in the main experiment *few*-events participants would be asked to recall two eating experiences, which should be relatively easy, whereas *many*-events participants would be asked to recall six eating experiences, which should be somewhat challenging.

Method

This study received ethical approval from Aston University Research Ethics Committee. The procedure and analysis plan for Experiment 4 were preregistered prior to data collection through AsPredicted.org, and can be found in Appendix H. But owing to the COVID-19 pandemic, data collection was halted well before the intended sample size had been achieved. Nevertheless, there was sufficient data to inform some preliminary conclusions about the aforementioned research questions. I discuss the implications of this small sample size in the *Results* section, below.

Participants and design. Per my preregistered plan, I had intended to recruit 128 participants following exclusions, which would have provided reasonable power to detect a medium-sized main effect (d = 0.5), in a two-tailed independent samples t-test with 80% power and alpha = .05. Initially, 81 participants registered their interest in taking part and subsequently completed a short pre-screening questionnaire (see Appendix I). Screening measures indicated that 12 prospective participants were not eligible to take part in the investigation: two had an existing anxiety disorder and/or depression; two had a food allergy; seven had a dietary restriction either as a result of medical advice (e.g., food intolerance), or personal choice (e.g., vegetarian); and one was on a calorie-controlled diet with the intention of losing weight. The remaining 69 students and members of university staff were all invited to take part, either in exchange for course credit or a cash voucher. Participants had no known food allergies or dietary restrictions; did not have an existing or historic eating disorder, diabetes, irritable bowel syndrome, Crohn's disease, an existing anxiety disorder and/or depression; were not presently taking any medications or dietary supplements that could affect appetite; and were not dieting with the intention of losing weight. In addition to 13 participants who did not attend the experiment, 15 participants were excluded from the analysis based on my preregistered inclusion criteria. Specifically, 12 reported a BMI outside 18.5-29.9; one had eaten within two hours prior to the testing session; one did not complete the experiment in full; and one failed to provide the minimum number of valid memories during the recall task. These removals left a final sample of 41 participants (33 females, 8 males; M_{age} = 20.32, SD = 2.09, range = 18-27; M_{BMI} = 22.69, SD = 2.69, range = 18.75-29.62), who were randomly assigned to either the few-eating experiences (n = 19) or many-eating experiences (n = 22) condition. The study used a between-subjects design with the number of eating memories recalled (few vs. many)[5] as the independent variable.

[5] Note that the number of eating memories recalled refers to the number of memories *requested* (i.e., two vs. six) rather than the actual number of memories retrieved.

Measures

Party Behaviour Questionnaire. As a measure of people's food choices, participants completed a modified version of the Party Behaviour Questionnaire (PBQ; Bernstein et al., 2005b). Participants were instructed to imagine that they were at a buffet serving a variety of foods and beverages. They then rated their willingness to consume each of 30, randomly ordered, foodstuffs using a series of 7-point Likert scales (1 = Definitely would not consume; 7 = Definitely would consume). Of these, 15 were high energy-dense (HED) foods (e.g., chocolate), and 15 were low energy-dense (LED) foods (e.g., grapes). Energy density refers to the amount of energy, in calories, per gram of food (i.e., kcal/g). The categorisation of foods as HED or LED was based on the values used by Epstein et al. (2018), in that a food with an energy density value exceeding 4 kcal/g was considered HED, and a food with a value lower than 2 kcal/g constituted LED (see Appendix J for a full list of the foods used and their energy density values). Participants' PBQ scores were averaged across all the HED foods and all the LED foods respectively, before subtracting the HED_{Mean} from the LED_{Mean} to produce a single score ranging from -6 to +6. Higher scores were therefore indicative of 'healthier' food choices.

Relative Reinforcement Value. As a measure of people's eating motivations, participants also completed an adapted version of Epstein et al.'s (2011) Relative Reinforcement Value (RRV) task, which has consistently been shown to predict *actual* food consumption (Epstein et al., 2011, 2018). In this instance, the RRV task measured how much effort people were willing to exert in pursuit of a LED snack-based reward, relative to a HED snack-based reward. Participants completed this task on two adjacent computers within a laboratory; one allowing the participants to work towards receiving a LED snack of their choice, the other allowing them to work towards receiving a HED snack. The assignment of LED and HED snacks to left and right computers was counterbalanced. The task itself was akin to playing a slot machine, in that each time participants clicked the left mouse-button within the response box, three on-screen shapes changed colour and form. Whenever all three shapes matched, the participant was awarded one point, and for every five points accrued the participants received a 10g portion of their preferred LED or HED snack (see Appendix K for energy density values). Participants' preferred snacks were determined by their responses to the pre-screening questionnaire, in which they were asked to rank their preferences for the three LED foods (apple slices, carrots, grapes) and three HED foods (chocolate chip cookies, Doritos, M&M's) respectively. In all cases, participants received their nominated first choice for both the LED and HED snacks. The number of mouse clicks needed in order to elicit a reward was determined by a fixed-ratio schedule, insofar as it became progressively harder to earn a reward. In the first instance, participants received a reward after 20-mouse clicks, then following an additional 40 mouse-clicks, and so on. Participants were free to move between the two computers as often as they liked, but they were only permitted to work towards one snack at a time. Upon earning a reward, an onscreen prompt notified participants of their 'winnings' and the researcher placed the weighed food into one of two separate bowls on a table behind them. Participants were able to see how much food they had earned, but were not permitted to consume anything until the very end of the experiment.

The task ended when the participant no longer wished to earn points towards either foodstuff, at which point the researcher recorded the total number of mouse-clicks achieved towards the LED snack, and HED snack respectively. For the sake of interpreting the results, the point at which the participant halted the experiment will henceforth be referred to as the *breakpoint*. The task therefore yielded two measures; specifically, the maximum number of clicks earned in pursuit of the LED snack ($LED_{Breakpoint}$) and HED snack ($HED_{Breakpoint}$). These two measures were analysed separately in addition to the RRV itself, calculated as: $HED_{Breakpoint} \div (HED_{Breakpoint} + LED_{Breakpoint})$. The RRV therefore presents the proportion of work done towards achieving a HED snack-based reward, relative to a LED snack-based reward, whereby higher scores were indicative of a greater work-rate in pursuit of a *less* healthy, HED food reward.

Food Choice Questionnaire. Participants' food choice motives were assessed using a subset of items from the Food Choice Questionnaire (FCQ; Steptoe et al., 1995).

Specifically, I was interested in the six items from the *health* factor of this scale, which relate to people's health-related reasons for choosing the foods they consume (e.g., "It is important to me that the food I eat on a typical day contains lots of vitamins and minerals"). Items are rated on a scale from 1 (Not at all important) to 4 (Very important). Participants' ratings were averaged into a single score, whereby higher scores signalled a greater preoccupation with the healthiness of people's food choices. See Appendix L for a full list of the items used.

Dutch Eating Behaviour Questionnaire. Participants completed the Dutch Eating Behaviour Questionnaire (DEBQ; van Strien et al., 1986), which measures three aspects of eating behaviour: (1) *dietary restraint* (10-items), refers to the extent to which people consciously restrict their food intake in order to achieve or maintain a particular weight, (2) *external eating* (10-items), reflects people's tendency to eat in response to food-related stimuli (e.g., a food's smell), irrespective of their current hunger or satiety, and (3) *emotional eating* (13-items) concerns eating to alleviate negative emotions, rather than to satisfy hunger. Participants were instructed to rate their agreement with a series of randomly ordered statements (e.g., "Do you have a desire to eat when you are irritated?") from 1 (Never) to 5 (Very often). See Appendix M for the full questionnaire.

Procedure. Participants completed the study individually, within a laboratory. To begin, participants were instructed to approximate the last time that they had eaten something, and to enter their response into an onscreen textbox. Next, participants completed two visual analogue scales (VAS) measuring their current hunger and fullness (0 = Not Hungry/Full at all; 100 = Very Hungry/Full) respectively, after which the main experimental manipulation began. Participants were then instructed to reflect upon their past eating experiences and provide either two or six occasions when they had eaten healthily, according to their random allocation to condition. Specifically, they were asked:

> "Please try to recall [two/six] examples of recent occasions, for example in the past month, when you have eaten something healthy. Use each textbox below to give a different example, and provide a brief description of what you remember eating. Roughly when was this? Where were you when you ate it? What did it taste like?"

Note that the term “healthy” was not defined for participants, simply because the experimental manipulation did not rely on the *actual* healthiness of the remembered foods per se, but rather people’s *perception* of what constituted something healthy. I discuss the implications of this distinction in Chapter 9. After describing their memories, participants then rated how difficult they found it to recall the requested number of eating experiences on a 7-point Likert scale (1 = very easy; 7 = very difficult). Once participants had responded, a new screen appeared with my two primary dependent measures. Firstly, participants’ appraisals of their *recent* dietary healthiness were assessed using the question: “To what extent do you agree with the following statement: “In recent weeks and months I have had a healthy diet” (1 = I have eaten very unhealthily; 7 = I have eaten very healthily). Secondly, participants’ appraisals of the *general* healthiness of their diets were measured using the question: “To what extent do you believe that you normally eat healthily in your day-to-day life?” (1 = I normally eat very unhealthily; 7 = I normally eat very healthily).

Participants then completed the PBQ, after which they were instructed to call the researcher who explained the RRV task (see Appendix N for task instructions). Participants were given a short practice session to familiarise themselves with the task, whereby they were instructed to earn their first reward (i.e., 20 mouse-clicks) for demonstrative purposes. The task was then reset and participants were free to start earning points towards their chosen snacks. The RRV task ceased when participants no longer wished to earn points towards either foodstuff, at which point participants completed the FCQ items, followed by the DEBQ. To conclude, participants answered some basic demographic questions and the researcher measured their height and weight for the purpose of calculating participants’ BMI. Participants were then free to consume any snacks they had earned during the RRV, and fully debriefed.

Results: Preregistered analysis

Coding of recalled eating experiences. Recall responses were coded in the same manner as the pilot study, insofar as each of the participants’ answers were required to describe at least one recognisable food or beverage, plus one additional detail about the eating experiences (e.g., where they were at the time) to be considered valid. As per my preregistered exclusion criteria, any participant in the few-events condition who failed to describe two valid memories was excluded from the analysis and replaced. Likewise, any many-events participants who did not provide at least three valid memories (i.e., one more than was required of the few-events participants) was excluded and replaced.

Demographics. The two groups did not differ significantly in age, BMI, baseline hunger and fullness, or emotional eating (see Table 5). There were however, significant between-groups differences on measures of dietary restraint, $t(39) = 2.60$, $p = .01$, $d = 0.82$, and external eating, $t(39) = 2.17$, $p = .04$, $d = 0.64$.

Manipulation checks. In my final dataset, participants assigned to the many-memories condition recalled an average of 5.41 memories of eating healthily ($SD = 1.01$, range = 3-6), with 68.2% of participants generating the maximum number of examples requested (i.e., six). There was however, no significant between-group difference in participants' retrieval difficulty scores, ($M_{Few} = 3.26$ out of 7, $SD = 1.49$; $M_{Many} = 3.82$, $SD = 1.82$; $t(39) = 1.06$, $p = .30$, $d = 0.33$), which suggests that the experimental manipulation was unsuccessful. Though not statistically significant, this result does at least show a modest effect size in the predicted direction.

Perceptions of healthiness. Of foremost interest was whether participants' perceptions of their recent and/or general dietary healthiness were affected by the number of healthy eating experiences they tried to retrieve. Contrary to my hypothesis, participants who recalled many memories of eating healthily reported significantly healthier perceptions of their recent diets ($M = 4.45$, $SD = 1.53$), compared to those who recalled a few memories ($M = 3.42$, $SD = 1.43$), $t(39) = 2.22$, $p = .03$, $d = 0.70$ (see Figure 14). Similarly, when participants were asked about the healthiness of their diets in general, many-memories

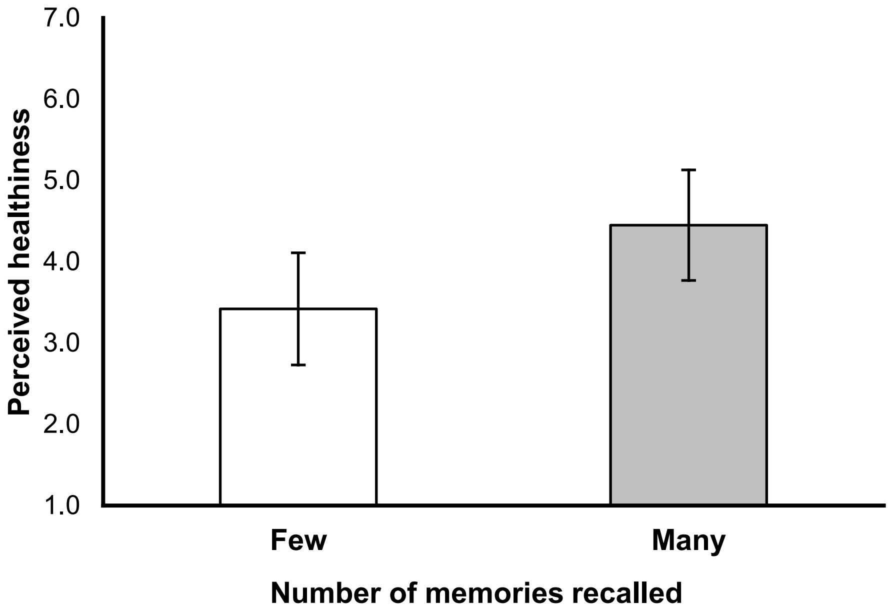
Table 5

Participant demographics for Experiment 4

	Number of events recalled	
	Few	**Many**
Age (years)	19.89 (1.41)	20.68 (2.51)
BMI (kg/m^2)	22.96 (3.22)	22.45 (2.18)
Hunger (VAS: 0-100)	57.32 (27.88)	57.82 (22.73)
Fullness (VAS: 0-100)	31.53 (31.37)	30.09 (27.48)
DEBQ dietary restraint	2.07 (0.79)	2.78 (0.94)
DEBQ external eating	3.76 (0.78)	3.28 (0.64)
DEBQ emotional eating	2.45 (1.09)	2.47 (0.86)

Figure 14

Mean ratings for participants' perceptions of recent dietary healthiness



Note. Error bars represent 95% confidence intervals.

participants rated their diets as healthier (*M* = 4.64, *SD* = 1.59), than few-memories participants (*M* = 3.53, *SD* = 1.47), *t*(39) = 2.31, *p* = .03, *d* = 0.72 (see Figure 15)[6].

Food choices and motivations. Next, I was interested in whether the number of remembered instances of eating healthily affected participants' future food choices and motivations. I first examined participants' PBQ scores, whereby more positive scores were indicative of a 'healthier' food choices. There was no significant difference between participants' PBQ selections according to whether they recalled a few (*M* = -0.64, *SD* = 1.26), or many eating experiences (*M* = -0.11, *SD* = 1.40), *t*(39) = 1.26, *p* = .21, *d* = 0.40.

Second, I examined the amount of effort participants exerted in accruing LED and HED snacks respectively, whereby higher scores were indicative of a higher work-rate (i.e., more mouse-clicks). A 2 (number of eating memories recalled: few vs. many) x 2 (breakpoint: LED vs. HED) mixed-factor ANOVA found no significant main effect of breakpoint, *F*(1, 39) = 1.37, *p* = .25, η^2_p = .03, nor was the number of eating memories recalled x breakpoint interaction significant, *F*(1, 39) = 0.03, *p* = .87, η^2_p < .01. Finally, I examined participants' RRV scores (i.e., the proportion of effort exerted in pursuit of an HED snack relative to a LED snack), whereby higher scores signalled a higher number of mouse-clicks registered in pursuit of a *less* healthy food reward. There was no significant difference between participants' RRV scores as a function of how many memories of eating healthily they recalled (M_{Few} = 0.52, *SD* = 0.32; M_{Many} = 0.37, *SD* = 0.32; *t*(39) = 1.48, *p* = .15, *d* = 0.47).

Finally, I looked at participants' FCQ scores to determine whether recalling memories of eating healthily affected people's health-related motives for the choosing the foods they consume. This was not the case (M_{Few} = 2.83, *SD* = 0.84; M_{Many} = 2.89, *SD* = 0.69; *t*(39) = -0.23, *p* = .82, *d* = 0.07).

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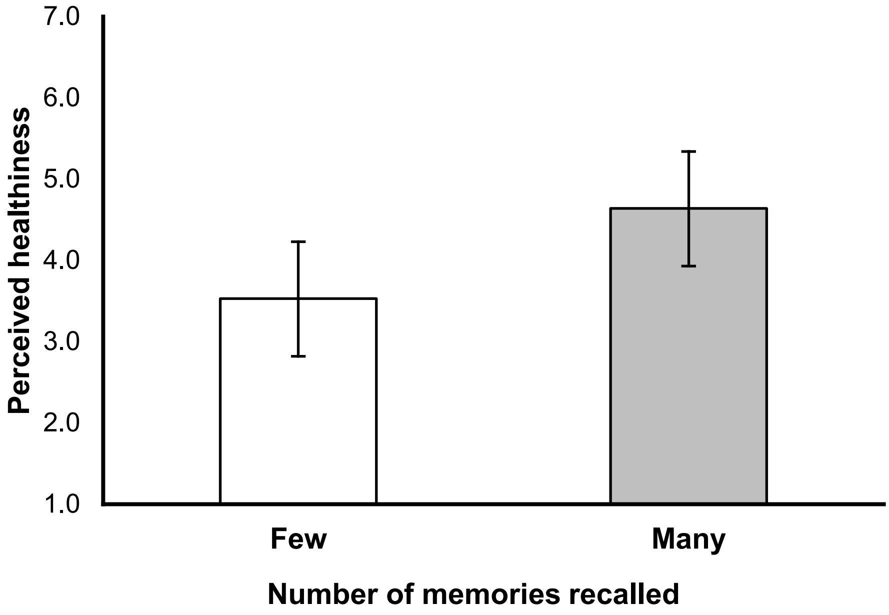
[6] To rule out the possibility that the observed between-group differences in habitual eating may have unduly influenced my results, I conducted separate (not preregistered) ANCOVAs using participants' dietary restraint and external eating scores as covariates for each of my dependent variables. The observed effect remained significant for participants' appraisals of their *recent* (*p* = .02), and *general* (*p* = .03) dietary healthiness when dietary restraint was factored in as a covariate. However, this was not the case for external eating (both *p* > .17). It is therefore plausible that any differences could be attributed to baseline differences in participants' external eating between conditions.

Figure 15

Mean ratings for participants' perceptions of general dietary healthiness



Note. Error bars represent 95% confidence intervals.

Results: Exploratory analysis

Contrary to my hypothesis, the results from my preregistered analyses lend support to a numerosity effect (Pelham et al., 1994), insofar as participants seemingly made inferences about their dietary healthiness based upon the *number* of remembered eating experiences rather than the subjective ease with which those experiences were brought to mind. Crucially, however, participants who recalled many healthy eating memories did not report significantly greater recall difficulty scores than did participants who recalled few memories. It would therefore be premature to conclude that the subjective ease of memory retrieval did not affect people's appraisals of their dietary healthiness. To further explore this issue, I conducted additional analyses to those I preregistered.

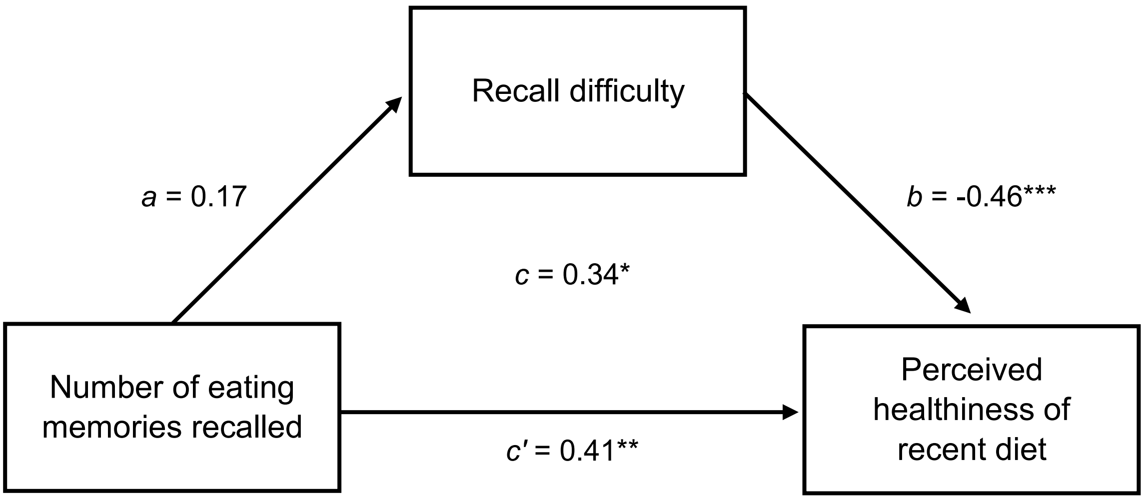
First, I examined the extent to which participants' subjective judgments of how difficult they found it to retrieve memories of eating healthily was correlated with each of my dependent variables. The results showed that participants who found it more challenging to remember instances of eating healthily were less positive about the healthiness of their recent diets, $r = -.39$, $p = .01$, as well as their diets in general, $r = -.39$, $p = .01$. Similarly, people placed less importance on the health properties of their food choices as recall difficulty increased, by way of a significant negative correlation between recall difficulty and participants' FCQ scores, $r = -.32$, $p < .05$. Conversely, there were no significant correlations between participants' recall difficulty scores and the healthiness of their food choices on the PBQ, $r = -.29$, $p = .07$, or the RRV task, $r = .04$, $p = .83$.

In contrast with the results from my preregistered analysis, these exploratory findings are consistent with the idea that participants may rely—in part—on the subjective ease with which they recall their eating memories when appraising the healthiness of their diets. However, it is important to acknowledge that these correlational data cannot prove causality. An alternative explanation for these findings then, is that the difficulty with which people recall instances of eating healthily is a direct consequence of the unhealthiness of their diets. It is nevertheless interesting to consider that cueing people to remember many instances of eating healthily could evoke both a numerosity *and* opposing fluency effect. That is to say that recalling multiple memories of eating healthily may inflate people's appraisals of their dietary healthiness, but also the subjective difficulty of memory retrieval may *decrease* their perceived dietary healthiness. I therefore conducted additional mediation analyses to examine the direct and indirect effects of my experimental manipulation upon each of my dependent variables, when factoring in recall difficulty as a potential mediator.

In my first model, I entered participants' judgments of their recent dietary healthiness as my dependent variable (see Figure 16). Per the findings of my preregistered analysis, the total effect of my manipulation was significant, $\beta = 0.34$, $SE = 0.46$ (95% CI [0.13, 1.93]), $p = .02$. There was also a significant direct effect of the number of eating memories recalled on people's judgments of their recent dietary healthiness, $\beta = 0.41$, $SE = 0.40$ (95% CI [0.48, 2.06]), $p < .01$, but the indirect effect via recall difficulty was not significant, $\beta = -0.24$, $SE = 0.23$ (95% CI [-0.68, 0.21]), $p = .30$.

Figure 16

Mediation model showing the effect of the number of remembered eating experiences on appraisals of recent dietary healthiness via recall difficulty

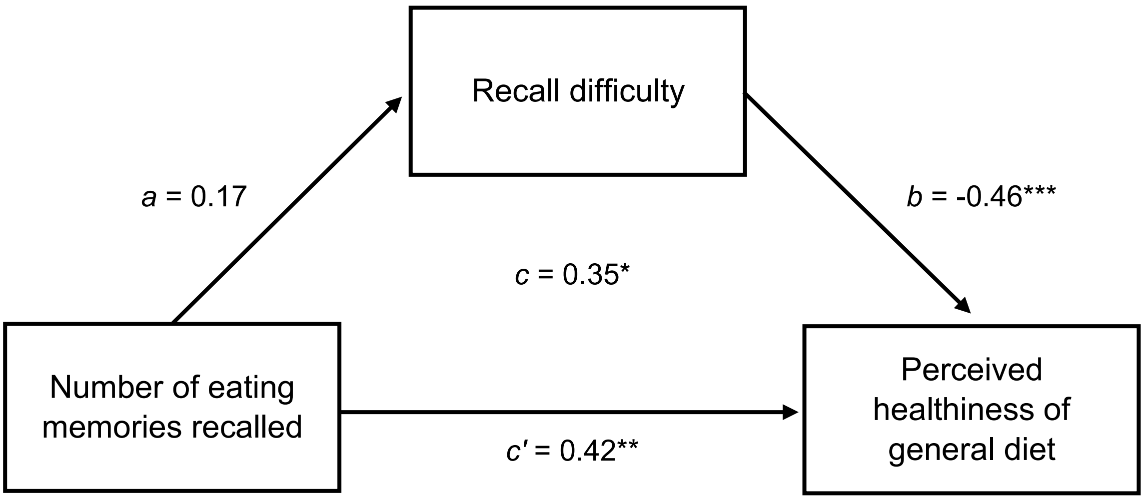


Note. **p* < .05, ** *p* < .01, *** *p* < .001; *c* = *total* effect; *c'* = *direct* effect

Next, I repeated this same analysis with participants' ratings of their general dietary healthiness as my dependent variable (see Figure 17). Again, the total effect of my manipulation was significant, β = 0.35, *SE* = 0.48 (95% CI [0.18, 2.04]), *p* = .02. The direct effect of the number of eating memories recalled was also significant, β = 0.42, *SE* = 0.42 (95% CI [0.54, 2.17]), *p* < .001, but the indirect effect via recall difficulty was not significant, β = -0.08, *SE* = 0.24 (95% CI [-0.71, 0.22]), *p* = .30. Finally, I repeated these mediation models for the remaining three dependent variables: PBQ scores, FCQ scores and RRV scores. In all three models, the total, direct and indirect effects were all statistically non-significant (all *p* > .08).

Figure 17

Mediation model showing the effect of the number of remembered eating experiences on appraisals of general dietary healthiness via recall difficulty



Note. **p* < .05, ** *p* < .01, *** *p* < .001; *c* = *total* effect; *c'* = *direct* effect

Discussion

The aims of Experiment 4 were firstly, to investigate the extent to which the subjective difficulty of recalling instances of eating healthily influenced participants' judgments of their dietary healthiness, and secondly, to examine whether these judgments in turn influenced their future food choices and motivations. The findings of Experiment 4 suggest that prompting people to remember past instances of eating healthily can indeed bias their appraisals of their dietary healthiness. Contrary to the hypothesis though, the results of my preregistered analysis do not fit well with a fluency-based explanation, which would predict that the subjective difficulty of recalling many examples of eating healthily would be interpreted as evidence that a person was an 'unhealthy' eater, resulting in a *less* favourable appraisal of their dietary healthiness. Instead, my findings are more consistent with the numerosity effect, insomuch as participants relied on the *number* of remembered healthy eating experiences as the basis for their self-appraised healthiness. In this way, participants who recalled many instances of eating healthily formed significantly healthier impressions of both their recent and general diets. One possible explanation for these findings is that many-memories participants simply found the task too easy to evoke the necessary degree of recall difficulty. Indeed, the absence of a significant between-groups difference in participants' recall difficulty scores would tend to support this rationale, as well as the fact that the majority of participants were able to recall the maximum number of events requested. Conversely, when I plotted participants' recall difficulty scores against each of my dependent variables, there was an inverse relationship between participants' appraisals of their dietary healthiness and how difficult they found it to remember instances of eating healthily. Whereas it is interesting to speculate that these data show evidence of *both* a numerosity and opposing fluency effect, the results of my exploratory mediation analysis do not support this conclusion. There was also no suggestion that participants' judgments of their dietary healthiness affected the healthiness of their eating food choices and motivations. Specifically, participants' self-appraised dietary healthiness had no effect on the proportion of LED (to HED) snacks they chose as part of a hypothetical buffet scenario, or the amount of effort that they were willing to exert in pursuit of a LED (or HED) snack-based food reward. However, it is difficult to draw any firm conclusions about the validity of my findings given the low statistical power observed.

Aside from the obvious drawback of sample size, a further limitation of Experiment 4 was that the duration of the experiment was not equated, insomuch as many-memories participants took an average of nine minutes longer to complete the study in full. It is therefore reasonable to assume that the lengthier experimental session may have unduly influenced the amount of effort that participants were willing to exert in pursuit of their respective snacks. Whereas this oversight should not have influenced the main effect of interest (i.e., the *proportion* of 'healthy' to 'unhealthy' snacks earned), future research using this method should nonetheless take measures to equate the study duration for the two (or more) conditions. This could be achieved through having few-memories participants complete a short filler task, though careful attention should be paid to the placement of such a task so as not to disrupt any potential fluency effects.

It is, however, important to acknowledge that neither the observed effect on participants' judgments of their recent or general dietary healthiness remained significant after factoring in participants' external eating scores as a covariate. Whilst it may be the case that such effects can therefore be explained by between-groups differences in habitual eating, an alternative explanation of these findings is that the experimental manipulation itself may have feasibly altered participants' DEBQ responses. Indeed, many of the items from the external eating subscale focus on 'resisting' temptation (e.g., "can you resist eating delicious foods?"), and thus prompting participants to remember multiple instances of eating healthily may have provided them with confirmatory examples of such an occurrence. These data may therefore have important ramifications for the way in which people's habitual eating habits are objectively assessed, though caution is advised given the low statistical power observed. It will nevertheless be interesting to examine whether this peculiarity is unique to this study or whether I find repeated evidence of between-group differences in participants' habitual eating habits, which could be attributed to the experimental manipulation.

The findings of Experiment 4 permit an initial test of the idea that people's remembered healthy eating experiences can inform their judgments about their dietary healthiness. Specifically, these data suggest that asking people to retrieve several examples of eating healthily can lead people to make more optimistic assumptions about their dietary healthiness. However, data collection ceased long before the intended sample size was achieved, making it difficult to draw any firm conclusions from these findings. I therefore attempted to address these concerns in Chapter 8 using two large, online experiments.

Chapter 8

Experiment 5

The main aim of Experiment 5 was to test the robustness of the previous experiment's findings using a larger, online sample. To address concerns that in the prior experiment there was no statistically significant difference between participants' recall difficulty scores, many-memories participants were now asked to recall an additional two eating experiences – eight in total. The second aim of Experiment 5 was to investigate the extent to which remembering instances of eating unhealthily may also affect people's judgments about their dietary healthiness and subsequent food choices. In much the same way that remembering multiple instances of eating healthily led participants to make more favourable assessments of their diets in Experiment 4, prompting participants to recall examples of unhealthy eating might lead them to infer that they are an 'unhealthy' eater. If, however, the aforementioned effect was due to the experimental manipulation being too easy to evoke the necessary degree of recall difficulty from many-memories participants, then participants may interpret the experienced difficulty of remembering many examples of eating unhealthily as evidence that they are a 'healthy' eater. Assuming that participants' judgments of their dietary healthiness do in fact influence the healthiness of their future food choices, it is reasonable to assume that participants' food choices may also vary depending on whether they are instructed to remember 'healthy' or 'unhealthy' eating experiences. That is to say, a person who infers they are a 'unhealthy' eater might behave according to their salient self-identity by selecting a greater proportion of HED, less healthy snacks (Wheeler et al., 2007). Conversely, someone who infers that they have eaten unhealthily in recent memory may look to counteract their prior indulgence by consuming a 'healthy' snack (Knäuper et al., 2004).

Setting aside the preliminary findings of Experiment 4, which could feasibly be attributed to baseline differences in external eating between conditions, I reasoned that when participants were instructed to remember a small number of unhealthy eating experiences, they would judge their diets to be less healthy. Conversely, the subjective difficulty of attempting to remember a large number of unhealthy eating experiences would lead participants to make more positive judgments of their dietary healthiness. In keeping with my previous predictions, I anticipated that the reverse would be true for participants asked to recall ‘healthy’ eating experiences.

Method

This study received a favourable ethical opinion from Aston University Research Ethics Committee. The procedure and analysis plan were preregistered prior to data collection through AsPredicted.org, and can be found in Appendix O.

Participants and design. Per my preregistered plan, I intended to recruit a total of 364 participants following exclusions. A priori power analysis suggested that this sample size should permit detection of a small-medium sized interaction effect (f = .15, given α = .05, power = .80). Ultimately, 441 UK residents were recruited via the online survey panel provider Prolific, in exchange for a small financial credit. To minimise the number of potential exclusions, I created custom pre-screening criteria—using Prolific’s in-built participant filters—to only recruit participants with no known food allergies or dietary restrictions, and a BMI between 20-29.9. In accordance with my preregistered exclusion criteria, data from 76 participants were removed from the analysis. Specifically, 49 had a BMI that—when calculated from the participants’ self-reported height and weight—fell outside 20-29.9, and 27 did not provide the minimum number of valid eating memories during the recall task. These removals left a final sample of 365 participants (147 males, 216 females, 2 others; M_{age} = 37.96, SD = 11.98, range = 18-75; M_{BMI} = 24.42, SD = 2.47, range = 20.03-29.77), slightly above my preregistered target of 364 participants. The study used a 2 (number of eating memories recalled: few vs. many) x 2 (memory type: healthy vs. unhealthy) between-subjects design. Participants were randomly allocated to one of the four experimental conditions; few-healthy (n = 92), many-healthy (n = 88), few-unhealthy (n = 88), many-unhealthy (n = 97).

Procedure. For the most part, the procedure remained unchanged from Experiment 4. Participants now completed the study online, and as such they were no longer asked to refrain from eating prior to the study or subsequently report the last time that they had eaten. Likewise, the RRV task was removed as it was not feasible to administer remotely, and participants were now asked to self-report their height and weight. Most notably, participants were now instructed to recall examples of either ‘healthy’ or ‘unhealthy’ eating during the recall task, based on their randomisation to condition. As a final consideration, given that participants’ recall difficulty scores did not differ significantly according to whether they remembered few- or many-memories of eating healthily, many-memories participants were now asked to recall *eight* eating memories, rather than six.

Results: Preregistered analysis

Demographics. Groups did not differ significantly in age, BMI, self-reported hunger and fullness, or measures of eating behaviour (see Table 6).

Manipulation checks. Recall responses were coded in the same manner as in Experiment 4. Following exclusions, many-memories participants recalled an average of 7.36 memories across both conditions (M_{Healthy} = 7.31, *SD* = 1.29; $M_{\text{Unhealthy}}$ = 7.41, *SD* = 1.05; range = 3-8), with 67% of participants providing the maximum number of examples requested (i.e., eight). Importantly, a 2 (number of eating memories recalled: few vs. many) x 2 (memory type: healthy vs. unhealthy) between-subjects ANOVA of participants’ recall difficulty ratings found a significant main effect of the number of eating memories recalled, insomuch as participants found it easier to recall few examples of eating (*M* = 2.24, *SD* = 1.60), than many examples (*M* = 3.88, *SD* = 1.98), $F(1, 361) = 79.26$, $p < .001$, $\eta^2_p = .18$. There was also a significant effect of memory type, with participants finding it easier to remember eating unhealthily (*M* = 2.75, *SD* = 1.85), than healthily (*M* = 3.40, *SD* = 2.05), $F(1, 361) = 14.48$, $p < .001$, $\eta^2_p = .04$. The two-way interaction was not, however, significant, $F(1, 361) = 0.04$, $p = .84$, $\eta^2_p < .001$ (see the first row of Table 7).

Table 6

Participant demographics for Experiment 5

	Number of events recalled			
	Few		Many	
	Healthy	Unhealthy	Healthy	Unhealthy
Age (years)	38.42 (11.77)	37.14 (10.79)	37.35 (12.16)	38.82 (13.07)
BMI (kg/m^2)	24.54 (2.54)	24.38 (2.36)	24.32 (2.62)	24.44 (2.40)
Hunger (VAS: 0-100)	47.01 (27.26)	47.66 (25.22)	47.91 (29.33)	49.30 (27.08)
Fullness (VAS: 0-100)	38.52 (27.18)	38.69 (29.19)	40.24 (28.35)	38.27 (29.25)
DEBQ dietary restraint	2.78 (0.79)	2.63 (0.88)	2.68 (0.85)	2.71 (0.88)
DEBQ external eating	3.14 (0.61)	3.12 (0.63)	3.13 (0.61)	3.24 (0.63)
DEBQ emotional eating	2.48 (1.01)	2.42 (0.95)	2.41 (0.87)	2.41 (0.95)

Table 7

Means (SDs) for recall difficulty, perceptions of healthiness, and food choices for Experiment 5

	Number of events recalled			
	Few		Many	
	Healthy	Unhealthy	Healthy	Unhealthy
Recall difficulty	2.61 (1.82)	1.86 (1.24)	4.23 (1.97)	3.56 (1.95)
Recent healthiness	3.86 (1.61)	3.73 (1.59)	4.06 (1.34)	2.94 (1.52)
General healthiness	4.83 (1.35)	4.88 (1.31)	4.70 (1.27)	4.55 (1.51)
PBQ Score	-0.11 (1.32)	-0.25 (1.23)	-0.13 (1.31)	-0.64 (1.45)
FCQ Score	2.85 (0.56)	2.87 (0.66)	2.85 (0.62)	2.66 (0.64)

Perceptions of healthiness. Having determined that the experimental manipulation evoked significant (and sizeable) between-groups differences in experienced recall difficulty, I next examined whether the number of remembered eating experiences affected participants' ratings of their recent and/or general dietary healthiness. A 2 (number of eating memories recalled: few vs. many) x 2 (memory type: healthy vs. unhealthy) between-subjects ANOVA found no significant main effect of the number of eating memories recalled on people's appraisals of the healthiness of their recent diets, (M_{Few} = 3.79, *SD* = 1.60; M_{Many} = 3.47, *SD* = 1.54; *F*(1, 361) = 3.44, *p* = .06, $\eta^2_p < .01$. There was, however, a significant main effect of memory type, with participants forming more favourable judgments of their recent dietary healthiness when they remembered instances of eating healthily (*M* = 3.96, *SD* = 1.49), rather than unhealthily (*M* = 3.31, *SD* = 1.60), *F*(1, 361) = 15.39, *p* < .001, $\eta^2_p = .04$. Crucially, the predicted two-way interaction was also significant, *F*(1, 361) = 9.60, *p* < .01 η^2_p = .03 (see the second row of Table 7). Contrary to my hypothesis though, post-hoc *t*-tests with Bonferroni corrected alpha (*p* < .0125) found participants who tried to retrieve many instances of eating unhealthily formed less favourable impressions of their recent dietary healthiness (*M* = 2.94, *SD* = 1.52), than those who recalled few examples of eating unhealthily (*M* = 3.73, *SD* = 1.59), *t*(178) = 3.45, *p* < .001, *d* = 0.51. Likewise, participants who attempted to recall many examples of eating healthily formed more favourable impressions of their dietary healthiness (*M* = 4.06, *SD* = 1.34), relative to those who tried to recall many examples of eating unhealthily (*M* = 2.94, *SD* = 1.52), *t*(183) = 5.29, *p* < .001, *d* = 0.78.

A separate between-subjects ANOVA of participants' ratings of their general dietary healthiness, found no significant main effect of the number of eating memories recalled, (M_{Few} = 4.85, *SD* = 1.33; M_{Many} = 4.62, *SD* = 1.40; *F*(1, 361) = 2.47, *p* = .12, $\eta^2_p < .01$). Likewise, there was no main effect of memory types, (M_{Healthy} = 4.77, *SD* = 1.31; $M_{\text{Unhealthy}}$ = 4.70, *SD* = 1.42; *F*(1, 361) = 2.47, *p* = .12, $\eta^2_p < .01$), nor was the two-way interaction significant, *F*(1, 361) = 0.52, *p* = .47, $\eta^2_p < .01$ (see third row of Table 7).

Food choices and motivations. Next, I repeated the between-subjects ANOVA using participants' PBQ scores to examine whether people's recollections of eating and subsequent dietary appraisals affected their future food choices. As in Experiment 4, the was no significant main effect of the number of eating memories recalled on participants' food choices, (M_{Few} = -0.18, *SD* = 1.28; M_{Many} = -0.40, *SD* = 1.40; *F*(1, 361) = 2.22, *p* = .14, $\eta^2_p <$ .01). There was, however, a significant effect of memory type, insomuch as participants chose a higher proportion of healthier, LED snacks when they remembered instances of eating healthily (*M* = -0.12, *SD* = 1.31), rather than unhealthily (*M* = -0.45, *SD* = 1.36), $F(1, 361) = 5.29$, $p = .02$, $\eta^2_p = .01$. However, the predicted two-way was not significant, $F(1, 361) = 1.74$, $p = .19$, $\eta^2_p < .01$ (see the fourth row of Table 7).

Regarding participants' health-related motives for their food choices, a separate between-subjects ANOVA reported no main effect of the number of eating memories recalled on participants' FCQ scores ($M_{Few} = 2.86$, $SD = 0.61$; $M_{Many} = 2.75$, $SD = 0.63$; $F(1, 361) = 2.50$, $p = .12$, $\eta^2_p < .01$). Likewise, there was no main effect of memory type ($M_{Healthy} = 2.85$, $SD = 0.59$; $M_{Unhealthy} = 2.76$, $SD = 0.65$; $F(1, 361) = 1.74$, $p = .19$, $\eta^2_p < .01$), nor was the two-way interaction significant, $F(1, 361) = 2.63$, $p = .11$, $\eta^2_p < .01$ (see the fifth row of Table 7).

Results: Exploratory mediation analysis

The findings from my preregistered analyses show further evidence of a numerosity heuristic, in that participants' judgements of their recent dietary healthiness were again influenced by the *number* of eating memories retrieved from memory. Specifically, participants who tried to remember multiple instances of eating unhealthily formed less favourable impressions of the healthiness of their recent diets, compared to those who recalled few examples of eating unhealthily. Importantly, this time participants found it significantly harder to recall many eating memories than few eating memories. However, it is important to acknowledge that many-memories participants still only found it mildly challenging to recall eight instances of past eating (*M* = 3.88 out of 7). Consequently, I decided to repeat the exploratory (not preregistered) mediation analyses from Experiment 4 to examine the direct and indirect effects of the number of eating memories recalled upon each of my dependent variables, when considering recall difficulty as a potential mediator. To this end, I ran separate mediation models for the healthy- and unhealthy-conditions respectively, using each of my dependent variables. Note that the reported mediation models remain part of my exploratory analyses (i.e., not preregistered) as the decision to look at participants' recall difficulty scores as a possible mediator was only decided upon after data collection had finished for both Experiments 5 and 6.

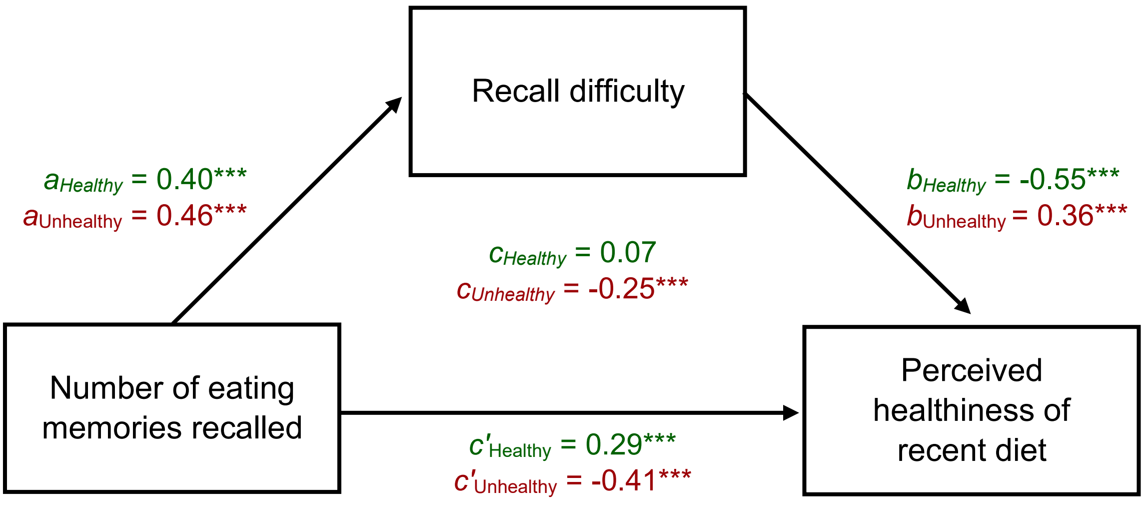
Perceptions of healthiness. To begin, I entered participants' healthiness ratings of their recent diets as my dependent variable (see Figure 18). Starting with the healthy-memories conditions, the total effect of my manipulation was not significant, β = 0.07, *SE* = 0.22 (95% CI [-0.24, 0.63]), *p* = .37. There was, however, a significant direct effect of the number of eating memories recalled on participants' judgments of their recent dietary healthiness, β = 0.29, *SE* = 0.21 (95% CI [0.44, 1.25]), *p* < .001. Unlike in Experiment 4, this time the indirect effect via recall difficulty was also significant, β = -0.22, *SE* = 0.14 (95% CI [-0.92, -0.38]), *p* < .001, in that participants found it harder to recall examples of eating healthily, β = 0.40, *SE* = 0.28 (95% CI [1.07, 2.17]), *p* <.001, and those experiencing recall as difficult formed *less* healthy perceptions of their dietary healthiness, β = -0.55, *SE* = 0.05 (95% CI [-0.50, -0.30]), *p* <.001.

Conversely, in the unhealthy-memories conditions, the total effect of my manipulation was significant, β = -0.25, *SE* = 0.23 (95% CI [-1.24, -0.34]), *p* <.001. There was also a significant direct effect of the number of eating memories recalled on participants' judgments of their recent dietary healthiness, β = -0.41, *SE* = 0.24 (95% CI [-1.78, -0.84]), *p* < .001. Additionally, there was a significant indirect effect, β = 0.16, *SE* = 0.13 (95% CI [0.26, 0.78]), *p* < .001, whereby retrieving more examples of eating unhealthily was associated with greater recall difficulty, β = 0.46, *SE* = 0.24 (95% CI [1.22, 2.17]), *p* < .001, but this time those experiencing recall as difficult formed healthier perceptions of their dietary healthiness, β = 0.36, *SE* = 0.07 (95% CI [0.18, 0.44]), *p* < .001.

The same pattern of results emerged when entering participants' ratings of their general dietary healthiness as my dependent variable (see Figure 19). In the healthy-memories conditions, the total effect of my manipulation was, again, not significant, β = -0.05, *SE* = 0.19 (95% CI [-0.50, 0.26]), *p* = .53. But the direct effect of the number of eating memories recalled on participants' judgements of their general dietary healthiness was significant, β = 0.15, *SE* = 0.19 (95% CI [0.03, 0.77]), *p* = .03. The indirect effect via recall

Figure 18

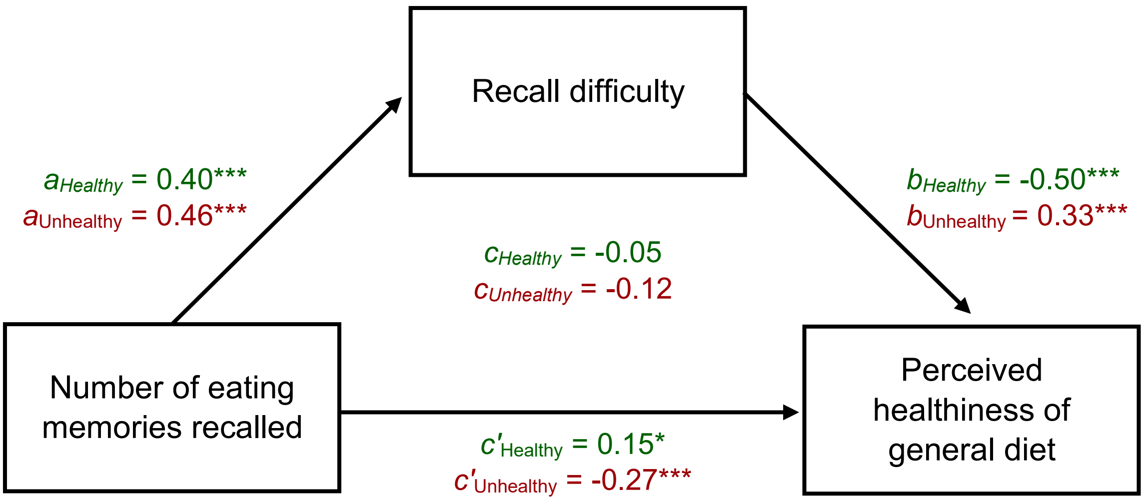
Combined mediation models showing the effect of the number of remembered healthy and unhealthy eating experiences on appraisals of recent dietary healthiness via recall difficulty



Note. *p < .05; ** p < .01; *** p < .001; c = *total* effect; c' = *direct* effect

Figure 19

Combined mediation models showing the effect of the number of remembered healthy and unhealthy eating experiences on appraisals of general dietary healthiness via recall difficulty



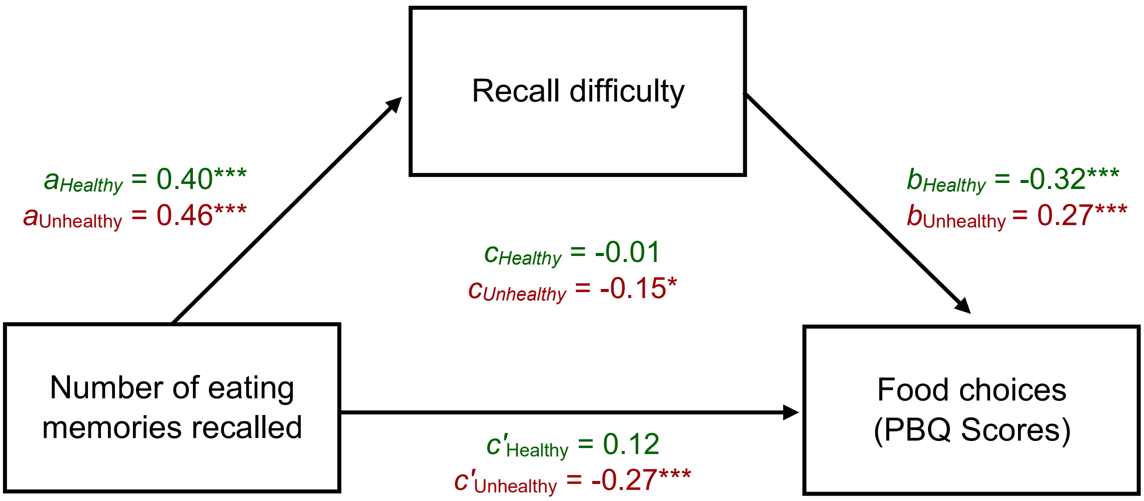
Note. *p < .05; ** p < .01; *** p < .001; c = *total* effect; c' = *direct* effect difficulty was again significant, β = -0.20, *SE* = 0.12 (95% CI [-0.75, -0.29]), $p < .001$, whereby participants found it harder to recall more examples of eating healthily, β = 0.40, *SE* = 0.28 (95% CI [1.07, 2.17]), $p < .001$, which in turn was associated with less favourable appraisals of the healthiness of participants' general diets. Likewise, in the unhealthy-memories conditions, the total effect of my manipulation was not significant, β = -0.12, *SE* = 0.21 (95% CI [-0.74, 0.08]), $p = .11$. However, the direct effect of the number of eating memories recalled on participants' judgements of their general dietary healthiness was significant, β = -0.27, *SE* = 0.22 (95% CI [-1.20, -0.32]), $p < .001$, as was the indirect effect, β = 0.15, *SE* = 0.12 (95% CI [0.20, 0.66]), $p < .001$. As with participants' judgments of their recent dietary healthiness, retrieving more examples of eating unhealthily was associated with greater recall difficulty, β = 0.46, *SE* = 0.24 (95% CI [1.22, 2.17]), $p < .001$, which in turn was associated with healthier dietary appraisals, β = 0.33, *SE* = 0.06 (95% CI [0.14, 0.37]), $p < .001$.

Food choices and motivations. Next, I repeated these mediation analyses with participants' PBQ scores as my dependent variable, to examine the extent to which the subjective ease of memory retrieval mediated the relationship between the number of eating memories recalled and the healthiness of participants' future food choices (see Figure 20). In the model with healthy-memories, the total effect of my experimental manipulation was not significant, β = -0.01, *SE* = 0.20 (95% CI [-0.41, -0.36]), $p = .90$. Similarly, there was no direct effect of the number of eating memories recalled on the healthiness of participants' food choices, $\beta = 0.12$, *SE* = 0.20 (95% CI [-0.09, 0.70]), $p = 0.14$. Conversely, the indirect effect via recall difficulty was significant, $\beta = -0.13$, *SE* = 0.10 (95% CI [-0.52, -0.14]), $p < .001$, in that participants found it harder to recall examples of eating healthily, β = 0.40, *SE* = 0.28 (95% CI [1.07, 2.17]), $p < .001$, and those experiencing retrieval as difficult chose a higher proportion of unhealthy, HED snacks on the PBQ, β = -0.32, *SE* = 0.05 (95% CI [-0.30, -0.11]), $p < .001$.

By comparison, in the unhealthy-memories conditions, the total effect of my experimental manipulation was significant, β = -0.15, *SE* = 0.20 (95% CI [-0.78, 0.00]), *p* <

Figure 20

Combined mediation models showing the effect of the number of remembered healthy and unhealthy eating experiences on people's food choices (PBQ scores) via recall difficulty



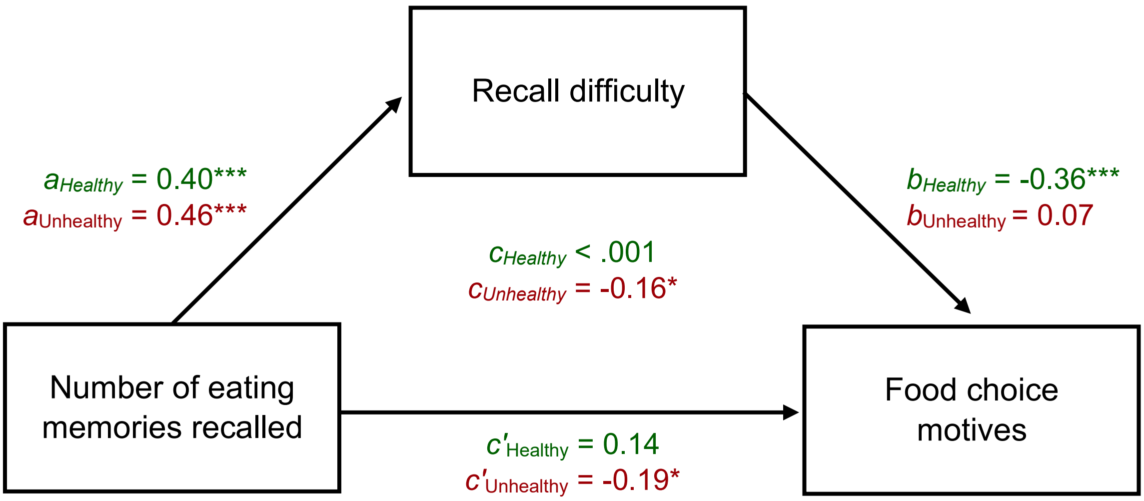
Note. $^*p < .05$; $^{**} p < .01$; $^{***} p < .001$; *c* = *total* effect; *c'* = *direct* effect

.05. Likewise, there was a significant direct effect of the number of eating memories recalled on the healthiness of participants' PBQ selections, β = -0.27, *SE* = 0.22 (95% CI [-1.14, -0.30]), *p* < .001, as well as a significant indirect effect via recall difficulty, β = 0.12, *SE* = 0.11 (95% CI [0.11, 0.54]), *p* < .01. Once again, retrieving more examples of eating unhealthily was associated with greater retrieval difficulty, β = 0.46, *SE* = 0.24 (95% CI [1.22, 2.17]), *p* < .001, which in turn was associated with more healthful PBQ choices (i.e., a greater proportion of LED foods), β = 0.27, *SE* = 0.06 (95% CI [0.08, 0.31]), *p* < .001.

Finally, I repeated these mediation models with participants' FCQ scores as my dependent variable, to examine the extent to which the effect of the number of eating memories recalled on participants' food choice motives was mediated by recall difficulty (see Figure 21). Starting with the healthy-memories conditions, neither the total effect, β = 0.00, *SE* = 0.09 (95% CI [-0.17, 0.17]), *p* = .98, nor the direct effect were significant, β = 0.14, *SE* = 0.09 (95% CI [-0.01, 0.34]), *p* = .06. However, the indirect effect via recall difficulty was significant, *β* = -0.17, *SE* = 0.05 (95% CI [-0.26, -0.08]), *p* < .001,

Figure 21

Combined mediation models showing the effect of the number of remembered healthy and unhealthy eating experiences on people's food choice motives via recall difficulty



Note. *$p < .05$; ** $p < .01$; *** $p < .001$; *c* = *total* effect; *c'* = *direct* effect

insofar as participants found it harder to recall more instances of eating healthily, $\beta = 0.40$, $SE = 0.28$ (95% CI [1.07, 2.17]), $p < .001$, and those participants who experienced recall as difficult placed less importance on the healthiness of their food choices, $\beta = -0.36$, $SE = 0.02$ (95% CI [-0.15, -0.06]), $p < .001$.

Conversely, in the unhealthy-memories conditions, the total effect of my manipulation was this time significant, β = -0.16, $SE = 0.10$ (95% CI [-0.39, 0.02]), $p = .03$, as was the direct effect of the number of eating memories recalled on people's food choice motives, β = -0.25, $SE = 0.11$ (95% CI [-0.46, -0.04]), $p = .02$. However, the indirect effect via recall difficulty was not significant, β = 0.03, $SE = 0.05$ (95% CI [-0.05, 0.14]), $p = .39$.

Discussion

Having made the retrieval task more challenging for many-memories participants, I was principally interested in whether the subjective difficulty with which participants recalled their past eating experiences affected their self-appraised dietary healthiness. The findings of my preregistered analyses again show that participants' judgments of their recent dietary healthiness were influenced by the *number* of eating experiences recalled. The key finding here, however, pertains to the results of my exploratory mediation analyses inasmuch as recall difficulty functioned as a suppressor of the relationship between the number of eating memories retrieved and participants' self-appraised dietary healthiness. That is to say, the absence of the predicted two-way interaction can be explained by a significant direct effect of the number of eating memories recalled that is either partially, or wholly counteracted by a significant *indirect* effect via recall difficulty. These data therefore provide evidence of both a numerosity effect, whereby recalling multiple examples of eating (un)healthily was construed as evidence of participants' (un)healthiness, and an opposing fluency-effect, whereby participants' appraisals of their dietary healthiness were inversely related to how challenging they found it to retrieve those examples. In this way, someone who found it especially difficulty to retrieve instances of eating healthily may—correctly or incorrectly—infer that they are an 'unhealthy' eater.

The second aim of Experiment 5 was to examine the extent to which participants' appraisals of their dietary healthiness affected their future food choices. Contrary to the results of Experiment 4, prompting participants to retrieve memories of past eating did in fact influence the healthiness of their food choices. Specifically, participants who recalled many instances of eating unhealthily—thus forming less favourable appraisals of their dietary healthiness—chose a greater proportion of unhealthy, HED snacks on the PBQ. These findings lend support to the idea that remembered autobiographical memories can influence people's present decisions about food (Kuwabara & Pillemer, 2010; Pezdek & Salim, 2011). Extending those findings, these data also suggest that people's future food choices may also be affected by the subjective difficulty with which those memories are retrieved. Specifically, participants who found it difficult to recall instances of eating unhealthily—thereby forming healthier appraisals of their diets—chose a greater proportion of healthier, LED snacks. These findings have important implications from a health psychology perspective, insomuch as whilst it may be possible to change a person's food choices by having them remember past instances of eating healthily, but care should be taken so as to avoid potential backfire effects. I discuss the implications of these findings in greater detail in Chapter 9.

As a final consideration of the findings, there were no between-group differences in participants' DEBQ scores on this occasion, meaning my prior speculation that retrieving memories of past eating may in turn bias participants' responses to measures of their habitual eating behaviours appears unfounded.

One limitation of the preceding two experiments concerns the use of the PBQ as a measure of participants food choices. Whereas this measure has previously been used in the false memories literature (e.g., Bernstein et al., 2005b) to examine participants' responses to a single *critical* food, here I was specifically interested in the ratio of LED to HED foods chosen as part of a hypothetical meal. Though the decision to classify foods based on their energy density values was ultimately borne of a necessity to provide an objective estimation of each food's 'healthiness', this approach does not take into consideration how healthy (or unhealthy) participants *perceive* these foods to be. Participants may have therefore selected a greater proportion of foods that they believe to be healthy, which actually represented less healthy, HED snacks (e.g., crackers). A second limitation of the PBQ is that participants' food *choices* do not necessarily provide an accurate estimation of their eating behaviours. That is to say, just because a person selects a greater proportion of healthier snacks from a list of foodstuffs does not mean to suggest that they *intend* to eat more healthily. This distinction is an important one, considering that frameworks such as the Theory of Planned behaviour predict that it is people's behavioural intentions that ultimately drive behaviour (Ajzen, 1991). In Experiment 6, I therefore had participants complete a new measure of people's eating intentions, the VPCT, in which participants were asked to create a hypothetical future meal from a combination of food portions. In addition to being a validated measure of eating intentions, the VPCT has also consistently been shown to be a good predictor of *actual* consumption (Wilkinson et al., 2012).

Another limitation of Experiment 5 is that whereas there was now a statistically significant difference in participants recall difficulty scores, crucially, many-memories participants sill found it relatively easy to remember eight healthy (or unhealthy) eating experiences (*M* = 3.88 out of 7). As such, the experimental manipulation may not elicit the necessary degree of retrieval difficulty amongst many-memories participants to fully yield the predicted effects. Thus, for the purpose of Experiment 6, many-memories participants were required to recall an additional two eating experiences, totalling ten overall. Taken together, the findings of Experiment 5 suggest that prompting people to retrieve many examples of past eating can inform their judgments about the healthiness of their diets, and these judgments can in turn influence the healthiness of their future food choices. But crucially, the subjective difficulty with which people retrieve these memories may counteract or even eliminate these effects entirely. The purpose of Experiment 6 was to therefore test the replicability of these findings using an additional, empirically validated measure of people's eating intentions. To all intents and purposes, the following study was otherwise a direct replication of Experiment 5.

Experiment 6

Method

This study received ethical approval from Aston University Research Ethics Committee. The procedure and analysis plan were preregistered prior to data collection through AsPredicted.org, and can be found in Appendix P.

Participants and design. As in Experiment 5, the study used a 2 (number of eating memories recalled: few vs. many) x 2 (memory type: healthy vs. unhealthy) between-subjects design. I therefore planned to recruit a total of 364 participants following exclusions, which should provide reasonable power to detect a small-medium sized interaction effect (f = .15, given α = .05, power = .80). In total, 426 UK residents were invited to take part via Prolific, in exchange for a small financial incentive. As before, I used Prolific's prescreeners to only recruit participants with no known food allergies or dietary restrictions, and a BMI between 20-29.9, who had not previously taken part in Experiment 5. Data from 62 participants were subsequently removed from the analysis, based on my preregistered exclusion criteria. Specifically, 30 did not produce the minimum number of valid memory responses during the recall task; 30 had a BMI outside 18.5-29.9, and two did not provide their weight, meaning I was unable to verify their BMI.[7] These exclusions left a final sample of 364 participants (165 males, 198 females, 1 other; M_{age} = 34.83, *SD* = 12.85, range = 18-75; M_{BMI} = 24.08, *SD* =2.60, range = 18.59-29.70), who were randomly allocated to one of the four experimental conditions; few-healthy (*n* = 89), many-healthy (*n* = 82), few-unhealthy (*n* = 95), many-unhealthy (*n* = 98).

Measures

Virtual Portion Creation Task. As a measure of people's eating intentions—which could be administered online—participants completed the VPCT. Participants were instructed to imagine that they were going to receive a meal tomorrow comprised of six snacks; three of which were LED foods (apples, carrots, grapes), and three were HED foods (chocolate chip cookies, Doritos, M&M's; see Appendix K for energy density values). For each snack, I created a set of 21 images; starting at 0g and increasing in 10g increments to a maximum of 200g (see Appendix Q, R for examples). Per Charbonnier et al., (2016), each food was photographed from a tripod mounted camera-phone set to a 45° downward angle so as to mimic a person's point-of-view during a meal. To minimise variations in lighting conditions across stimuli, the photo subject was illuminated by two 5.51-inch LED light boxes placed either side of the tripod. These images were subsequently mapped onto separate 21-point horizontal sliders, so that each interval on the slider represented a different image.

Initially, participants saw images of six empty plates, each of which was labelled as a different snack. Underneath each image was a slider that could be used to adjust the depicted portion size of the corresponding foodstuff. Moving the slider to the right increased the pictured portion size, whereas moving the slider to the left decreased the pictured portion

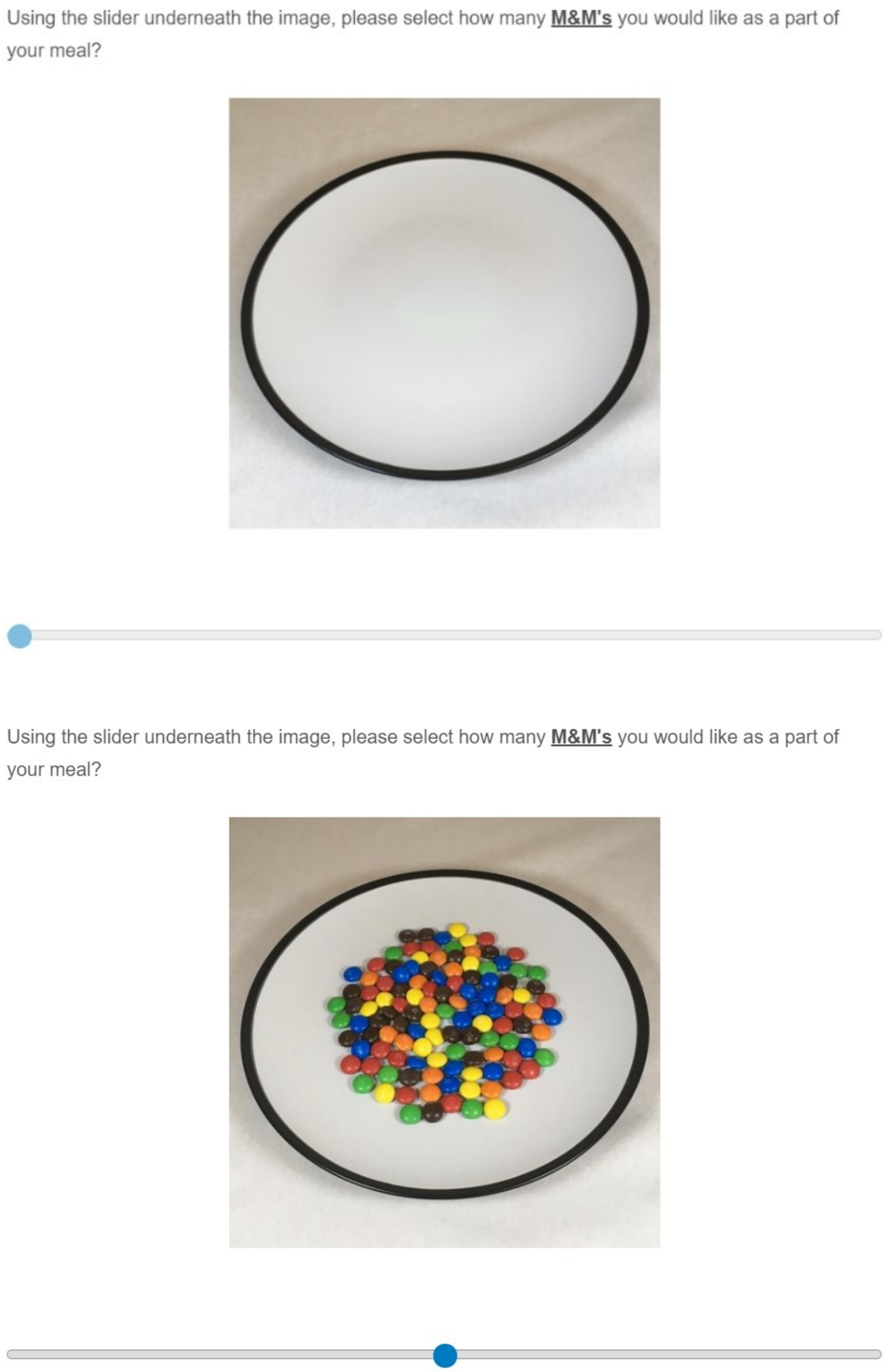
[7] Note that the preregistered inclusion criteria for participants' BMI differed from Prolific's prescreener, as there was no option to recruit participants with a healthy BMI (i.e., 18.5-24.9). Given the number of prior exclusions in Experiment 5 based on erroneous BMI data, I decided to recruit participants using the same prescreener (i.e., participants with a BMI between 20-29.9), but to also include participants with a BMI that—when manually calculated—fell within 18.5-29.9.

size (see Figure 22 for an example). For each snack, participants were instructed to adjust the slider to represent the amount of that food they wanted to receive as part of their fictitious meal. Their selections for each foodstuff were recorded as the weight (in grams) of the depicted portion size. Having made their selections, participants were instructed to review their choices carefully before continuing. Responses were averaged across all the HED foods and all the LED foods respectively, before subtracting the HED_{Mean} from the LED_{Mean} to produce a single score, whereby higher scores were indicative of 'healthier' food choices.

Procedure. This study was near identical to that of Experiment 5; the main change being that participants now completed the VPCT instead of the FCQ. To further increase the difficulty of the recall task, many-memories participants were now asked to recall ten examples of eating either 'healthily' or 'unhealthily'. In addition, the wording of the recall task was changed across all conditions to read: "Please try to recall [two/ten] examples of recent occasions, for example in the past month, when you have eaten a [healthy/unhealthy] meal", as the findings of my pilot study had previously suggested that participants found it slightly harder to generate examples of *meals*.

Figure 22

Example of two differently selected portion sizes on the Virtual Portion Creation Task



Results: Preregistered analysis

Demographics. Experimental conditions did not differ significantly in age, baseline hunger and fullness, or characteristic eating behaviours (see Table 8). There was, however, a significant interaction between the number of eating memories recalled and memory type for BMI, $F(1, 360) = 4.61$, $p = .03$, $\eta^2_p = .01$. Post-hoc *t*-tests with Bonferroni correct alpha ($p = .0125$) found that participants who attempted to recall many-unhealthy eating experiences had significantly higher BMI scores on average (M = 24.44, SD = 2.70), than those who recalled few-unhealthy eating memories (M = 23.41, SD = 2.32), $t(191) = 2.83$, $p < .01$, $d = 0.41$.

Manipulation checks. Recall responses were coded in the same manner as Experiment 4 and 5. In my final dataset, many-memories participants recalled an average of 8.61 memories across both conditions ($M_{Healthy} = 8.82$, $SD = 1.98$; $M_{Unhealthy} = 8.43$, $SD = 2.39$; range = 3-10), with 58.1% of participants providing all ten requested examples. As in Experiment 5, a 2 (number of eating memories recalled: few vs. many) x 2 (memory type: healthy vs. unhealthy) between-subjects ANOVA of participants' recall difficulty ratings found a significant main effect of the number of eating memories recalled, in that participants found it easier to recall a few examples of meals eaten ($M = 2.38$, $SD = 1.62$), than many examples ($M = 4.31$, $SD = 1.87$), $F(1, 360) = 109.68$, $p < .001$, $\eta^2_p = .23$. There was again a significant effect of memory type, however, this time participants found it slightly easier to recall healthy ($M = 3.11$, $SD = 1.87$), as opposed to unhealthy meals ($M = 3.53$, $SD = 2.09$), $F(1, 360) = 4.25$, $p = .04$, $\eta^2_p = .01$. In addition, the two-way interaction was also significant, $F(1, 360) = 11.17$, $p < .01$, $\eta^2_p = .03$ (see first row of Table 9). Post-hoc *t*-tests with Bonferroni corrected alpha ($p = .0125$) reported that for the healthy conditions, participants found it easier to recall few eating memories ($M = 2.49$, $SD = 1.64$), than many eating memories ($M = 3.78$, $SD = 1.89$), $t(169) = 4.77$, $p < .001$, $d = 0.73$. Likewise, in the unhealthy conditions, participants found it easier to remember few eating memories ($M = 2.26$, $SD = 1.60$), than many eating memories ($M = 4.76$, $SD = 1.75$), $t(191) = 10.33$, $p < .001$, $d = 1.49$. Furthermore, participants found it significantly easier to recall many examples of having eaten a healthy meal ($M =$

Table 8

Participant demographics for Experiment 6

	Number of events recalled			
	Few		Many	
	Healthy	Unhealthy	Healthy	Unhealthy
Age (years)	35.17 (12.97)	33.34 (12.42)	35.22 (13.28)	35.65 (12.86)
BMI (kg/m^2)	24.31 (2.56)	23.41 (2.32)	24.17 (2.73)	24.44 (2.70)
Hunger (VAS: 0-100)	45.36 (26.68)	46.06 (26.82)	49.82 (27.97)	43.49 (25.01)
Fullness (VAS: 0-100)	40.25 (27.41)	42.96 (28.36)	37.67 (28.73)	43.61 (29.24)
DEBQ dietary restraint	2.66 (0.81)	2.84 (0.85)	2.92 (0.91)	2.78 (0.80)
DEBQ external eating	3.22 (0.55)	3.14 (0.61)	3.12 (0.66)	3.27 (0.62)
DEBQ emotional eating	2.36 (0.86)	2.35 (0.92)	2.39 (1.13)	2.36 (0.84)

Table 9

Means (SDs) for recall difficulty, perceptions of healthiness, eating choices and intentions for Experiment 6

	Number of events recalled			
	Few		Many	
	Healthy	Unhealthy	Healthy	Unhealthy
Recall difficulty	2.49 (1.64)	2.26 (1.60)	3.78 (1.89)	4.76 (1.75)
Recent healthiness	4.30 (1.42)	4.33 (1.45)	4.93 (1.28)	3.98 (1.53)
General healthiness	4.69 (1.32)	4.82 (1.36)	4.89 (1.33)	4.66 (1.24)
PBQ Score	-0.26 (1.21)	-0.40 (1.14)	0.27 (1.22)	-0.27 (1.27)
VPCT Score	42.10 (28.70)	37.93 (29.28)	52.20 (31.91)	36.33 (27.02)

3.78, *SD* = 1.89), compared to an unhealthy meal (*M* = 4.76, *SD* = 1.75), $t(178) = 3.60$, $p < .001$, $d = 0.54$.

Perceptions of healthiness. As with Experiment 5, I began by examining the extent to which the number of remembered eating memories affected people's appraisals of their recent dietary healthiness. A 2 (number of eating memories recalled: few vs. many) x 2 (memory type: healthy vs. unhealthy) between-subjects ANOVA of participants' healthiness ratings of their recent diets found no significant main effect of the number of eating memories recalled (M_{Few} = 4.32, *SD* = 1.43; M_{Many} = 4.41, *SD* = 1.49; *F*(1, 360) = 0.85, *p* = .36, η^2_p < .01). The main effect of memory type was again significant, with participants forming more favourable appraisals of their recent diets when they remembered examples of having eaten healthy meals (*M* = 4.60, *SD* = 1.39), rather than unhealthy meals (*M* = 4.15, *SD* = 1.49), *F*(1, 360) = 9.50, *p* < .01, η^2_p = .03. Importantly, the predicted two-way interaction was also significant, *F*(1, 360) = 10.46, *p* < .01, η^2_p = .03 (see second row of Table 9). Post-hoc *t*-tests with Bonferroni corrected alpha (*p* = .0125) found that participants who tried to remember many examples of eating healthily formed healthier impressions of their recent diets (*M* = 4.93, *SD* = 1.28), than those who remembered few examples of eating healthily (*M* = 4.30, *SD* = 1.42), *t*(169) = 3.01, *p* < .001, *d* = 0.47. Furthermore, participants who tried to remember many instances of having eaten healthily appraised their recent diets to be healthier (*M* = 4.93, *SD* = 1.28), than those who tried to remember many instances of having eaten unhealthily (*M* = 3.98, *SD* = 1.53), *t*(178) = 4.45, *p* < .001, *d* = 0.67.

A separate ANOVA of participants' appraisals of the general healthiness of their diets again found no main effect of the number of eating memories recalled (M_{Few} = 4.76, *SD* = 1.34; M_{Many} = 4.77, *SD* = 1.29; *F*(1, 360) = 0.03, *p* = .87, η^2_p < .001). Likewise, there was no main effect of memory type ($M_{Healthy}$ = 4.78, *SD* = 1.33; $M_{Unhealthy}$ = 4.74, *SD* = 1.30; *F*(1, 360) = 0.11, *p* = .74, η^2_p < .001), nor was the two-way interaction significant, *F*(1, 360) = 1.73, *p* = .19, η^2_p < .01 (see the third row of Table 9).

Eating choices and intentions. Next, I conducted a new between-subjects ANOVA with participants' PBQ scores, to investigate the extent to which participants' recollections of their eating experiences affected their future food choices. There was a significant main effect of the number of eating memories recalled on participants' PBQ scores, in that many-memories participants chose a greater proportion of healthier, LED snacks (*M* = -0.03, *SD* = 1.27), than few-memories participants (*M* = -0.33, *SD* = 1.17), *F*(1, 360) = 6.58, *p* = .01, η^2_p =

.02. The main effect of memory type was also significant, with participants making healthier selections having recalled instances of eating healthily (*M* = -0.01, *SD* = 1.24), rather than unhealthily (*M* = -0.33, *SD* = 1.21), $F(1, 360) = 7.05$, $p < .01$, $\eta^2_p = .02$. However, the interaction between the number of eating memories recalled and memory type was not significant, $F(1, 360) = 2.48$, $p = .12$, $\eta^2_p < .01$ (see the fourth row of Table 9).

Finally, I repeated this analysis with participants' VPCT scores. In contrast with the findings from participants' PBQ data, there was no significant main effect of the number of eating memories recalled on the healthiness of people's food choices ($M_{Few} = 39.9$, *SD* = 29.0; $M_{Many} = 43.6$, *SD* = 30.3; $F(1, 360) = 1.92$, $p = .17$, $\eta^2_p < .01$). There was, however, a significant main effect of memory type, in that healthy-recall participants chose a greater proportion of LED snacks (*M* = 46.94, *SD* = 30.62), than unhealthy-recall participants (*M* = 37.12, *SD* = 28.10), $F(1, 360) = 10.68$, $p < .01$, $\eta^2_p = .03$. The two-way interaction was, however, not significant, $F(1, 360) = 3.64$, $p = .06$, $\eta^2_p = .01$ (see fifth row of Table 9).[8]

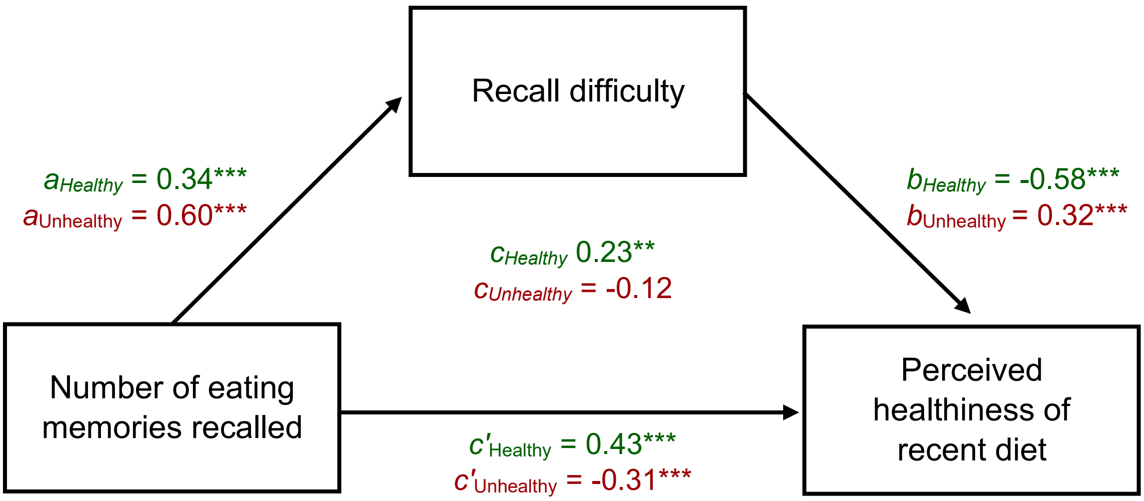
Results: Exploratory mediation analysis

Perceptions of healthiness. Based on the findings of Experiment 5, I repeated the exploratory mediation analyses again here. As before, I ran separate mediation models for the healthy- and unhealthy-recall conditions for each of my dependent variables, starting with participants' judgments of their recent dietary healthiness (see Figure 23). In the healthy-memories conditions, the total effect of my experimental manipulation was significant, β = 0.23, *SE* = 0.21 (95% CI [0.22, 1.03]), $p < .01$, as was the direct effect of the number of eating memories recalled, β = 0.43, *SE* = 0.18 (95% CI [0.82, 1.54]), $p < .001$. The indirect effect via recall difficulty was also significant, β = -0.20, *SE* = 0.13 (95% CI [-0.81, -0.30]), $p < .001$, in that participants found it harder to recall more examples of eating healthily, β = 0.34, *SE* = 0.27 (95% CI [0.76, 1.81]), $p < .001$, and those experiencing recall as difficult formed

[8] To rule out the possibility that the observed effects were a by-product of significant intergroup differences in BMI, I repeated all of the analyses using participants' BMI scores as a covariate. Regarding participants' retrieval difficulty scores (i.e., the manipulation check), both the effect of the number of eating memories recalled and the observed interaction remained significant when factoring in BMI as a covariate ($p < .001$), but this was not the case for memory type ($p = .06$). All other main effects remained significant at $p < .01$.

Figure 23

Combined mediation models showing the effect of the number of remembered healthy and unhealthy eating experiences on appraisals of recent dietary healthiness via recall difficulty



Note. *$p < .05$; ** $p < .01$; *** $p < .001$; *c* = *total* effect; *c'* = *direct* effect

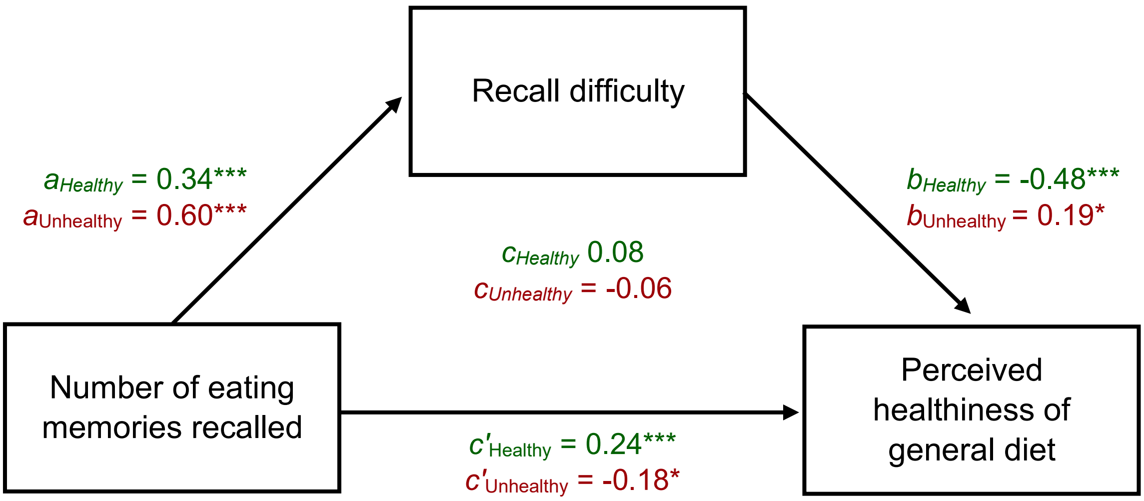
less favourable perceptions of their recent diets, β = -0.58, *SE* = 0.05 (95% CI [-0.53, -0.34]), $p < .001$.

By comparison, in the unhealthy-memories conditions, the total effect of my experimental manipulation was not significant, β = -0.12, *SE* = 0.21 (95% CI [-0.77, 0.07]), $p = .11$. Conversely, the direct effect of the number of eating memories recalled on participants' judgments about their recent dietary healthiness was significant, β = -0.31, *SE* = 0.26 (95% CI [-1.42, -0.42]), $p < .001$. The indirect effect via recall difficulty was also significant, β = 0.19, *SE* = 0.16 (95% CI [0.25, 0.89]), $p < .001$, whereby retrieving more examples of eating unhealthily was associated with greater recall difficulty, β = 0.60, *SE* = 0.24 (95% CI [2.02, 2.96]), $p < .001$, and those experiencing retrieval as difficult, formed healthier impressions of their recent dietary healthiness, β = 0.32, *SE* = 0.06 (95% CI [0.11, 0.35]), $p < .001$.

Next, I repeated these analyses with participants' judgments of their general dietary healthiness (see Figure 24). Starting with the healthy-memories conditions, there was no total effect of my manipulation, β = 0.08, *SE* = 0.20 (95% CI [-0.19, 0.60]), $p = .31$. However,

Figure 24

Combined mediation models showing the effect of the number of remembered healthy and unhealthy eating experiences on appraisals of general dietary healthiness via recall difficulty



Note. *$p < .05$; ** $p < .01$; *** $p < .001$; *c* = *total* effect; *c'* = *direct* effect

the direct effect of the number of eating memories recalled on participants' appraisals of their general dietary healthiness was significant, β = 0.24, *SE* = 0.19 (95% CI [0.26, 1.02]), $p <$ .001. There was also a significant indirect effect, β = -0.16, *SE* = 0.11 (95% CI [-0.65, -0.22]), $p <.001$, whereby retrieving more examples of eating healthily was associated with greater recall difficulty, β = 0.34, *SE* = 0.27 (95% CI [0.76, 1.81]), $p <.001$, which was in turn associated with less favourable appraisals of participants' general diets, β = -0.48, *SE* = 0.05 (95% CI [-0.44, -0.24]), $p <.001$.

Likewise, in the unhealthy-memories conditions, the total effect of my manipulation was not significant, β = -0.06, *SE* = 0.19 (95% CI [-0.52, 0.21]), $p = .40$. But both the direct effect of the number of eating memories recalled on participants' judgments of their general dietary healthiness, β = -0.18, *SE* = 0.23 (95% CI [-0.91, -0.01]), $p < .05$, and indirect effect via recall difficulty, β = 0.12, *SE* = 0.14 (95% CI [0.02, 0.57]), $p = .03$, were significant. As with participants' appraisals of their recent dietary healthiness, retrieving more instances of eating unhealthily was associated with greater recall difficulty, β = 0.60, *SE* = 0.24 (95% CI

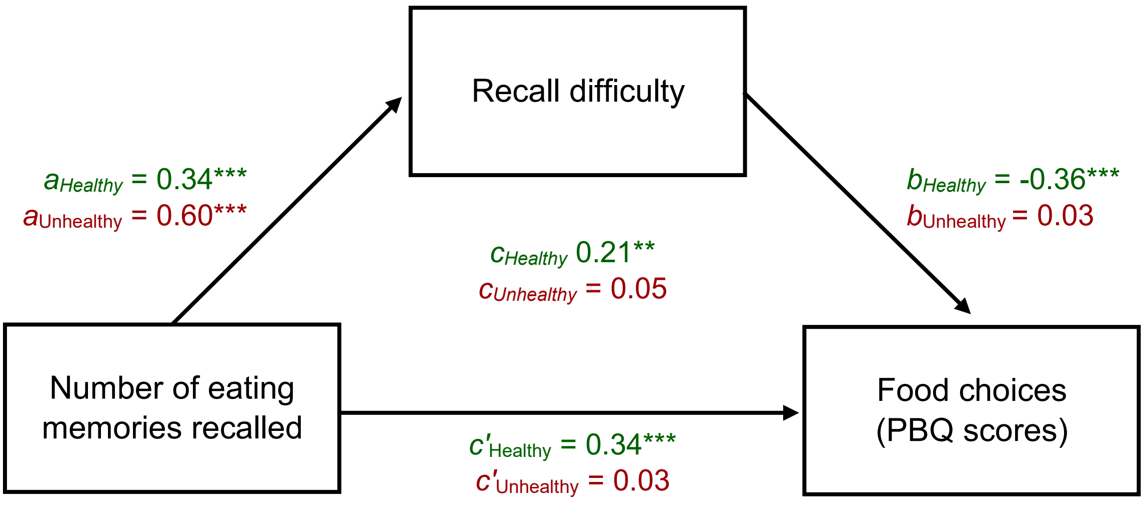
[2.02, 2.96]), $p < .001$, and those experiencing recall as difficult formed healthier impressions of their general diets, β = 0.19, *SE* = 0.06 (95% CI [0.01, 0.23]), $p = .03$.

Eating choices and intentions. Lastly, I repeated these analyses with participants' PBQ (see Figure 25) and VPCT scores (see Figure 26) respectively, to examine the extent to which the subjective ease of memory recall mediated the relationship between the number of eating memories recalled and the healthiness of participants' future food choices. In the healthy-memories conditions, there was a significant total effect of my manipulation on participants' PBQ scores, β = 0.21, *SE* = 0.19 (95% CI [0.16, 0.89]), $p < .01$, and VPCT scores, β = 0.17, *SE* = 4.62 (95% CI [1.04, 19.16]), $p = .03$. In contrast with the findings from Experiment 5, the direct effect of the number of eating memories recalled on the healthiness of participants' PBQ choices was this time significant, β = 0.34, *SE* = 0.18 (95% CI [0.47, 1.20]), $p < .001$. Likewise, the indirect effect via recall difficulty was also significant, β = -0.12, *SE* = 0.09 (95% CI [-0.48, -0.13]), $p < .001$, in that participants found it more difficult to recall many examples of eating healthily, β = 0.34, *SE* = 0.27 (95% CI [0.76, 1.81]), $p < .001$, with those experiencing recall as difficult choosing a greater proportion of unhealthy, HED snacks on the PBQ, *β* = -0.36, *SE* = 0.05 (95% CI [-0.34, -0.14]), $p < .001$. Mirroring these findings, there was a significant direct effect of the number of eating memories recalled on the healthiness of participants' VPCT selections, β = 0.28, *SE* = 4.66 (95% CI [7.92, 26.19]), $p < .001$, as well as a significant indirect effect via recall difficulty, β = -0.11, *SE* = 2.16 (95% CI [-11.20, -2.72]), $p < .01$. As before, retrieving more examples of eating healthily was associated with greater recall difficulty, β = 0.34, *SE* = 0.27 (95% CI [0.76, 1.81]), $p < .001$, which was in turn associated with the creation of a less healthy meal overall, β = -0.33, *SE* = 1.25 (95% CI [-7.86, -2.96]), $p < .001$. Conversely, in the unhealthy-memories conditions, the total, direct and indirect effects for the measures of eating choices and intentions were all statistically non-significant (all $p > .44$).

Covariate analysis. Collectively, the findings from Experiments 4-6 suggest that people's appraisals of their dietary behaviours are based on *both* the number of remembered eating memories and the subjective ease with which those memories are brought to mind.

Figure 25

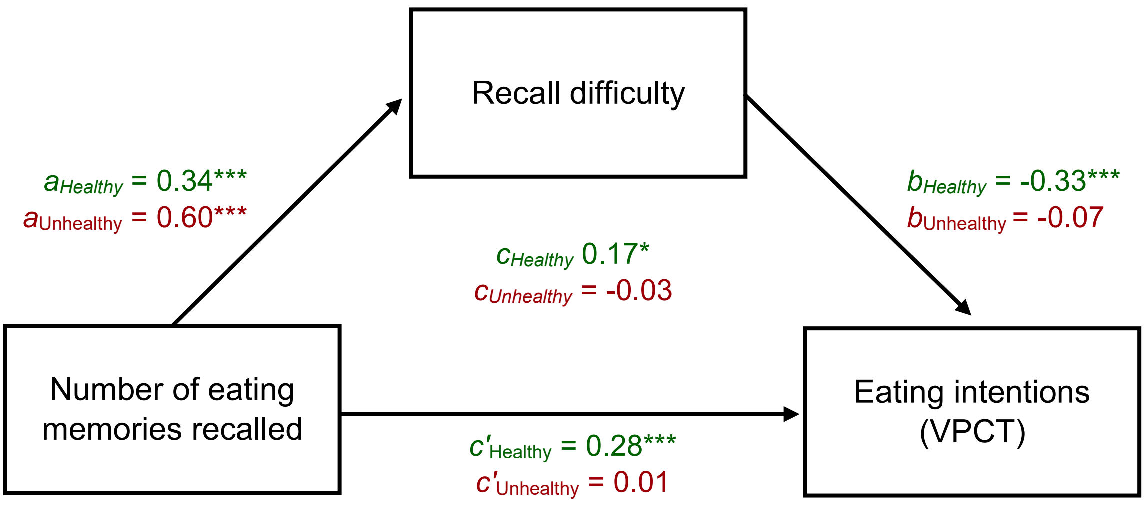
Combined mediation models showing the effect of the number of remembered healthy and unhealthy eating experiences on people's food choices (PBQ scores) via recall difficulty



Note. *p < .05; ** p < .01; *** p < .001; c = *total* effect; c' = *direct* effect

Figure 26

Combined mediation models showing the effect of the number of remembered healthy and unhealthy eating experiences on people's eating intentions (VPCT scores) via recall difficulty



Note. *p < .05; ** p < .01; *** p < .001; c = *total* effect; c' = *direct* effect

But these findings should be interpreted with a degree of caution given that these mediation models cannot be presumed to prove causality. Whereas I surmise that people's perceptions of their dietary healthiness were informed by the subjective ease with which they recalled their past eating experiences, an equally plausible explanation is that the experienced difficulty with which people recalled their past eating experiences may have reflected the *actual* (un)healthiness of their dietary behaviours. That is to say, habitually unhealthy eaters may have genuinely found it difficult to remember instances of eating healthily and vice versa. One way to examine this relationship in greater detail is to consider whether the indirect effect via recall difficulty disappears after factoring in participants' BMI scores as a covariate. Though there are obvious limitations to using participants' BMI scores as a proxy of their dietary healthiness, not least because BMI is increasingly recognised as a poor indicator of people's body composition (Nuttall, 2015), this approach nonetheless permits an initial test of these contrasting explanations. To this end, I reran all of the exploratory mediation analyses from Experiments 4-6 with participants' BMI as a covariate. In all but one case, the total, direct and indirect effects remained unchanged from the original analyses (see Appendices S-W); the only notable difference being that in the unhealthy conditions of Experiment 6 neither the direct effect of the number of eating memories recalled on participants' judgments of their general dietary healthiness, $\beta = -0.10$, $SE = 0.23$ (95% CI [-0.71, 0.20]), $p = .28$, nor the indirect effect via recall difficulty, $\beta = 0.09$, $SE = 0.15$ (95% CI [-0.06, 0.51]), $p = .12$, remained significant after factoring in BMI as a covariate (see Appendix W). Collectively these findings support my initial conclusions that participants' remembered eating experiences bias their self-appraised healthiness and subsequent eating choices and intentions, rather than the observed effects being an artefact of people's habitual eating habits.

Discussion

The results from Experiment 6 replicate the key findings of the preceding experiment, in that prompting participants to retrieve past eating experiences shaped their appraisals of the healthiness of their diets, which in turn influenced how healthily they intended to eat in future. To comment on the first point, the results of my preregistered analysis again show that participants made inferences about the healthiness of their *recent* diets based on the number of ‘healthy’ or ‘unhealthy’ eating experiences they recalled, but not the general healthiness of their diets. Importantly, the results of my exploratory mediation analyses again suggest that the subjective difficulty of recall functioned as a suppressor variable, inasmuch as it partially counteracted the observed numerosity effect. Likewise, a similar pattern of results emerged with regards to measures of participants’ eating choices and intentions, albeit only in the healthy-memories conditions. Specifically, participants who found it especially difficult to remember instances of eating healthily—thereby forming less favourable impressions of their dietary healthiness—chose a greater proportion of less healthy, HED snacks on the PBQ and VPCT respectively.

A strength of Experiment 6 is that I was able to replicate the observed effect of eating memories on participants’ eating intentions using an empirically validated measure, which has been shown to be a good predictor of actual consumption (Wilkinson et al., 2012). Thus, these data not only increased confidence in the validity of the prior study’s findings, but also provide an approximation of how such an effect may influence people’s *actual* consumption. A logical next step would be to more closely examine how people’s remembered eating experiences shape their subsequent eating behaviours, as was originally intended in Experiment 4 prior to the COVID-19 pandemic. I discuss how this might be achieved in Chapter 9.

Taken together, the findings from Experiment 6 suggest that prompting people to recall many instances of eating healthily may encourage them to make healthier food choices. However, it is important to be aware of potential backfire effects whereby if a person finds it especially difficult to remember examples of eating healthily, they may be more inclined to consume *less* healthy food alternatives. The implications of these findings will be discussed in the following chapter.

Chapter 9

General Discussion

The overarching aims of my thesis were firstly to investigate how people's inferences about products' healthiness inform what they remember about those products, and secondly, to examine what people infer about their own healthiness from their recollections of eating. People's inability to directly experience a sense of 'healthiness', necessitates that their judgments about health are based on their aptitude to *infer* meaning from other sources of information (Grunert, 2006). But such inferences are rarely based on the totality of information available. People instead draw conclusions from the way in which their subjective experiences *feel* (Schwarz, 2011), and thus, something that feels intuitively familiar or is retrieved more easily from memory might be appraised more favourably.

Indeed, the findings from Experiments 1 and 2 show that health-related package imagery can lead people to infer additional health benefits about the products on which they appear, even when those products are identified as being unhealthy. These findings contribute to the existing literature that suggests in the absence of more purposeful information about a product's healthiness, FoP images on product packaging can lead people to infer additional health benefits about those products (Carrillo et al., 2014; Klepacz et al., 2016; Saba et al., 2009). But contrary to previous research suggesting additional contextual information could protect consumers from potentially misleading health claims (Franco-Arellano, 2020a, b), the data herein suggest that these health inferences persist even when people have access to more explicit, written information to inform those appraisals. Specifically, in Experiment 1 I found that changing the colour of the products' MTL had no effect on the number of falsely remembered health claims. In Experiment 2, an explicit and salient statement of the products' relative healthiness equally had no effect on the number of remembered health claims. Extending those findings, the results from Experiment 3 showed health images appearing on fictitious dietary supplements increased both the perceived health benefits and extent to which the benefits outweighed the risks of consuming those products, whilst also *decreasing* the perceived risks of consumption.

Crucially, the effect of imagery depended on participants' initial expectations about the products' supposed function—as informed by the package image, when present—being confirmed to be true. When the health-related image (e.g., a heart) intuitively matched the product's function and related risk-benefit information (e.g., "aids in the maintenance of a healthy heart") participants were more likely to infer that the product was beneficial to health. However, when this contextual information contradicted participants' initial product expectations, the addition of a health image either had no effect on their health-related judgments, or *reversed* the effect altogether. Consistent with a fluency-effect, these data suggest that package imagery can provide a rapid, intuitive sense of comprehending a product's supposed function, which can in turn lead people to make more general positive judgments about the product's other attributes. Prior research has indeed shown that package imagery is an effective method of capturing consumer interest (Piqueras-Fiszman et al., 2013; Varela et al., 2014), which can generate product expectations more rapidly than related textual information (Smith et al., 2015). Thus, based on the evidence presented here, Alessandri (1982, as cited in Houston et al., 1987) was correct to suggest that package images may serve as an "advance organiser", in that they are capable of generating product expectations that—if proven true—can inflate people's judgments of a product's health benefits. In this way, images appearing on packaging may function as a sort of semantic prime by cuing people to think about the products' probable functions.

This rationale may offer a potential explanation for the findings of Experiments 1 and 2. In particular, the fluency-conditional model (Fazio et al., 2015) theorises that people only engage in effortful, systematic processing when perceived fluency is absent or otherwise discounted. Thus, an easy-to-process package may evoke a sense of fluency, which may in turn lead consumers to disregard other more diagnostic information pertaining to the product's general healthiness. Though purely speculative, one might therefore assume that the package imagery and related nutrient claims appearing on the product stimuli in Experiments 1 and 2, afforded participants a sense of fluency that in turn led them to make health-related inferences about those products despite more objective health information being present. These findings could be interpreted as evidence of enhanced *conceptual* fluency, whereby a nutrient claim gives meaning to a conceptually related package image. Indeed, according to the aforementioned relevance theory (Wilson & Sperber, 2002), package imagery is assumed by the consumer to be indicative of something about the product itself. But when an image's meaning is ambiguous, consumers compare different interpretations of that image—stored in memory—with other, contextual information until a consensus on the product's purpose is reached (Smith et al., 2015). In this way, a conceptually related nutrient claim (e.g., a source of calcium) may give meaning to an otherwise unclear package image (e.g., a bone). Crucially, these fluency effects seemingly tap into something that is implicitly known—but not necessarily *true*—which can lead people to make causal inferences that extend beyond that which is explicitly stated on the product's packaging (e.g., calcium helps build stronger bones).

Not only are these assumed health claims misleading, but the experiential sense of familiarity might also affect people's judgments about the *validity* of such claims. As evidenced elsewhere, the addition of a nonprobative photo to a trivia claim may increase the perceived truthfulness of those claims (Fenn et al., 2019; Newman et al., 2012, 2015), and can persist for at least 48 hours after the participants were initially exposed to the claim-image pairings (Fenn et al., 2013). Consider then, that unregulated structure-function claims may not only assume a different meaning when paired with a related health image, but that such claims may appear more credible to consumers. As such, these more simplistic claims may be perceived as more truthful (Newman et al., 2012, 2015), likeable (Reber et al., 1998), and persuasive (Okuhara et al., 2017) than more complex, regulated information. Crucially, however, the findings of my thesis should not be limited to discussions about package imagery per se, but rather the key finding applies to *any* visual device that affords consumers a quick and easy sense of understanding a product's supposed purpose. In this way, a product's name (Irmak et al., 2011), the package's colour (Wąsowicz, et al., 2015; Mai et al., 2016; Tijssen et al., 2017), and even the product's shape (Ares & Deliza, 2010), might create product expectations that—if proven true—may elicit a sense of fluency.

The issue then, is that these fluency effects can lead consumers to make inferences about a product's healthiness, even when that product is—directly or indirectly—identified as being unhealthy. This point is particularly pertinent given that images can evoke a variety of different interpretations (Smith et al., 2015), and even ambiguous images can have health-related connotations (Carrillo et al., 2014) that may lead consumers to make inferences about a product's healthiness. Because of this, consumers may never definitively know the intended message that the manufacturers are attempting to convey through the use of on-pack imagery (Smith et al., 2015). The overt use of pomegranate and blueberry imagery on Minute Maid's fruit juice packaging for instance, was supposedly only ever meant to be indicative of the product's taste (Ikeda & Blackburn, 2016). But it is reasonable to assume that such imagery may have led consumers to believe that the product in fact *contained* these ingredients in greater proportions than were actually present in the apple-grape concoction. At a purely superficial level, the idea that packaging imagery can lead people to infer that a product does or does not contain a specific ingredient is perhaps somewhat unremarkable. However, when you consider that these particular fruits are widely touted as so-called superfoods with innumerable health benefits, their inclusion on a product's packaging could reasonably inflate people's perceptions of that product's overall healthiness. Despite the ultimate dismissal of this legal case, it is nevertheless easy to imagine how consumers' inferences might have been unintentionally misled in these circumstances.

Aside from the fact that such inferences may lead people to overconsume objectively unhealthy foods that they perceive to be healthy (Cavanagh & Forestell, 2013; Irmak et al., 2011; Provencher et al., 2009), the findings from Experiments 4-6 go on to suggest that what they infer about their remembered eating experiences might in turn affect their perceptions of their *own* dietary healthiness. In all three experiments, prompting participants to retrieve examples of (un)healthy eating experiences biased people's perceptions of the healthiness of their diets. Specifically, the results of my preregistered analyses consistently showed that participants made inferences about the healthiness of their recent diets based on the *number* of (un)healthy eating memories they recalled. That is to say, retrieving multiple examples of eating healthily, for instance, led participants to identify more as a 'healthy' eater. However, the results of my preregistered analyses did not find evidence that participants' self-appraised dietary healthiness informed their future food choices and decisions. It therefore falls to the results of my exploratory analyses to further unpick my key findings. The absence of significant interaction effects between the number of memories retrieved and the content of those memories, could in many cases be explained by the occurrence of contrasting numerosity and retrieval fluency effects. Put simply, participants' judgments of the healthiness of their diets—and crucially, their future food choices—were informed by *both* the number of (un)healthy eating experiences they recalled, as well as the subjective difficulty with which those memories were brought to mind. That is to say, asking a participant to recall multiple instances of eating healthily seemingly affirmed their previous healthiness, which in turn led them to make healthier food choices. However, someone who found it particularly difficult to remember instances of eating healthily in turn formed a *less* favourable impression of their dietary healthiness, leading them to make less healthy food choices.

One possible explanation for these findings is that asking participants to recall multiple instances of eating (un)healthily might have created certain behavioural expectations, which in turn biased people's self-appraised healthiness and subsequent food choices. In Experiment 6 for instance, asking participants to recall instances of eating healthily might have led them to appraise their diets more favourably and choose a higher proportion of healthier snacks based on what they *thought* was required of them. However, this account seems unlikely given that people's recollections of eating did not always influence the healthiness of their food choices and decisions. Were it the case that participants behaved according to apparent researcher expectancies, then one would expect to see a consistent pattern of results for both healthy- and unhealthy-memories conditions across experiments. Likewise, these findings do not fit well with theoretical accounts such as the Compensatory Health Beliefs model (Rabia et al., 2006) and more generalised licensing effects, which would predict that in response to an unfavourable appraisal of their diets, participants would make healthier selections so as to counteract their previous unhealthiness.

An alternative explanation of these findings is that prompting people to retrieve instances of eating (un)healthily activates cognitive structures, which in turn affect the healthiness of their food choices and motivations. According to Papies (2016), the consumer world is configured in a way that exposes consumers to cues that trigger short-term *hedonic* goals, fulfilment of which provides immediate gratification. These often compete with *investment* goals, such as eating healthily for the benefit of one's long-term health. Activation of a health-related goal inhibits incongruous behaviours in the pursuit of the primed goal (Custers & Aarts, 2005), particularly when the primed concept is important to the individual (Weingarten et al., 2016). Put into context, activating a personally relevant health-related goal (e.g., losing weight) might inhibit competing behaviours, such as indulging in a piece of cake. Consider then that in all three experiments I purposefully excluded participants who were following a calorie-controlled diet, for whom eating healthily was presumably of little concern. Prior to the COVID-19 pandemic, participants' recollections of eating only influenced the healthiness of their food choices in the unhealthy-memories conditions. That is to say, prompting people to retrieve multiple examples of eating unhealthily might have activated a hedonic goal, which in turn led people to select a greater proportion of less healthy snacks on the PBQ. But in Experiment 6—which was conducted at the height of the pandemic—the reverse was true, in that retrieving multiple examples of eating healthily led participants to make healthier food choices. It might then have been the case that whilst participants were not explicitly following a calorie-controlled diet with the intention of *losing weight*, people's heightened health consciousness during the pandemic (Nicomedes & Avila, 2020) may have prompted an investment goal (i.e., the need to stay healthy to prevent illness) that inhibited their desire for unhealthy foods. The difficulty with this account is that it can not fully explain the mediating effect of retrieval difficulty insomuch as prompting people to retrieve examples of eating healthily should theoretically evoke an investment goal even if they found this especially difficult.

Instead, these findings might be better explained in relation to the Active-Self account (Wheeler et al., 2007), in that the healthiness of participants' food choices were seemingly determined by their salient self-identity. However, these findings suggest that it is not simply the case that retrieving examples of eating (un)healthily leads people to identify as an (un)healthy eater, but rather, it is what they *infer* from these memories that ultimately informs their salient self-identity. In this way, a person who finds it easy to remember several instances of eating healthy may infer that they are a 'healthy' eater, and thus choose a greater proportion of healthier, LED snacks so as to maintain a consistent self-concept (Bluck, 2003; Bluck et al., 2005). The practical implications of these findings are discussed in greater detail below.

Insomuch as fluency plays a crucial role in the effects demonstrated here, other fluency research can shed light on some conditions under which such effects should not occur. When people's naïve theories about *why* information is easy or difficult to retrieve from memory are challenged, these fluency effects may disappear or even reverse (Weingarten & Hutchinson, 2018). Previous research has, for instance, shown that when participants are explicitly made aware of the difficult nature of the task, they instead rely on the number of remembered instances rather than the subjective ease with which the recalled content came to mind as the basis for their judgments (e.g., Schwarz et al., 1991). Similarly, people who are particularly knowledgeable of the judgment's domain are seemingly less influenced by the feelings that arise from a sense of quick and easy processing, presumably because they instead rely upon their accumulated knowledge as the basis for their judgement (Greifeneder et al., 2011). In one study for instance, politically uninterested participants formed less favourable attitudes towards the politician, Tony Blair, the harder they found it to recall positive characteristics about the former Prime Minister. However, participants with an interest in politics showed no differences in their favourability ratings as a function of the number of positive attributes recalled (Haddock, 2002). In another study, retrieval difficulty was associated with greater risk perception of developing heart disease for healthy participants with no known family history of heart disease. But for participants with a prior history of heart disease, participants' risk-perceptions were instead informed by the number of risk factors recalled rather than the subjective ease with which those factors were brought to mind (Rothman & Schwarz, 1998).

Perhaps then, interventions tailored towards improving health literacy might reduce people's reliance on these more incidental feelings that arise from a perceived sense of fluency. Indeed, there is evidence to suggest that people with more advanced literacy skills place less emphasis on pictorial cues when attempting to interpret health information (Austin et al., 1995). Likewise, one might anticipate that someone with a greater understanding of what constitutes a healthy diet might confidently assert that they have eaten healthily, irrespective of how difficult they found it to remember examples of doing so.

Careful attention should, however, be paid to the manner in which such interventions are delivered. Whereas tackling misconceptions about a healthy diet might prove effective in the short-term, the exact specifics of these corrective messages may subsequently fade from memory. Thus, explicitly drawing people's attention towards false information might increase people's familiarity with said information, but they may not retain an accurate perception of whether this information was truthful (Schwarz & Jalbert, 2021). In one study for instance, Skurnik et al.'s (2005) participants encoded health-related product statements (e.g., "Shark cartilage is good for your arthritis") as either 'true' or 'false'. Some of these statements were shown once, whereas others were shown three times. Immediately after encoding, participants made fewer memory errors the more often they saw the claims. Following a three-day delay though, older participants were more likely to misremember a false claim as 'true' the more often they had seen it previously. Whereas people may initially remember which statements were objectively 'true', as their memory deteriorates the increased familiarity afforded by having repeatedly seen the claim may lead them to infer that it must be correct. Indeed, efforts by the Los Angeles Times to debunk rumours about supposed flesh-eating bananas at the turn of the century, ultimately led some to falsely remember that the news outlet had in fact warned readers about consuming such products (Schwarz et al., 2016). Efforts to redress people's understanding of what constitutes a healthy diet should therefore focus primarily on restating factual information rather than dispelling myths.

In sum, the results of Experiments 1 and 2 show that people's inferences about more incidental package features can inform what they remember about the products on which they appear. In this way, images appearing on product packaging can lead people to infer additional health properties about those products, even when more objective information explicitly identifies such products as being 'unhealthy'. Based on the findings from Experiment 3, it is theorised that such effects occur because the addition of a health-related image to a product's packaging affords people an intuitive sense of understanding the product. This perceived sense of fluency not only leads consumers to make generally more positive appraisals of the product's other attributes, but may actually increase how memorable these products are. In one study for instance, an easy-to-process brand name comprised of phonetically similar sounds (e.g., PicturePerfect TV) was better remembered than a phonetically dissimilar, hard-to-pronounce alternative (e.g., PictureSuperior TV; Lee & Baack, 2014). In this way, products with a fluent package design might be more easily remembered, and thus, more readily accepted as evidence that a person has eaten 'healthily'. Indeed, the findings from Experiment 4-6 suggest that when retrieval is experienced as easy, people are more likely to form favourable impressions about their perceived healthiness based on the *number* of eating experiences recalled. But if people's inferences about product healthiness are predominantly based on subjective, nonprobative information then the conclusions they ultimately draw about those products—and in turn their own healthiness—may be unfounded.

Practical implications

Next, I consider the practical implications of the two main arms of my thesis respectively. To begin, the findings from Experiments 1-3 provide important evidence to inform debates about the ways in which regulators govern the use of FoP product imagery. Some countries already acknowledge that FoP images are in themselves a form of claim (e.g., EC, 2006; FDA, 2020b), and are therefore subjected to the same regulations as more explicit, written information. But unlike written claims, it is difficult to objectively measure what 'claim' a particular image is trying to make. Certainly, the evidence presented in my thesis suggests that even pictures that are not overtly misleading—such as a silhouette of a torso—can shape the way in which people appraise products' health benefits. The inherently ambiguous nature of on-pack pictorial cues then, makes it difficult to prescribe exactly how regulators should respond to these findings. Certainly, it would be untenable to suggest that manufacturers abandon the use of package imagery altogether, particularly in light of evidence that suggests plain label packaging may actually *increase* sweet-snack consumption, at least among males (Werle et al., 2016). Likewise, whereas previous research has advocated making nutritional labels more salient on product packages to help consumers make healthier food choices (Graham et al., 2012), the findings presented in my thesis suggest these imagery-based inferences could in fact override more salient cues about a product's healthiness. Indeed, the data presented here suggests that a health-related package image appearing on an overtly 'unhealthy' product may be no less influential than when it features on a healthier product.

One possible recommendation then, is that regulators should pay particular attention to the broader nutrient profile of the products on which these kinds of pictorial claims appear. Whereas existing regulations permit the use of specialised claims on product packages provided they contain a specific nutrient (e.g., calcium) in sufficient amounts, most countries do not systematically consider the general healthiness of the products on which these claims feature. Here in the UK for instance, several children's breakfast cereals prominently feature nutrient claims such as "a source of folic acid" and "added vitamins", despite containing over half the recommended daily sugar intake for children aged between 4 and 6 years old (Khehra et al., 2018). Likewise, a recent review by Action on Sugar reported that 63% of children's yoghurts—which frequently feature misleading package nutrient claims—contained at least one-third of children's recommended daily sugar intake (Osborne, 2021). Whereas there is evidently already a discourse surrounding potentially misleading written claims, the data herein suggests that equal attention should be paid to package imagery. Making manufacturers accountable for the types of claims that are permitted on product packaging, may have the additional benefit of improving the nutritional quality of purchasable foods at an industry level. Indeed, increased nutritional transparency through the introduction of mandatory on-pack labelling has thus far led to an 8.9% reduction in sodium content and a 64.3% reduction in the amount of trans-fats appearing in pre-packaged foods (Shangguan et al., 2019). Therefore, limiting the use of health-related package imagery to objectively healthy foods may prompt industry reformations with regards to improving the nutritional quality of the foods on sale.

Elsewhere, some countries have already introduced directive FoP labels, which identify healthier food choices through an easily recognisable graphic (e.g., Nutri-Score). But such labels pose two notable concerns. First, the fact that these imagery effects occur spontaneously and without conscious control means that people may not necessarily use these nutritional labels to inform their product appraisals. Indeed, the findings from Experiments 1 and 2 would suggest that consumers make these imagery-based inferences in spite of more objective information about the products' healthiness being available. Second, these purely directive labels could hypothetically be considered a different type of health imagery. Whereas, semi-directive labels (e.g., MTL labels) provide consumers with interpretative information about a product's healthiness, directive labels arguably have more in common with package imagery insomuch as they provide consumers with a definitive marker of a product's healthiness without explaining the *reason* behind this outcome. Though not explicitly related to my findings per se, these reductionist labels may in turn inflate consumers' perceptions of a product's general healthiness. Indeed, a recent review of the nutritional labelling literature found that such visual devices may create a halo effect akin to reading package health claims (Ikonen et al., 2020). And whereas these particular types of nutritional label should theoretically only appear on universally healthy products, this is not always the case. The now defunct Smart Choices label for instance, was widely admonished for appearing on a range of less healthy foods, such as fat-ladened mayonnaise and sugary breakfast cereals (Roberto et al., 2012). Policy recommendations may therefore be best informed by further research investigating the extent to which these directive labels inform people's more general appraisals of a product's healthiness.

Furthermore, careful consideration should be paid to the manner in which FoP nutritional labels interact with more incidental indicators of a product's healthiness, such as package imagery. Deciding on the 'best' way of conveying product nutritional information to consumers has been the subject of much debate in recent years. But if consumers are prone to making inferences about a product's healthiness in spite of more explicit information being present, then an important consideration in future is discovering which—if any—nutritional labels can effectively override such inferences. Though there are some nuanced findings in the literature that explore how consumers' perceptions of a product's healthiness change in response to *both* a FoP nutritional label and written health claim (e.g., Franco-Arellano et al., 2020b), I would argue that such considerations should become a mainstay of research seeking to evaluate the effectiveness of potential FoP labelling initiatives.

Conversely, the lessons learned here could be used to inform the creation of more persuasive health materials in other, related domains. From a food marketing perspective, the issue of exploiting a perceptually fluent package design arises from the fact that these fluency effects inflate the perceived healthiness of *both* healthy and unhealthy foods alike. But that is not to say that such effects could not be effectively used elsewhere to facilitate people's understanding of health-related information. Not only are fluently processed stimuli typically rated as safer (Song & Schwarz, 2009) and more trustworthy (Newman et al., 2012, 2015) than less fluently processed stimuli, but crucially, they are more likely to foster behavioural change (Song & Schwarz, 2008b). In particular, a recent meta-analysis found that perceptually fluent health materials were typically judged to be more likeable and persuasive than those containing excessive medical jargon and complex statistics (Okuhara et al., 2017). Creating easy-to-process materials that evoke an intuitive sense of understanding to explain the benefits of regular exercise for instance, may be an effective method of facilitating healthier lifestyle-behaviours. Importantly, the findings from Experiment

3 emphasise that such effects are contingent on presenting a coherent health message and so any use of imagery should ideally complement the message's meaning.

By comparison, the findings from Experiments 4-6 have important ramifications for the way in which eating specialists collect information regarding people's eating habits. Indeed, much of what is gleaned about consumers' eating behaviours derives from 24-hour dietary recall assessments in which a person is asked to recall everything they have consumed in the preceding 24-hours (Castell et al., 2015). However, the findings from my thesis would suggest that the exhaustive nature of this task may create a metacognitive experience of difficulty that may lead people to make potentially misleading inferences about their self-appraised healthiness. Specifically, the 24-hour task sees people repeatedly try to recall increasingly more complex details about each remembered eating experience, such as the method of cooking used or the foods' brand. In this way, a person who—quite reasonably—finds it difficult to recall highly specific details about instances of foods that they perceive to be healthy may in fact infer that they are an unhealthy eater. It may therefore be more beneficial to rely more heavily on prospective methods, such as food diaries, to gain a more accurate picture of people's eating habits.

Relatedly, the findings from Experiments 5 and 6 offer important insights as to how memory retrieval could be utilised as a means of facilitating healthier behaviours. Notably, whereas previous research has shown that having participants remember a prior meal consumed under experimental conditions can indeed bias their subsequent food intake (e.g., Higgs, 2002), a possible confound of these studies pertains to the unusual circumstances under which participants consume their initial meal. That is to say, being instructed to consume a fixed meal in unfamiliar surroundings, within a set period of time, whilst an experimenter lies poised to ask a series of follow-up questions might yield a highly distinctive memory of the meal itself. That I was therefore able to show that people's everyday eating memories had similar effects on their future food choices is a significant strength of these studies.

Furthermore, whereas previous research has shown that recalling a single health-related memory can foster healthier practices (e.g., Biondolillo & Pillemer, 2015), the present research suggests that retrieving multiple memories can have a cumulative effect on people's food choices. That is to say, instructing people to recall several instances of eating healthily may have a more pronounced effect on the healthiness of people's future food choices, relative to having people recall a solitary healthy eating experience. The caveat being that should a person find it particularly difficult to remember instances of eating healthily, they might in turn make *less* healthful future eating decisions. Thus, for any such intervention to be successful, particular attention must be paid to the point at which a person finds it especially difficult to retrieve examples of behaving healthily. There will of course be considerable individual differences in where exactly this breakpoint exists. In Experiment 6 for instance, it is noted that while some people found it incredibly easy to recall ten instances of (un)healthy eating, others struggled to remember just two. Future research should therefore examine how best to monitor a person's sense of retrieval difficulty without explicitly drawing their attention to the feelings that arise when recall is hard.

Lastly, the present findings highlight the importance of considering suppressor variables that may otherwise conceal key effects of interest. Suppression occurs when the direct relationship between the independent and dependent variables is either partially, or wholly counteracted by an *opposing* indirect effect (Rucker et al., 2011). In the context of Experiments 5 and 6, thinking of multiple examples of (un)healthy eating gave participants evidence of their prior (un)healthiness, but also increased the subjective difficulty with which those memories were retrieved. Thus, remembering several examples of eating healthily may have given a person an inflated sense of healthiness—unless that is—they found this to be especially difficult. The nature of these contrasting effects means they have the capacity to undermine, or even abolish the overall effect of the manipulation. For instance, were I to have omitted recall difficulty as a potential mediator, I would have wrongfully concluded that people's recollections of eating had no effect of their subsequent food choices. Researchers should therefore plan for occurrence of possible suppressor variables when designing their experiments.

Limitations

An overarching limitation of my thesis is that I was unable to provide conclusive evidence that people's inferences about health affected their *actual* behaviours. Specifically, whereas consumers may have inferred that the fictional products used in Experiments 1-3 possessed additional health benefits, this does not imply that participants would have been any more likely to purchase and/or consume such products. Likewise, although the findings from Experiments 6 found evidence that participants' remembered eating experiences affected their eating *intentions*—which should theoretically inform their behaviours—future research should nevertheless test this assumption. Though efforts were made to include a measure of actual eating behaviour in Experiment 4, the onset of the COVID-19 pandemic meant data collection ceased long before my intended sample size was achieved. A logical next step would therefore be to investigate whether people's inferences about health do in fact influence their eating behaviours. Future research may also consider the way in which foods *perceived* to be 'healthy' are represented in memory, and whether such foods have a greater influence on consumers self-appraised healthiness and subsequent eating behaviours. As such, a product bearing a health-related symbol on its packaging may be remembered as being healthier than a plain-labelled equivalent product, which might—when later questioned—bias consumers' self-appraised dietary healthiness and subsequent eating behaviours.

A further limitation of my thesis as a whole—albeit one necessitated by the COVID-19 pandemic—was the reliance on online methods. There are of course limitations to this approach, not least that the increased sense of anonymity afforded by such studies may undermine participants' motivation to engage in such experiments in the intended manner. However, research has shown that the monetary incentives provided, coupled with participants' desire to maintain a reputation as a 'high-quality' worker may actually produce high quality data, at least compared to student samples who often possess little external motivation to provide good-quality data (Paolacci et al. 2010; Thomas & Clifford, 2017). Notably, the survey provider Prolific—used here in Experiments 5 and 6—has been found to yield higher quality research data than other, comparable survey hosts, such as Amazon Mechanical Turk (Peer et al., 2021). Nevertheless, additional measures were taken to limit the amount of spurious data in my final dataset. Most notably, the inclusion of post-hoc attention checks helped to quickly identify, and subsequently exclude, those participants who had not paid sufficient attention during the experiment. These measures help to reduce the noisiness of my data and increase confidence in the reliability of my findings.

On the other hand, there are some distinct advantages to online data collection. For example, online research granted me access to a broader, more diverse pool of participants, which in turn lends support to the generalisability of my findings. For instance, an anticipated criticism of Experiments 1 and 2 is that the observed effects of imagery may only pertain to consumers who are perhaps less concerned with the healthiness of their food purchases in favour of other factors, such as their cheapness (Chalamon & Nabec, 2016). That I was able to produce a similar effect of imagery in Experiment 3—albeit one that answered a slightly different research question—using a more representative sample, suggests that these effects are not limited to participants who are perhaps less interested in the healthiness of their consumables. Likewise, the use of US participants in Experiment 3 provided an initial test of these kinds of imagery effects outside of countries governed by EU legislation. The significance here being that legislation governing the way in which risk-benefit information is conveyed to consumers varies substantially between these two regions. Specifically, US legislation mandates that advertisements concerning the use of medicinal products must explicitly state the potential side of effects of consuming such commodities (FDA, 1999). One might have therefore have anticipated that US participants' familiarity with this kind of overt risk-benefit information would have made them less susceptible to making imagery-based product inferences, however, this was not the case.

Another limitation of the present research concerns the use of single-item measures to assess key constructs of interest. Specifically, Experiment 3 used single-item scales to measure the perceived benefits, risks and extent to which the benefits outweighed the risks of consuming each supplement. Similarly, in Experiments 4-6, participants' appraisals of their recent and general dietary healthiness were again assessed using single-item measures. Such measures are typically considered to have lower content validity than comparable multi-item measures, inasmuch as a single item might not fully evaluate the intricacies of a specific construct in sufficient detail to be meaningful. Whereas this approach was an important first step, future research using more comprehensive and empirically validated measures—such as Strachan and Brawley's (2008) healthy eater identity questionnaire—would support my ability to draw confident conclusions about whether people's health-related inferences influence their food choices and intentions.

Concerning Experiments 1-3 in particular, one limitation is that participants were only exposed to images of fictitious product packages, for which they held no prior beliefs about the products' healthiness. Conversely, when consumers already possess knowledge of a brand's healthiness, these beliefs may overrule the feelings that arise from a sense of processing fluency (Greifeneder et al., 2011). Previous research has for instance shown that FoP nutritional labels are less likely to influence participants' appraisals of branded products' healthiness than comparable unbranded products (Ikonen et al., 2020). For this reason, I am unable to confidently conclude that the observed effect of imagery also pertains to well-known, branded commodities. That is not to say that the results from Experiments 1-3 are not without merit, particularly given the frequency with which new products are brought to market. Likewise, little is currently known about how people's judgements of an already established brand may alter after rebranding, particularly if the purpose of this reinvention is to cast a previously 'unhealthy' brand in a more favourable light. Further research should therefore consider the way in which consumers' brand beliefs influences the observed effect of imagery, as well as the extent to which a reimagining of a brand's identity would undermine people's confidence in their beliefs about that brand.

A further limitation of Experiments 1-3 pertains to the use of ANOVAs, which assume that every observation is independent of one another (Barr et al., 2013). But this oversimplification does not take into consideration that such observations are *nested* within each individual, and thus, the way in which they process information and ultimately arrive at a decision is unique to that person. In the case of people's memories for instance, the likelihood of a person recalling a particular package claim might be influenced by the availability of other, related memories (Wright, 1998). Suppose then that a person erroneously remembers reading the health claim "calcium helps build strong bones" during the cued recall task. This may in turn lead them to make similar inferences about other dairy-based products of which calcium is a principal nutrient. Similarly, the way in which this information is initially encoded might also vary as a function of various packaging elements, such as the perceived congruity between the written claim and package image. It might therefore be the case that certain package configurations elicit a particularly large effect of imagery, which in turn drives the overall effect. It might therefore be more appropriate to use mixed-effects modelling to investigate the contributions of these random effects so as to improve the generalisability of these findings.

It is also important to better understand the extent to which individual differences influence the way in which consumers are unduly influenced by package imagery. Though the findings from Experiment 3 suggest that these imagery effects are not limited to consumers who are less preoccupied with their foods' healthiness, future research should nonetheless consider consumers who are more keenly aware of disease-diet relations, who may be more inclined to scrutinise on-pack information (Drichoutis et al., 2006). For instance, parents with children living at home are significantly more interested in product nutritional information than adults without children or 'empty-nesters' (Grunert & Wills, 2007). Likewise, restrained eaters seemingly possess a greater attentional bias towards food-related cues (Polivy & Herman, 2017), and consequently appear more able to accurately judge the healthiness of foods in spite of misleading textual cues identifying stereotypically unhealthy food (e.g., pizza) as low fat (Lwin et al., 2014). Further investigation of these subgroups may hold important information on how best to counteract these effects of imagery for objectively unhealthy foods.

Likewise, individual differences might affect the healthiness of people's food choices following their self-appraised dietary healthiness, particularly if those appraisals are at odds with their health *goals*. As discussed in Chapter 6, the Compensatory Health Beliefs model (Rabia et al., 2006) posits that people attempt to counteract the negative ramifications of behaving unhealthily by engaging in more healthful activities. One might therefore expect that participants who formed less favourable impressions of their dietary healthiness would have subsequently chosen a higher proportion of healthier snacks when prompted, but this was not the case. The absence of an effect might, however, be explained by the decision to exclude participants who were following a calorie-controlled diet so as not to undermine any potential fluency effects. In doing so, I excluded those participants with a specific health goal (i.e., losing weight) who would be most likely to exhibit these compensatory health behaviours. Indeed, Giles and Brennan (2014) reported that young adults trying to follow a healthy lifestyle do in fact recognise the consequences of unhealthy behaviours (e.g., binge drinking) and make compromises, such as consuming more fruits and vegetables, to compensate. Future research should therefore consider how retrieval difficulty might inversely affect people's food choices and behaviours for health-conscious individuals.

A further, as yet unresolved issue regarding Experiments 4-6 remains the issue of causation. Based on the evidence presented here I cannot confidently assert that participants' self-appraised dietary healthiness was in fact biased by the subjective difficulty of recalling multiple examples of past eating. An equally plausible explanation for these findings is that remembering instances of eating healthily for instance, may be legitimately difficult for someone who is a habitually unhealthy eater. In support of the former explanation, the results of my exploratory mediation analyses remained constant in all but one instance after factoring in participants' BMI as a covariate. However, it would be imprudent to draw any firm conclusions from this poor predictor of people's eating behaviours. Future research could remedy this limitation by including an empirically validated measure of people's habitual eating habits, such as the food frequency questionnaire (Willett, 2012).

Conclusion

Taken together, the findings of this thesis show that what people infer about a product's healthiness shapes their memories and cognitions about that product, which in turn inform people's inferences about their own healthiness. Rather than using more objective health information, people make judgments about healthiness based on their metacognitive *feelings*. In this way, information matching something that is implicitly known—but not necessarily true—may evoke a fluent sense of comprehension, and thus, be appraised more favourably. Likewise, people may form contrasting opinions of their dietary healthiness based on the number of (un)healthy eating experiences remembered, if retrieval is perceived to be difficult. Importantly, the findings from Experiment 1-3 inform debates about how package imagery is used to market food and health products. In particular, the present research has important implications for unregulated written claims that could assume an altogether different meaning when presented in conjunction with a related health image. Furthermore, the findings from Experiments 4-6 highlight the potential utility of using memory retrieval as a means to encourage positive health behaviours, however, it is important to be aware of potential backfire effects should retrieval be perceived to be difficult. Initiatives aimed at improving people's understanding of what constitutes a healthy diet might in turn make people less reliant on the feelings that arise from a quick and easy sense of processing and/or retrieval. This approach ought to focus on restating the facts rather than 'correcting' common misconceptions, so as not to acquaint consumers with a false claim, whose veracity may later be judged primarily on how *familiar* it feels.

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Appendices

Appendix A. *List of nutrient claims as they appeared on products' packaging*

Product	Nutrient Claim
Fish Fingers	Source of Zinc
Porridge Oats	High in Oat Beta-Glucans
Natural Yogurt	A source of Vitamin D
Wholegrain Bread	Naturally High in Fibre
Cereal Bar	An important source of carbohydrates
Cheddar Cheese	Enriched with Calcium
Wholegrain Pasta	High Fibre
Energy Drink	A Carbohydrate-electrolyte Solution
Skimmed Milk	A Source of Calcium
Peanuts	Naturally High in Zinc
Oat Biscuits	Contains naturally derived Beta-Glucans
Smoothie	Contains Vitamin D

Appendix B. *List of health claims as they appeared on (filler) products' packaging*

Product	Health Claim
British Beef Mince	Protein contributes to the maintenance of muscle mass
Free Range Eggs	Vitamin A contributes to the maintenance of normal vision
Houmous	Folate contributes to normal psychological function
Corn Flakes	Riboflavin contributes to the maintenance of normal red blood cells
Orange Juice	Vitamin C contributes to the normal function of the immune system
Banana Chips	Potassium contributes to normal muscle function
Sausages	Iron contributes to the reduction of tiredness and fatigue
Sunflower Seeds	Magnesium contributes to electrolyte balance
Tinned Mackerel	Zinc contributes to the maintenance of normal hair
Blueberry Muffins	Riboflavin contributes to the reduction of tiredness and fatigue
Chicken Goujons	Protein contributes to a growth in muscle mass
Sweet Popcorn	Fibre contributes to normal bowel function

Appendix C. *Examples of fictional (filler) product packages containing health claims*

A.

B.

C.

Note. Panel A represents the green (healthy) MTL label condition; Panel B represents the red (unhealthy) MTL label condition; Panel C represents the white (control) MTL label condition.

Appendix D. *Preregistration for Experiment 1*

1. **Data collection**. Have any data been collected for this study already?

   No

2. **Hypothesis.** What's the main question being asked or hypothesis being tested in this study?

   We ask (a) to what extent the use of health function images on product packaging increases false memories of reading health function claims, and (b) to what extent a "traffic light" nutrition label moderates this effect. We predict that participants will be more likely to falsely remember reading health function claims when a package contains a health-related image, than when it contains no image. In addition, we will test the interaction between image (present vs. absent) and traffic light label (green vs. red vs. white) for each of our dependent variables. We anticipate that the addition of a green traffic light label to a package containing a health-related image will result in participants falsely remembering significantly more health function claims, compared to the white or red traffic light label conditions.

3. **Dependent variable.** Describe the key dependent variable(s) specifying how they will be measured.

   Recall – For each product, participants will attempt to recall the written claim they had read on the label. Responses will be coded into one of three categories: (a) health function claim, whereby the participant refers to a specific health function of the product (e.g. helps build strong bones), (b) nonfunction claim, whereby the participant either refers to a specific nutrient/ingredient that the product contains (e.g. contains calcium), or a general feature about the product (e.g. easy to cook), or (c) omission, whereby the participant either gives no meaningful response, or says "don't know" or equivalent. We will analyse the proportion of function claims recalled in each of the study conditions.

   Recognition – For each product, participants will be asked to select the claim that they read on the product package, from a list of six, including a critical lure which is a health function claim. We will analyse the proportion of critical lures falsely recognised in each of the study conditions.

4. **Conditions.** How many and which conditions will participants be assigned to?

   There will be a total of six conditions; 2(image: present vs. absent) x 3(traffic light label: green vs. red vs. white).

5. **Analyses.** Specify exactly which analyses you will conduct to examine the main question/hypothesis.

   For the analysis of recall we will use a 2(image: image present vs. image absent) x 3(traffic light label: green vs. red vs. white) repeated-measures ANOVA on the proportion of claims recalled as health function claims. For the analysis of recognition, we will use a 2(image: image present vs. image absent) x 3(traffic light label: green vs. red vs. white) repeated-measures ANOVA on the proportion of critical lures recognised. For both analyses and for post-hoc tests, where appropriate, we will adopt an alpha level of .05.

6. **Outliers and Exclusions.** Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.

   We will exclude participants if they affirm that either they or anyone in their immediate family has been formally diagnosed as colour blind. Furthermore, on completion of the study participants will complete a comprehension test to assess their ability to interpret a traffic light label. Participants who fail to give the correct answers to any of these test questions will be excluded from the data analysis and replaced with a new participant. Likewise, any participant who gives 'omission' responses to more than 25% of the items on the recall test will be excluded from analyses, and will be replaced by a new participant.

7. **Sample Size.** How many observations will be collected or what will determine sample size?

   A total of 60 participants will be recruited, following any exclusions.

8. **Other.** Anything else you would like to pre-register.

   None

9. **Name.** Give a title for the AsPredicted pre-registration.

   Do traffic light labels moderate the effect of images on front-of-pack information recall?

10. **Participating Authors**

    Dr Robert Nash (*Aston University*)
    Dr Jason Thomas (*Aston University*)
    Dr Claire Farrow (*Aston University*)

Appendix E. *Preregistration for Experiment 2*

1. **Data collection**. Have any data been collected for this study already?

   No

2. **Hypothesis.** What's the main question being asked or hypothesis being tested in this study?

   We ask (a) to what extent the use of health function images on product packaging increases false memories of reading health function claims, and (b) to what extent a statement of the products' relative 'healthfulness' moderates this effect. We predict that participants will be more likely to falsely remember reading health function claims when a package contains a health-related image, than when it contains no image. In addition, we will test the interaction between image (present vs. absent) and statement (healthy vs. unhealthy) for each of our dependent variables. We anticipate that the predicted effect of image on false memories is greater for supposedly 'healthy' products than for 'unhealthy' products.

3. **Dependent variable.** Describe the key dependent variable(s) specifying how they will be measured.

   Recall – For each product, participants will attempt to recall the written claim they had read on the label. Responses will be coded into one of three categories: (a) health function claim, whereby the participant refers to a specific health function of the product (e.g. helps build strong bones), (b) nonfunction claim, whereby the participant either refers to a specific nutrient/ingredient that the product contains (e.g. contains calcium), or a general feature about the product (e.g. easy to cook), or (c) omission, whereby the participant either gives no meaningful response, refers to something that is otherwise visible on the packaging (e.g. the products' weight), or says "don't know" or equivalent. We will analyse the proportion of function claims recalled in each of the study conditions.

   Recognition – For each product, participants will be asked to select the claim that they read on the product package, from a list of six, including a critical lure (i.e., a health function claim). For each response, participants will be asked to justify their choice from either; (1) "I remember seeing it on the packaging", (2) "I know I saw it on the packaging, although I don't explicitly remember it, or (3) "It was just a guess".

4. **Conditions.** How many and which conditions will participants be assigned to?

   There will be a total of four within-subject conditions; 2(image: present vs. absent) x 2(statement: healthy vs. unhealthy).

5. **Analyses.** Specify exactly which analyses you will conduct to examine the main question/hypothesis.

   For the analysis of recall we will use a 2(image: present vs. absent) x 2(statement: healthy vs. unhealthy) repeated-measures ANOVA on the proportion of claims recalled as health function claims. For the analysis of recognition, we will conduct the same analysis on the total proportion of critical lure choices. If the latter reveals a significant main effect of image, then we will conduct additional repeated-measures ANOVAs to ascertain whether the effect remains significant after excluding 'guess' responses. For main analyses and for post-hoc tests, where appropriate, we will adopt an alpha level of .05.

6. **Outliers and Exclusions.** Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.

   Any participant who gives 'omission' responses to more than 50% of the items on the recall test will be excluded from the analyses, and will be replaced with a new participant.

7. **Sample Size.** How many observations will be collected or what will determine sample size?

   A total of 64 participants will be recruited, following exclusions. This sample size should provide reasonable power (.80) to detect a medium main effect (d = 0.5), assuming alpha = .05, two-tailed.

8. **Other.** Anything else you would like to pre-register.

   None.

9. **Name.** Give a title for the AsPredicted pre-registration.

   Does a product's 'healthfulness' moderate the effect of images on packaging recall?

10. **Participating Authors**

    Dr Robert Nash (*Aston University*)
    Prof Claire Farrow (*Aston University*)
    Dr Jason Thomas (*Aston University*)

Appendix F. *Preregistration for Experiment 3*

1. **Data collection**. Have any data been collected for this study already?

   No

2. **Hypothesis.** What's the main question being asked or hypothesis being tested in this study?

   We ask (a) to what extent the use of health function images on product packaging influences people's perceptions of the risks and/or benefits of consuming the products, and (b) to what extent this effect depends on the congruence between the health image and the product's supposed health function. We predict that the inclusion of a health function image on a product's packaging will increase participants' perceptions of the benefits of the product, but only when the image is congruent with the product's supposed health function.

3. **Dependent variable.** Describe the key dependent variable(s) specifying how they will be measured.

   For each product, participants will rate on a 10-point Likert scale (a) the extent to which somebody with the specified health condition would benefit from taking the product, (b) the extent to which somebody with the specified health condition might be at risk from taking the product, (c) the extent to which the benefits of taking the product would outweigh the risks.

4. **Conditions.** How many and which conditions will participants be assigned to?

   There will be a total of four conditions; 2(image: present vs. absent) x 2(expectation: congruent vs. incongruent).

5. **Analyses.** Specify exactly which analyses you will conduct to examine the main question/hypothesis.

   For each dependent variable we will carry out a 2(image: present vs. absent) x 2(expectation: confirmed vs. disconfirmed) repeated-measures ANOVA, adopting an alpha level of .05.

6. **Outliers and Exclusions.** Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.

   Participants will be excluded if they report that they have a comprehensive understanding of either the Dutch/German language (because the stimuli have been prepared using Dutch text, which participants should not understand). Participants will also be excluded from the data analysis should they fail to respond correctly to an attention check at the end of the study, which involves identifying two of the stimuli that they have previously seen. Participants will be excluded if they provide the same response to every question (i.e., 100% consistency when combining all three DVs).

7. **Sample Size.** How many observations will be collected or what will determine sample size?

   Following exclusions, 300 participants will be recruited.

8. **Other.** Anything else you would like to pre-register.

   When they first see each health product (before completing the DVs), participants will be asked to predict its supposed health function. To do this they will rate the extent to which each of eight statements about the product are true (e.g., this product aids in the maintenance of a healthy heart). Of the eight statements, one of these represents the “correct” function. We will use these ratings as a manipulation check, predicting that agreement with the ‘correct’ statements will be higher when an image is present on the packaging.

9. **Name.** Give a title for the AsPredicted pre-registration.

   Do front-of-pack health images enhance the perceived benefits of health supplements?

10. **Participating Authors**

    Dr Robert Nash (*Aston University*)
    Dr Jason Thomas (*Aston University*)
    Dr Claire Farrow (*Aston University*)

Appendix G. *List of health supplements' risks and benefits*

Product Category	Risks	Benefits
Heart health	Can irritate the gastrointestinal tract.	May slow down the development of atherosclerosis.
	May slow blood clotting.	May slightly lower blood pressure.
Joints and muscles	Gastrointestinal disorders; diarrhoea, nausea, vomiting, abdominal pain.	Might help maintain normal joints and muscles.
	Can affect heart rate.	Decreases pain from osteoarthritis.
Memory	Headaches and dizziness.	For the improvement of cognitive impairment.
	Allergic skin reactions, oedema, itching and rash.	Might help improving memory.
Weight management	Cases of liver damage have been reported.	Contributes to fat oxidation.
	May cause sleep disturbances.	Helps to reduce the appetite.
*Bowel function**	Electrolyte disturbances.	Purification of blood.
	Possibility of a carcinogenic risk from long-term use.	Improves bowel function.
*Cold and flu**	Do not take if you have an autoimmune disorder.	Fights infections, especially the common cold.
	Possibility of allergic reaction.	Supports the immune system and the body's defence.

Note. Information relating to the 'bowel function' and 'cold and flu' supplements were used in the expectation-disconfirmed conditions (i.e., participants saw the risk-benefit information for one of these supplements paired with a package label that featured an incongruous health-related image).

Appendix H. *Preregistration for Experiment 4*

1. **Data collection**. Have any data been collected for this study already?

   No

2. **Hypothesis.** What's the main question being asked or hypothesis being tested in this study?

   We ask (a) to what extent does the perceived ease of recalling one's past eating experiences bias a person's appraisal of their 'healthiness', and (b) to what extent does this appraisal influence their subsequent eating intentions and/or behaviour. We predict that when participants are asked to recall a small number of recent instances when they have consumed something 'healthy' they will form a more positive appraisal of their recent eating behaviours. Conversely, when participants are asked to generate a larger number of instances, they will form a less positive appraisal.

3. **Dependent variable.** Describe the key dependent variable(s) specifying how they will be measured.

   Healthiness rating (state) – Participants will answer the critical question; "To what extent do you agree with the following statement: In recent weeks and months I have had a **healthy** diet", on a 7-point Likert scale (1 = I have eaten very unhealthily; 7 = I have eaten very healthily).

   Additional (non-critical) DVs:

   Healthiness rating (trait) – Participants will answer the question; "To what extent do you believe you normally eat healthily in your day-to-day life?", on a 7-point Likert scale (1 = I normally eat very unhealthily; 7 = I normally eat very healthily).

   Party Behaviour Questionnaire (30 items) – Participants will rate their willingness to consume 15 high-energy dense (HED) foods (e.g., chocolate) and 15 low-energy dense (LED) foods (e.g., grapes), each on a 7-point Likert scale (1 = Definitely would not consume; 7 = Definitely would consume). We will average the responses to the LED foodstuffs and HED foodstuffs respectively, before subtracting the HED_{Mean} from the LED_{Mean} to produce a single outcome score, representing the healthfulness of their choices.

   Food Choice Questionnaire (6 items) – Participants will complete a subset of items from the Food Choice Questionnaire (FCQ), which measures people's motives for choosing the foods that they eat. Specifically, participants will complete the six items pertaining to *health* factors (questions 9, 10, 22, 27, 29 and 30) (e.g., "It is important to me that the food that I eat on a typical day contains lots of vitamins and minerals). Responses to these six items will be averaged into a single score.

   Relative Reinforcement Value (RRV) – Participants will be asked to complete a reinforcement task whereby they are awarded points for repeatedly clicking inside a response box. The number of mouse-clicks needed to earn a point is determined by a progressive fixed-ratio schedule. For every five points earned participants receive a 10g partition of their desired snack. In the first instance, the participant receives a reward after 20-mouse-clicks, then following an additional 40 mouse-clicks and so on. The task is presented on two computer stations; one allowing the participant to work towards a predetermined LED snack, the other a HED snack. The point at which the participant no longer wants to earn points towards either foodstuff is known as the breakpoint. This value represents the total number of mouse clicks made in pursuit of earning a LED snack or a HED before ceasing the experiment. The experiment therefore yields two measures; namely the breakpoint for the LED snack ($Breakpoint_{LED}$) and HED snack ($Breakpoint_{HED}$), which will be analysed separately in addition to the relative reinforcement value. The relative reinforcement value is then calculated using the formula; Relative Reinforcement Value (RRV) = $Breakpoint_{HED} \div (Breakpoint_{HED} + Breakpoint_{LED})$, (Epstein et al., 2018).

4. **Conditions.** How many and which conditions will participants be assigned to?

   There will be two between-subject conditions, with participants being asked to recall either *few* or *many* eating experiences.

5. **Analyses.** Specify exactly which analyses you will conduct to examine the main question/hypothesis.

   For each dependent variable we will carry out an independent-samples *t*-test, adopting an alpha level of .05. To compare the breakpoints for the LED and HED snacks we will conduct a 2(events: few vs. many) x 2(breakpoint: HED snack vs. LED snack) mixed-factor ANOVA, adopting an alpha level of .05.

6. **Outliers and Exclusions.** Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.

   Participants will be excluded from participating if they indicate that they; (1) have eaten within the past two hours, (2) have a known food allergy or any other dietary restriction, either as a result of medical advice or out of personal choice (e.g. vegetarian), (3) have an existing, or prior, eating disorder (e.g. anorexia, bulimia nervosa), (4) are currently taking any medications or supplements that affect their appetite and/or eating behaviour, (5) have diabetes, irritable bowel syndrome (IBS) or Crohn’s disease, (6) currently have depression or an anxiety disorder, or (7) are following a calorie restricted diet, with the intention of losing weight.

   During the recall task, participants will be asked to elaborate on their past eating experiences (e.g., “Where were you when you ate it?”). Responses that do not contain at least one recognisable food and/or beverage, in addition to at least one other detail about the event (e.g., where they were at the time) will be coded as invalid. Any participant assigned to the many-events condition who fails to produce at least one more valid example than is required of the few-examples participants, will be excluded from the analysis and replaced with a new participant. Similarly, participants assigned to the few-events condition who fail to provide the required number of valid examples will be excluded and replaced. In addition, we will exclude participants whose Relative Reinforcement Value equals zero (i.e., they do not register a single mouse click at either computer station).

   We will only include participants in the analysis that have a body mass index (BMI) that falls between 18.5-29.9. This will be calculated from the participants’ height and weight, recorded during the experiment, using the equation: BMI = kg/m^2. Participants that fall outside of this range will be removed and replaced with another participant. Finally, participants will be excluded if they provide the same response to every item on the Party Behaviour Questionnaire.

7. **Sample Size.** How many observations will be collected or what will determine sample size?

   A total of 128 participants will be recruited, following exclusions. This sample size should provide reasonable power (.80) to detect a medium main effect (d = 0.5), assuming alpha = .05, two-tailed.

8. **Other.** Anything else you would like to pre-register.

   Once participants have completed the recall task, they will rate how difficult they found it to generate the required number of instances, using a 7-point Likert scale (1= Very easy; 7 = Very difficult). We predict that the perceived difficulty will be significantly lower in the few events conditions compared to the many events conditions.

   Participants will complete two visual analogue scales (VAS), measuring hunger and fullness (0 = Not Hungry/Full at all; 100 = Very Hungry/Full). Participants will also complete the Dutch Eating Behaviour Questionnaire (33 items), We will examine participants' scores on these measures to determine whether there are any significant differences between conditions.

9. **Name.** Give a title for the AsPredicted pre-registration.

   The role of ease of retrieval on perceived 'healthiness' and subsequent eating behaviour.

10. **Participating Authors**

    Dr Robert Nash (*Aston University*)
    Prof Claire Farrow (*Aston University*)
    Dr Jason Thomas (*Aston University*)

Appendix I. *Pre-screening questionnaire for Experiment 4*

<u>Pre-Screening Questionnaire</u>

Thank you for registering your interest in the study "Investigating the Influence of Recalled Eating Experiences on Perceived Healthiness". Before we begin, we would appreciate it if you could answer a few questions to determine your suitability for the study.

1. Do you speak fluent English?

Yes / No

2. To the best of your knowledge, do you have any food allergies or dietary restrictions, either as a result of medical advice or personal choice (e.g., vegetarian, vegan)?

Yes / No

3. Do you presently have, or have you ever had, an eating disorder (e.g., anorexia, bulimia nervosa)?

Yes / No / Prefer not to say

4. Do you presently have depression or an anxiety disorder?

Yes / No / Prefer not to say

5. Are you currently taking any medications or supplements that affect your appetite and/or eating behaviour?

Yes / No / Prefer not to say

6. Do you have diabetes, irritable bowel syndrome (IBS) or Crohn's disease?

Yes / No / Prefer not to say

7. Are you currently following a calorie restricted diet, with the intention of losing weight?

Yes / No

8. How do you wish to be paid for your participation?

Course Credit / Voucher

9. As part of the experiment, you will have the opportunity to earn two contrasting snack-based rewards. Below are two tables depicting the foods that you can earn for participating. In the right-hand column please rank the foods from 1 to 3 based on which food you would prefer to receive **(1 = your preferred choice, 3 = your least preferred choice)**.

Snack 1:

Food	**Rank (1 -3)**
Apple(s)	
Grape(s)	
Carrot(s)	

Snack 2:

Food	**Rank (1 -3)**
Chocolate Chip Cookie(s)	
Doritos (Tangy Cheese)	
M&M’s	

Appendix J. *Energy density values for Party Behaviour Questionnaire foods*

Food	Energy Density *(kcal/g)*
High energy dense	
Chocolate	5.62
Crisps	5.44
Peanuts	6.26
Cheddar cheese	4.16
Crackers	4.54
Danish pastry	4.32
Chocolate chip cookies	4.90
Waffles (sweet)	4.45
Flapjack	4.20
Bakewell tart	4.17
Popcorn	5.22
Tortilla chips	4.99
Cake	4.56
Doughnut	4.28
Sweets	4.04
Low energy dense	
Sushi	1.50
Tomato soup	0.57
Strawberries	0.30
Blueberries	0.68
Yoghurt	0.50
Orange juice	0.43
Cottage cheese	1.05
Celery	0.10
Hard-boiled egg	1.31
Fruit salad	0.32
Banana	0.90
Fruit smoothie	0.59
Jelly	0.56
Baked beans	0.87
Olives	1.44

Appendix K. *Energy density values for foods pertaining to the Relative Reinforcement Value task (Experiment 4), and Virtual Portion Creation Task (Experiment 6)*

Food	**Energy Density *(kcal/g)***
High energy dense	
Chocolate chip cookies	4.90
Doritos (tangy cheese)	5.00
M&M’s	4.80
Low energy dense	
Apple slices	0.71
Carrots	0.43
Grapes	0.67

Appendix L. *Food Choice Questionnaire*

Several different factors influence our choice of food. For every person, there will be a different set of factors that are important. In the next set of questions, we are interested in finding out what factors influence your choice of food. On the next page you will see a series of factors that may be relevant to **your** choice of foods. Read each item carefully and decide how important the item is to you. Remember, there are no right or wrong answers - we are interested in **what is important to you**.

	Not important at all	A little important	Moderately important	Very important
It is important to me that the food I eat on a typical day is high in fibre and roughage.				
It is important to me that the food I eat on a typical day keeps me healthy.				
It is important to me that the food I eat on a typical day contains lots of vitamins and minerals.				
It is important to me that the food I eat on a typical day is high in protein.				
It is important to me that the food I eat on a typical day keeps me healthy.				
It is important to me that the food I eat on a typical day is good for my skin/teeth/hair/nails etc.				

Appendix M. *Dutch Eating Behaviour Questionnaire*

DEBQ: Dietary Restraint (10-items)

When you have put on weight do you eat less than you usually do?	Not relevant	Never	Seldom	Sometimes	Often	Very often
Do you try to eat less at mealtimes than you would like to eat?	-	Never	Seldom	Sometimes	Often	Very often
How often do you refuse food or drink offered to you because you are concerned about your weight?	-	Never	Seldom	Sometimes	Often	Very often
Do you watch exactly what you eat?	-	Never	Seldom	Sometimes	Often	Very often
Do you deliberately eat foods that are slimming?	-	Never	Seldom	Sometimes	Often	Very often
When you have eaten too much, do you eat less than usual the following day?	Not relevant	Never	Seldom	Sometimes	Often	Very often
Do you deliberately eat less in order not to become heavier?	-	Never	Seldom	Sometimes	Often	Very often
How often do you try not to eat between meals because you are watching your weight?	-	Never	Seldom	Sometimes	Often	Very often
How often in the evenings do you try not to eat because you are watching your weight?	-	Never	Seldom	Sometimes	Often	Very often
Do you take your weight into account with what you eat?	-	Never	Seldom	Sometimes	Often	Very often

DEBQ: External Eating (10-items)

If food tastes good to you, do you eat more than usual?	-	Never	Seldom	Sometimes	Often	Very often
If food smells good, do you eat more than usual?	-	Never	Seldom	Sometimes	Often	Very often
If you smell something delicious, do you have a desire to eat it?	-	Never	Seldom	Sometimes	Often	Very often
If you have something delicious to eat, do you eat it straight away?	-	Never	Seldom	Sometimes	Often	Very often
If you walk past a baker, do you have a desire to buy something delicious?	-	Never	Seldom	Sometimes	Often	Very often
If you walk past a snackbar or café, do you have a desire to buy something delicious?	-	Never	Seldom	Sometimes	Often	Very often
If you see others eating, do you also have a desire to eat?	-	Never	Seldom	Sometimes	Often	Very often
Can you resist eating delicious foods?*	-	Never	Seldom	Sometimes	Often	Very often
Do you eat more than usual, when you see others eating?	-	Never	Seldom	Sometimes	Often	Very often
When preparing a meal, are you inclined to eat something?	-	Never	Seldom	Sometimes	Often	Very often

*reverse-scored

DEBQ: Emotional Eating (13-items)

Do you have a desire to eat when you are irritated?	Not relevant	Never	Seldom	Sometimes	Often	Very often
Do you have a desire to eat when you have nothing to do?	Not relevant	Never	Seldom	Sometimes	Often	Very often
Do you have a desire to eat when you are depressed or discouraged?	Not relevant	Never	Seldom	Sometimes	Often	Very often
Do you have a desire to eat when you are feeling lonely?	Not relevant	Never	Seldom	Sometimes	Often	Very often
Do you have a desire to eat when you somebody lets you down?	Not relevant	Never	Seldom	Sometimes	Often	Very often
Do you have a desire to eat when you are cross?	Not relevant	Never	Seldom	Sometimes	Often	Very often
Do you have a desire to eat when you are something unpleasant is about to happen?	-	Never	Seldom	Sometimes	Often	Very often
Do you get the desire to eat when you are anxious, worried or tense?	-	Never	Seldom	Sometimes	Often	Very often
Do you have a desire to eat when things are going against you and when things have gone wrong?	-	Never	Seldom	Sometimes	Often	Very often
Do you have a desire to eat when you are frightened?	Not relevant	Never	Seldom	Sometimes	Often	Very often
Do you have a desire to eat when you are disappointed?	Not relevant	Never	Seldom	Sometimes	Often	Very often
Do you have a desire to eat when you are emotionally upset?	Not relevant	Never	Seldom	Sometimes	Often	Very often
Do you have a desire to eat when you are bored or restless?	Not relevant	Never	Seldom	Sometimes	Often	Very often

Appendix N. *Script for Relative Reinforcement Value task*

RRV Script

[To be read aloud to participants]

For the next part of the study, you will play a game to earn snacks!

In a moment, you'll see two screens each with three coloured shapes. Every time you click the mouse inside the large box on the screen, the shapes will rotate and change colour. Whenever all the shapes match, you will earn 1 point. After each 5 points you will rewarded with a portion of your chosen snack, which will be placed on the table behind you. You can earn [apples/carrots/ grapes] by playing on the computer to your [left/right], and [cookies/Doritos/M&M's] by playing on the computer to your [left/right]. You are free to move between the two computers as often as you want, but you can only play on one computer at a time.

After earning any snack, if you want to continue playing then the experimenter will reset the game and you can then continue for as long as you want. When you no longer wish to continue playing, please tell the experimenter and you will then be free to eat the snacks you've earned at the end of the experiment. You don't have to eat everything, but you may not take any leftovers away with you.

You will now complete a short practice session to get you familiar with the game.

Appendix O. *Preregistration for Experiment 5*

1. **Data collection**. Have any data been collected for this study already?

   No

2. **Hypothesis.** What's the main question being asked or hypothesis being tested in this study?

   We ask (a) to what extent does the perceived ease of recalling one's past eating experiences bias a person's appraisal of their 'healthiness', and (b) to what extent does this appraisal influence their subsequent eating intentions. We predict that when participants are asked to recall a small number of recent instances when they have consumed something 'healthy' they will form a more positive appraisal of their recent eating behaviours. Conversely, when participants are asked to generate a larger number of instances, they will form a less positive appraisal. We anticipate that the reverse will be true for participants asked to recall 'unhealthy' eating experiences.

3. **Dependent variable.** Describe the key dependent variable(s) specifying how they will be measured.

   Healthiness rating (state) – Participants will answer the critical question; "To what extent do you agree with the following statement: In recent weeks and months I have had a **healthy** diet", on a 7-point Likert scale (1 = I have eaten very unhealthily; 7 = I have eaten very healthily).

   Additional (non-critical) DVs:

   Healthiness rating (trait) – Participants will answer the question; "To what extent do you believe you normally eat healthily in your day-to-day life?", on a 7-point Likert scale (1 = I normally eat very unhealthily; 7 = I normally eat very healthily).

   Party Behaviour Questionnaire (30 items) – Participants will rate their willingness to consume 15 high-energy dense (HED) foods (e.g., chocolate) and 15 low-energy dense (LED) foods (e.g., grapes), each on a 7-point Likert scale (1 = Definitely would not consume; 7 = Definitely would consume). We will average the responses to the LED foodstuffs and HED foodstuffs respectively, before subtracting the HED_{Mean} from the LED_{Mean} to produce a single outcome score, representing the 'healthfulness' of their choices.

   Food Choice Questionnaire (6 items) – Participants will complete a subset of items from the Food Choice Questionnaire (FCQ), which measures people's motives for choosing the foods that they eat. Specifically, participants will complete the six items pertaining to *health* factors (questions 9, 10, 22, 27, 29 and 30) (e.g., "It is important to me that the food that I eat on a typical day contains lots of vitamins and minerals). Responses to these six items will be averaged into a single score.

4. **Conditions.** How many and which conditions will participants be assigned to?

   There will be a total of four between-subject conditions; 2(events: few vs. many) x 2(content: healthy vs. unhealthy).

5. **Analyses.** Specify exactly which analyses you will conduct to examine the main question/hypothesis.

   For each dependent variable we will carry out a 2(events: few vs. many) x 2(content: healthy vs. unhealthy) between-subjects ANOVA, adopting an alpha level of .05.

6. **Outliers and Exclusions.** Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.
   For the purpose of this study, we will only recruit British nationals with no known food allergies or other dietary restrictions, either as a result of medical advice or out of personal choice (e.g., vegetarian). In addition, we will only recruit participants that have a body mass index that falls between 20-29.9.

   During the recall task, participants will be asked to elaborate on their past eating experiences (e.g., "Where were you when you ate it?"). Responses that do not contain at least one recognisable food and/or beverage, in addition to at least one other detail about the event (e.g., where they were at the time) will be coded as invalid. Any participant assigned to the many-events condition who fails to produce at least one more valid example than is required of the few-examples participants, will be excluded from the analysis and replaced with a new participant. Similarly, participants assigned to the few-events condition who fail to provide the required number of valid examples will be excluded and replaced. Finally, participants will be excluded if they provide identical responses to every item on the Party Behaviour Questionnaire.

7. **Sample Size.** How many observations will be collected or what will determine sample size?

   A total of 364 participants will be recruited, following exclusions. This sample size should provide reasonable power (.80) to detect a small-medium interaction effect (f = .15), assuming alpha = .05, two-tailed. If the overall interaction is significant, then the 91 participants in each cell will provide reasonable power (.80) to detect a medium-sized pairwise differences (d = .50) between conditions, with a Bonferroni-corrected alpha = .0125, two-tailed.

8. **Other.** Anything else you would like to pre-register.

   Once participants have completed the recall task, they will rate how difficult they found it to generate the required number of instances, using a 7-point Likert scale (1= Very easy; 7 = Very difficult). We predict that the perceived difficulty will be significantly lower in the few-events conditions compared to the many-events conditions.

   Participants will complete two visual analogue scales (VAS), measuring hunger and fullness (0 = Not Hungry/Full at all; 100 = Very Hungry/Full). Participants will also complete the Dutch Eating Behaviour Questionnaire (33 items), We will examine participants' scores on these measures to determine whether there are any significant differences between conditions.

9. **Name.** Give a title for the AsPredicted pre-registration.

   The role of ease of retrieval on perceived ‘healthiness’ and subsequent eating intentions.

10. **Participating Authors**

    Dr Robert Nash (*Aston University*)
    Prof Claire Farrow (*Aston University*)
    Dr Jason Thomas (*Aston University*)

Appendix P. *Preregistration for Experiment 6*

1. **Data collection**. Have any data been collected for this study already?

   No

2. **Hypothesis.** What's the main question being asked or hypothesis being tested in this study?

   We ask (a) to what extent does the number of recalled eating experiences bias a person's appraisal of their 'healthiness', and (b) to what extent does this appraisal influence their subsequent eating intentions. We predict that when participants are asked to recall a small number of recent instances when they have consumed something 'healthy' they will form a more positive appraisal of their recent (state) eating behaviours. Conversely, when participants are asked to generate a larger number of instances, they will form a less positive appraisal. We anticipate that the reverse will be true for participants asked to recall 'unhealthy' eating experiences.

3. **Dependent variable.** Describe the key dependent variable(s) specifying how they will be measured.

   Healthiness rating (state) – Participants will answer the critical question; "To what extent do you agree with the following statement: In recent weeks and months I have had a **healthy** diet", on a 7-point Likert scale (1 = I have eaten very unhealthily; 7 = I have eaten very healthily).

   Party Behaviour Questionnaire (30 items) – Participants will rate their willingness to consume 15 high-energy dense (HED) foods (e.g., chocolate) and 15 low-energy dense (LED) foods (e.g., grapes), each on a 7-point Likert scale (1 = Definitely would not consume; 7 = Definitely would consume). We will average the responses to the LED foodstuffs and HED foodstuffs respectively, before subtracting the HED_{Mean} from the LED_{Mean} to produce a single outcome score, representing the 'healthfulness' of their choices.

   Virtual Portion Creation Task **–** Participants will see images of three HED and three LED foods, and will be asked; "Imagine that tomorrow you'll be given a selection of snacks to eat as part of a meal. How much of each snack do you think you would eat?". For each food, participants will adjust the visually depicted portion size using the horizontal slider underneath the image. We will average the chosen weight (in grams) of the three LED foods and the three HED foods respectively, before subtracting the HED_{Mean} from the LED_{Mean} to produce a single outcome score, representing the 'healthfulness' of their choices.

   Additional (non-critical) DVs:

   Healthiness rating (trait) – Participants will answer the question; "To what extent do you believe you normally eat healthily in your day-to-day life?", on a 7-point Likert scale (1 = I normally eat very unhealthily; 7 = I normally eat very healthily).

4. **Conditions.** How many and which conditions will participants be assigned to?

   There will be a total of four between-subject conditions; 2(events: few vs. many) x 2(content: healthy vs. unhealthy).

5. **Analyses.** Specify exactly which analyses you will conduct to examine the main question/hypothesis.

   For each dependent variable we will carry out a 2(events: few vs. many) x 2(content: healthy vs. unhealthy) between-subjects ANOVA, adopting an alpha level of .05.

6. **Outliers and Exclusions.** Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.

   For the purpose of this study, we will only recruit British nationals with no known food allergies or other dietary restrictions, either as a result of medical advice or out of personal choice (e.g., vegetarian). In addition, we will only recruit participants that have a body mass index that falls between 18.5-29.9.

   During the recall task, participants will be asked to elaborate on their past eating experiences (e.g., "Where were you when you ate it?"). Responses that do not contain at least one recognisable food and/or beverage, in addition to at least one other detail about the event (e.g., where they were at the time) will be coded as invalid. Any participant assigned to the many-events condition who fails to produce at least one more valid example than is required of the few-examples participants, will be excluded from the analysis and replaced with a new participant. Similarly, participants assigned to the few-events condition who fail to provide the required number of valid examples will be excluded and replaced. Finally, participants will be excluded if they provide identical responses to every item on the Party Behaviour Questionnaire.

7. **Sample Size.** How many observations will be collected or what will determine sample size?

   A total of 364 participants will be recruited, following exclusions. This sample size should provide reasonable power (.80) to detect a small-medium interaction effect (f = .15), assuming alpha = .05, two-tailed. If the overall interaction is significant, then the 91 participants in each cell will provide reasonable power (.80) to detect a medium-sized pairwise differences (d = .50) between conditions, with a Bonferroni-corrected alpha = .0125, two-tailed.

8. **Other.** Anything else you would like to pre-register.

   Once participants have completed the recall task, they will rate how difficult they found it to generate the required number of instances, using a 7-point Likert scale (1= Very easy; 7 = Very difficult). We predict that the perceived difficulty will be significantly lower in the few-events conditions compared to the many-events conditions.

   Participants will complete two visual analogue scales (VAS), measuring hunger and fullness (0 = Not Hungry/Full at all; 100 = Very Hungry/Full). Participants will also complete the Dutch Eating Behaviour Questionnaire (33 items), We will examine participants' scores on these measures to determine whether there are any significant differences between conditions.

9. **Name.** Give a title for the AsPredicted pre-registration.

   Subjective ease of retrieval on perceived healthiness and subsequent eating intentions.

10. **Participating Authors**

    Dr Robert Nash (*Aston University*)
    Prof Claire Farrow (*Aston University*)
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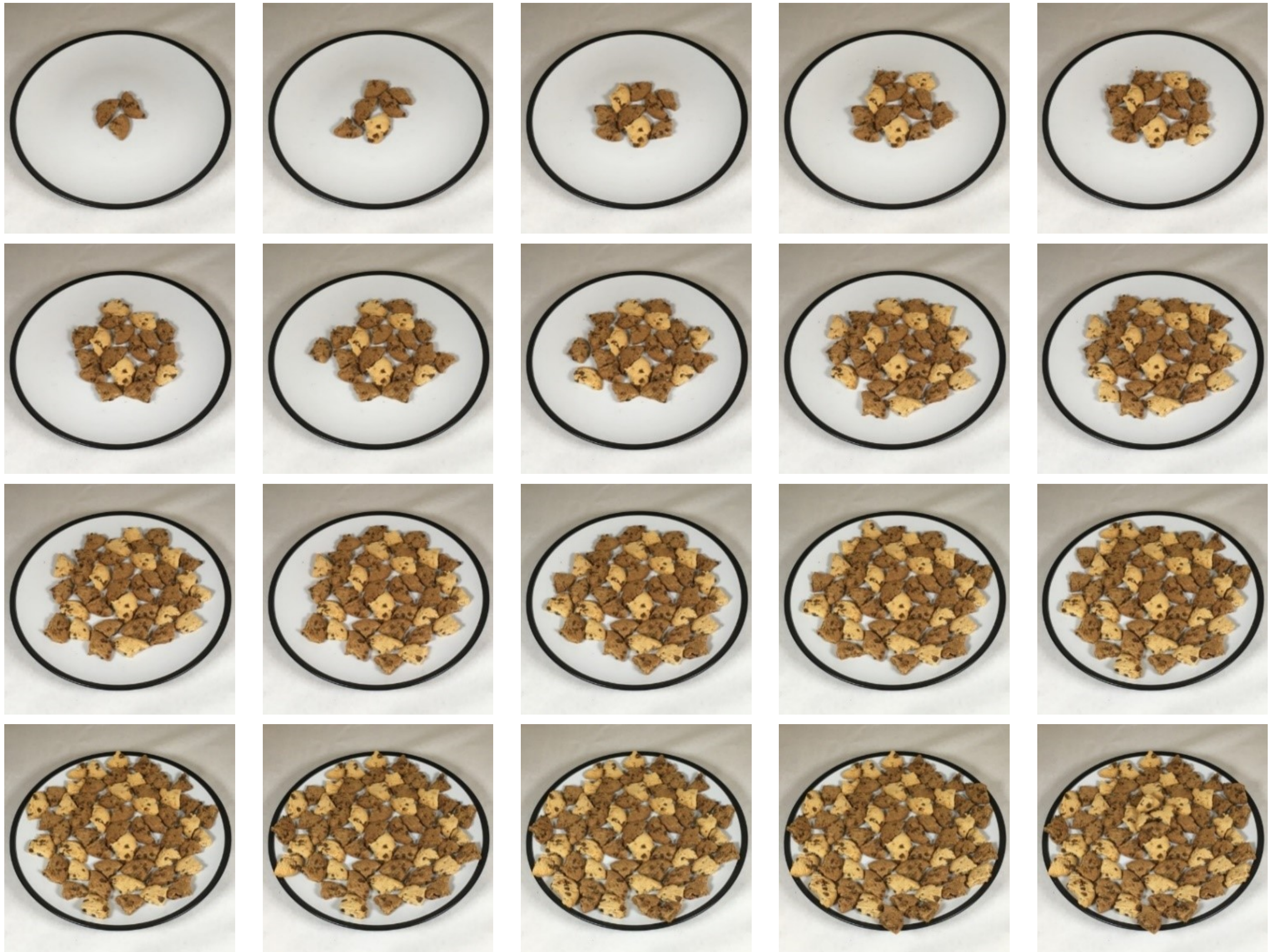
Appendix Q. *Example of 'unhealthy' food stimuli (chocolate chip cookies) as seen in Virtual Portion Creation Task*



Appendix R. *Example of 'healthy' food stimuli (carrots) as seen in Virtual Portion Creation Task*

Appendix S. *Results of the mediation analyses from Experiment 4 showing direct and indirect effects of the number of eating memories retrieved on participants' perceived dietary healthiness, food choices and motivations after controlling for BMI*

Pathway	β	*SE*	*p*	95% CI Lower bound	95% CI Upper bound
Recent healthiness					
Total effect	0.35	0.46	.02	0.18	1.97
Direct effect					
Memories retrieved → Perceived healthiness	0.42	0.40	< .01	0.52	2.09
Indirect effect	-0.07	0.23	.31	-0.67	0.21
Memories retrieved → Recall difficulty	0.16	0.51	.29	-0.46	1.55
Recall difficulty → Perceived healthiness	-0.45	0.12	< .001	-0.66	-0.18
General healthiness					
Total effect	0.35	0.48	.02	0.19	2.05
Direct effect					
Memories retrieved → Perceived healthiness	0.42	0.42	< .01	0.54	2.18
Indirect effect	-0.07	0.24	.31	-0.70	0.22
Memories retrieved → Recall difficulty	0.16	0.51	.29	-0.46	1.55
Recall difficulty → Perceived healthiness	-0.46	0.13	< .001	-0.69	-0.19
Food choices (PBQ scores)					
Total effect	0.22	0.40	0.14	-0.20	1.38
Direct effect					
Memories retrieved → Food choices	0.27	0.38	.06	-0.02	1.47
Indirect effect	-0.05	0.15	.34	-0.42	0.15
Memories retrieved → Recall difficulty	0.16	0.51	.29	-0.46	1.55
Recall difficulty → Food choices	-0.32	0.11	.03	-0.48	-0.03
Eating motivations (RRV scores)					
Total effect	-0.26	0.10	.08	-0.35	0.02
Direct effect					
Memories retrieved → Eating motivations	-0.27	0.10	.07	-0.36	0.01
Indirect effect	0.01	0.02	.69	-0.03	0.04
Memories retrieved → Recall difficulty	0.16	0.51	.29	-0.46	1.55
Recall difficulty → Eating motivations	0.06	0.03	.66	-0.04	0.07
Food choice motives (FCQ scores)					
Total effect	0.05	0.23	.77	-0.38	0.51
Direct effect					
Memories retrieved → Food choice motives	0.10	0.22	.50	-0.28	0.57
Indirect effect	-0.05	0.08	.34	-0.24	0.08
Memories retrieved → Recall difficulty	0.16	0.51	.29	-0.46	1.55
Recall difficulty → Food choice motives	-0.33	0.06	.03	-0.27	-0.01

Appendix T. *Results of the mediation analyses from Experiment 5 showing direct and indirect effects of the number of healthy eating memories retrieved on participants' perceived dietary healthiness, food choices and motivations after controlling for BMI*

Pathway	**β**	***SE***	***p***	**95% CI**	
				Lower bound	**Upper bound**
Recent healthiness					
Total effect	0.05	0.21	.45	-0.25	0.58
Direct effect					
Memories retrieved → Perceived healthiness	0.26	0.20	< .001	0.39	1.17
Indirect effect	-0.21	0.13	< .001	-0.88	-0.36
Memories retrieved → Recall difficulty	0.40	0.28	< .001	1.09	2.18
Recall difficulty → Perceived healthiness	-0.52	0.05	< .001	-0.47	-0.28
General healthiness					
Total effect	-0.05	0.19	.46	-0.52	0.24
Direct effect					
Memories retrieved → Perceived healthiness	0.14	0.19	< .05	0.00	0.73
Indirect effect	-0.19	0.11	< .001	-0.73	-0.28
Memories retrieved → Recall difficulty	0.40	0.28	< .001	1.09	2.18
Recall difficulty → Perceived healthiness	-0.49	0.05	< .001	-0.40	-0.22
Food choices (PBQ scores)					
Total effect	-0.02	0.19	.84	-0.42	0.34
Direct effect					
Memories retrieved → Food choices	0.11	0.20	.17	-0.12	0.67
Indirect effect	-0.12	0.10	< .01	-0.51	-0.12
Memories retrieved → Recall difficulty	0.40	0.28	< .001	1.09	2.18
Recall difficulty → Food choices	-0.30	0.05	< .001	-0.29	-0.10
Food choice motives (FCQ scores)					
Total effect	0.00	0.09	.96	-0.17	0.17
Direct effect					
Memories retrieved → Food choice motives	0.13	0.09	.08	-0.02	0.33
Indirect effect	-0.14	0.05	< .001	-0.25	-0.07
Memories retrieved → Recall difficulty	0.40	0.28	< .001	1.09	2.18
Recall difficulty → Food choice motives	-0.34	0.02	< .001	-0.14	-0.06

Appendix U. *Results of the mediation analyses from Experiment 5 showing direct and indirect effects of the number of unhealthy eating memories retrieved on participants' perceived dietary healthiness, food choices and motivations after controlling for BMI*

Pathway	**β**	***SE***	***p***	**95% CI**	
				Lower bound	**Upper bound**
Recent healthiness					
Total effect	-0.24	0.22	< .001	-1.22	-0.34
Direct effect					
Memories retrieved → Perceived healthiness	-0.41	0.24	< .001	-1.76	-0.84
Indirect effect	0.16	0.13	< .001	0.26	0.78
Memories retrieved → Recall difficulty	0.46	0.24	< .001	1.22	2.17
Recall difficulty → Perceived healthiness	0.36	0.06	< .001	0.18	0.43
General healthiness					
Total effect	-0.11	0.21	.12	-0.73	0.08
Direct effect					
Memories retrieved → Perceived healthiness	-0.27	0.22	< .001	-1.19	-0.32
Indirect effect	0.15	0.12	< .001	0.20	0.66
Memories retrieved → Recall difficulty	0.46	0.24	< .001	1.22	2.17
Recall difficulty → Perceived healthiness	0.33	0.06	< .001	0.14	0.37
Food choices (PBQ scores)					
Total effect	-0.14	0.20	< .05	-0.78	0.00
Direct effect					
Memories retrieved → Food choices	-0.27	0.21	< .001	-1.14	-0.30
Indirect effect	0.12	0.11	< .01	0.11	0.54
Memories retrieved → Recall difficulty	0.46	0.24	< .001	1.22	2.17
Recall difficulty → Food choices	0.26	0.06	< .001	0.08	0.31
Food choice motives (FCQ scores)					
Total effect	-0.16	0.09	.03	-0.39	-0.02
Direct effect					
Memories retrieved → Food choice motives	-0.19	0.11	.02	-0.45	-0.04
Indirect effect	0.03	0.05	.40	-0.05	0.14
Memories retrieved → Recall difficulty	0.46	0.24	< .001	1.22	2.17
Recall difficulty → Food choice motives	0.07	0.03	.39	-0.03	0.08

Appendix V. *Results of the mediation analyses from Experiment 6 showing direct and indirect effects of the number of healthy eating memories retrieved on participants' perceived dietary healthiness, eating choices and intentions after controlling for BMI*

Pathway	β	*SE*	*p*	95% CI	
				Lower bound	Upper bound
Recent healthiness					
Total effect	0.22	0.20	< .01	0.21	1.01
Direct effect					
Memories retrieved → Perceived healthiness	0.42	0.18	< .001	0.83	1.52
Indirect effect	-0.20	0.13	< .001	-0.82	-0.30
Memories retrieved → Recall difficulty	0.34	0.27	< .001	0.76	1.81
Recall difficulty → Perceived healthiness	-0.59	0.05	< .001	-0.53	-0.35
General healthiness					
Total effect	0.08	0.20	.32	-0.20	0.60
Direct effect					
Memories retrieved → Perceived healthiness	0.24	0.19	< .001	0.26	1.01
Indirect effect	-0.17	0.11	< 0.01	-0.66	-0.22
Memories retrieved → Recall difficulty	0.34	0.27	< .001	0.76	1.81
Recall difficulty → Perceived healthiness	-0.48	0.05	< .001	-0.44	-0.24
Food choices (PBQ scores)					
Total effect	0.21	0.19	< .01	0.16	0.89
Direct effect					
Memories retrieved → Food choices	0.34	0.18	< .001	0.47	1.19
Indirect effect	-0.12	0.09	< .001	-0.48	-0.13
Memories retrieved → Recall difficulty	0.34	0.27	< .001	0.76	1.81
Recall difficulty → Food choices	-0.36	0.05	< .001	-0.34	-0.14
Eating intentions (VPCT scores)					
Total effect	0.17	4.62	.03	1.08	19.20
Direct effect					
Memories retrieved → Eating intentions	0.28	4.66	< .001	7.93	26.19
Indirect effect	-0.11	2.16	< .01	-11.15	-2.69
Memories retrieved → Recall difficulty	0.34	0.27	< .001	0.76	1.81
Recall difficulty → Eating intentions	-0.33	1.25	< .001	-7.85	-2.95

Appendix W. *Results of the mediation analyses from Experiment 6 showing direct and indirect effects of the number of unhealthy eating memories retrieved on participants' perceived dietary healthiness, eating choices and intentions after controlling for BMI*

Pathway	β	*SE*	*p*	95% CI	
				Lower bound	Upper bound
Recent healthiness					
Total effect	-0.06	0.21	.38	-0.60	0.23
Direct effect					
Memories retrieved → Perceived healthiness	-0.23	0.26	< .01	-1.19	-0.17
Indirect effect	0.17	0.17	< .01	0.17	0.83
Memories retrieved → Recall difficulty	0.63	0.24	< .001	2.16	3.10
Recall difficulty → Perceived healthiness	0.27	0.06	< .01	0.07	0.31
General healthiness					
Total effect	-0.01	0.19	.87	-0.39	0.33
Direct effect					
Memories retrieved → Perceived healthiness	-0.10	0.23	.28	-0.71	0.20
Indirect effect	0.09	0.15	.12	-0.06	0.51
Memories retrieved → Recall difficulty	0.63	0.24	< .001	2.16	3.10
Recall difficulty → Perceived healthiness	0.14	0.06	0.12	-0.02	0.19
Food choices (PBQ scores)					
Total effect	0.08	0.18	.29	-0.16	0.53
Direct effect					
Memories retrieved → Food choices	0.08	0.22	.40	-0.25	0.62
Indirect effect	0.00	0.14	1.00	-0.27	0.27
Memories retrieved → Recall difficulty	0.63	0.24	< .001	2.16	3.10
Recall difficulty → Food choices	0.00	0.05	1.00	-0.10	0.10
Eating intentions (VPCT scores)					
Total effect	-0.01	4.11	.90	-8.55	7.56
Direct effect					
Memories retrieved → Eating intentions	0.05	5.20	.57	-7.23	13.16
Indirect effect	-0.06	3.24	.29	-9.80	2.88
Memories retrieved → Recall difficulty	0.63	0.24	< .001	2.16	3.10
Recall difficulty → Eating intentions	-0.10	1.22	.28	-3.72	1.09