IMPLICIT IDENTITY AS A PREDICTOR OF EATING BEHAVIOUR

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Abstract

Despite the importance of healthy eating for physical, mental, and cognitive wellbeing, many people struggle to increase healthy eating and reduce unhealthy eating behaviours. It is therefore crucial to understand the predictors of eating behaviour in order to identify and intervene with individuals who may be at risk of poor health outcomes. Implicit eating-related identity (identification with eating behaviours that is below conscious awareness) was hypothesised be one such predictor. A series of 5 studies were conducted to assess the ability of implicit eating-related identity to predict eating-related behaviours. Studies 1-3 used two Single-Category Implicit Association Tests (SC-IATs) to measure implicit identification with healthy eating and implicit identification with unhealthy eating separately. While Study 1 provided some initial evidence that implicit identity was predictive of eating-related outcomes, this was not replicated in Study 2 or Study 3. Further research was therefore conducted using a different implicit measure. Studies 4-5 used an Implicit Association Test (IAT) to measure implicit identification with healthy eating relative to unhealthy eating, but also failed to find reliable evidence that implicit identity predicts eating-related behaviours. Across the five studies, significant associations between implicit identity and the eating-related outcomes were inconsistent and largely non-significant in both bivariate correlations and regression models. Moderation analyses assessed whether the relationship between implicit identity and eating behaviour is affected by levels of trait self-control or stress. However contrary to hypotheses, self-control and stress did not appear to reliably moderate the relationship between implicit identity and eating behaviour. Thus, implicit identity as measured by both the two Single-Category Implicit Association Tests and the Implicit Association Test does not appear to be a good predictor of eating behaviour. Rather, other predictors – most notably healthy and unhealthy eating habits – appeared to be predictive of eating-related outcomes. Implicit identity may have been better considered at

the context (group) level rather than at the individual level. In addition, the ability of implicit identity to predict behaviour may have been reduced by individual differences in how healthy and unhealthy eating are defined or by a need for greater measurement correspondence. Further research is needed to investigate these possibilities.

Chapter 1: Introduction

Eating a healthy diet (a diet low in sugar, saturated fats, and salt, and high in fibre, fruit, and vegetables) has been associated with health benefits in multiple domains including reduced risk of obesity and non-communicable diseases, better emotional wellbeing, and improved cognitive functioning (e.g. Kulkarni et al, 2015; Lee et al., 2015; Schwingshackl & Hofmann, 2015). Despite the physical benefits being typically well-known, many people struggle to eat a healthy diet (Ministry of Health, 2020; Office of Disease Prevention and Health Promotion, 2017; University of Otago and Ministry of Health, 2011). It is crucial to understand the predictors of eating behaviour in order to identify individuals who may be at risk of poor health outcomes and to design interventions to increase healthy eating and reduce unhealthy eating. Theoretically, health-related behaviours can be influenced by both explicit and implicit processes (Hofmann et al., 2008). Although the role of explicit processes has been widely studied in the past, the role of implicit processes in predicting eating behaviour is less clear. One implicit variable which has been researched in a variety of domains, but is yet to be studied in relation to eating behaviour, is implicit identity.

This thesis will discuss a series of five studies that were conducted to assess the ability of implicit eating-related identity to predict eating-related behaviours. In this introductory chapter, I will first define healthy and unhealthy eating and discuss why the prediction of eating behaviours is important. I will then discuss why implicit identity may be a useful predictor of eating behaviour and why research in this area is needed. I will define the concepts of identity and implicit identity, explain how implicit identity is measured, and summarise evidence suggesting that implicit identity may be able to predict eating behaviour. I will then outline several established predictors of eating behaviour as well as limitations of these predictors and discuss why it is also important to consider implicit predictors such as implicit identity. Finally, I will explain the aims and structure of this thesis.

Definitions of Healthy and Unhealthy Eating

There is no exact definition of what a healthy diet looks like; however, most healthy eating recommendations provided by Western governments and health organisations share similar features. In general, there is a focus on increasing consumption of fruits, vegetables, lean sources of protein, and high-fibre foods and on limiting intake of sugar, salt, and saturated fats (Department of Health, 2015, 2017; Health Canada, 2019; Ministry of Health, 2020; Office of Disease Prevention and Health Promotion, 2017; Public Health England, 2016a, 2016b; World Health Organization, 2017a, 2017b, 2017c, 2020a). Many guidelines also focus on consuming a variety of foods in order to meet nutritional requirements (Ministry of Health, 2020; World Health Organization, 2020a). Based on these guidelines, this thesis will define a healthy diet as one which is largely based around fruits, vegetables, wholegrains, and lean sources of protein. Conversely, an unhealthy diet is defined as one which contains large amounts of sugar, salt, saturated fats, and highly processed foods.

Many forms of disordered eating have been identified and researched. Diagnosable eating disorders include anorexia nervosa, bulimia nervosa, and binge-eating disorder (American Psychiatric Association, 2013). People may also experience forms of disordered eating that do not constitute an eating disorder diagnosis, such as emotional eating or restrained eating (Frayn et al., 2018; Herman & Mack, 1975). This thesis will not investigate or discuss predictors of disordered eating, but instead will focus on predictors of general healthy and unhealthy eating behaviours (e.g. consumption of fruits and vegetables, consumption of high-fat foods).

Importance of Healthy Eating

Eating a healthy diet has been associated with health benefits in three key domains: physical health, mental health, and cognitive functioning.

Physical Health and the Obesity Epidemic

One domain of wellbeing that is predicted by eating behaviour is physical health. Unhealthy eating patterns, including overconsumption of foods high in fat, salt, and sugar, are associated with an increased risk of obesity (Bray & Popkin, 1998; Fabricatore & Wadden, 2006; Johnson et al., 2007; World Health Organization, 2020b; Zhou et al., 2019). The World Health Organization has described obesity as a “rising epidemic” and as “a major contributor to the global burden of chronic disease and disability” (World Health Organization, 2000, p.1). Alarmingly, obesity rates have almost tripled since 1975 and currently over 650 million adults are estimated to be obese worldwide (World Health Organization, 2020b). In New Zealand the prevalence is 30.9% among those aged 15 and above, with rates even higher among Māori and Pacific adults (Ministry of Health, 2019b). Obesity is associated with increased risk of many noncommunicable diseases, including cancer, cardiovascular disease, Type 2 diabetes, hypertension, osteoarthritis, asthma, and gout (Blüher, 2019; Dixon, 2010; Fabricatore & Wadden, 2006; Stroebe, 2008; World Health Organization, 2020b). For example, a prospective cohort study of 28,129 obese individuals found that obesity increased the risk for a variety of different cancers relative to prevalence rates in the general population (Wolk et al., 2001), and obesity has been identified as a risk factor for cancer even in the absence of metabolic dysfunction (Lin et al., 2020). Nguyen et al. (2011) found that the prevalence of Type 2 diabetes increased with BMI classification, while another study found that cumulative exposure to obesity over a 19-year period was a risk factor for Type 2 diabetes (Luo et al., 2020). Obesity has also been found to predict all-cause mortality (Aune et al., 2016; Dixon, 2010; Stroebe, 2008).

Recently, obesity has been linked to worse outcomes from the Covid-19 epidemic. Studies from multiple countries have found worse outcomes in Covid-19 patients with overweight and obesity compared to normal-weight patients (Busetto et al., 2020; Cai et al., 2020; Popkin et al., 2020; Richardson et al., 2020). A meta-analysis of 75 studies on obesity and Covid-19 outcomes found that obesity is a risk factor for a positive Covid-19 diagnosis as well as for hospitalization, intensive care unit (ICU) admission, and death resulting from Covid-19 (Popkin et al., 2020). Obesity-related conditions such as Type 2 diabetes, hypertension, and cardiovascular disease have also been associated with worse outcomes from Covid-19 (Nadolsky et al., 2020).

In contrast, healthy eating patterns are associated with reduced risk of obesity and noncommunicable diseases such as cancer, Type 2 diabetes, and heart disease, as well as with increased life expectancy (Arem et al., 2013; Cespedes et al., 2016; Esposito & Giugliano, 2014; Farvid & Chen, 2016; Hariri et al., 2017; Mourouti et al., 2015; Onvani et al., 2017; Sun et al., 2016; Theodoratou, 2013). A meta-analysis of 15 cohort studies by Schwingshackl and Hoffmann (2015) found that high-quality diets are associated with decreased risk of all-cause mortality (by 22%), cardiovascular disease (by 22%), cancer (by 15%), and Type 2 diabetes (by 22%). As well as protecting against non-infectious diseases such as cancer, healthy eating can also protect against infectious diseases through improving immune system functioning (Genoni et al., 2014; Murphy et al., 2017; Myles, 2014). While unhealthy eating is a risk factor for obesity and poor health, healthy eating is associated with better health outcomes.

Mental Health and Wellbeing

A second domain of wellbeing that is predicted by healthy eating is mental health. Eating a healthy diet has been linked to the promotion of positive moods and prevention against mood and other mental disorders (Fabricatore & Wadden, 2006; Hoare et al., 2014; Jacka et al., 2010; Khalid et al., 2016; Kohlboeck et al., 2012; Kulkarni et al., 2015; Lee et al., 2015; Malt et al., 2008; Nanri et al., 2010; Oddy et al., 2009; Samieri et al., 2008; Sánchez-Villegas et al., 2012). For example, Conner et al. (2015) found that young adults reported higher levels of wellbeing on days when they consumed more fruits and vegetables, while Nanri et al. (2010) found that a healthy diet was associated with fewer depressive symptoms. Other research has found that giving fruits and vegetables to young adults with low fruit and vegetable intake is associated with improvements in self-reported wellbeing (Conner et al., 2017). This may be because a healthy diet provides the brain with the nutrients it needs for optimum functioning, thus supporting good mental health and wellbeing (Rucklidge et al., 2021).

Obesity, which is associated with unhealthy eating patterns, predicts lower quality of life (Jia & Lubetkin, 2005; Pimenta et al., 2015). Obese individuals often face social stigma and blame for their weight and may be subject to discrimination resulting from negative stereotypes about obesity (Puhl & Brownell, 2001; Puhl & Heuer, 2010). This stigma can impact individuals in many different areas of life, including at work, in the healthcare system, and in interpersonal relationships (Puhl & Brownell, 2001; Puhl & Heuer, 2010). As a result of this stigma, obese individuals are at risk for negative outcomes such as depression and low self-esteem (Hackman et al., 2016; Hatzenbuehler et al., 2009; Puhl & Brownell, 2001). Stigma-induced stress can result in negative health outcomes and may be at least partially responsible for the link between obesity and disease (Muennig, 2008; Tomiyama et al., 2018). Weight stigma may even increase the risk of obesity, creating a negative cycle which places individuals at even greater risk of poor outcomes (Tomiyama et al., 2018).

Cognitive Functioning

As well as improved physical and mental health, a third benefit of healthy eating is improved cognitive functioning, including increased concentration and academic performance and reduced risk of dementia (Cohen et al., 2016; Florence et al., 2008; Haapala et al., 2015; Henriksson et al., 2017; Lee et al., 2015; Nijholt et al., 2016; Yusufov et al., 2017). For instance, switching to a Mediterranean diet – characterised by high intake of fruits and vegetables, wholegrains, and legumes – was associated with increased alertness and memory (Lee et al., 2015). In a study comparing diet and cognitive performance in adults with Alzheimer's disease, mild cognitive impairment, or healthy controls, lower vegetable intake was associated with poorer cognitive performance in the total sample (Fieldhouse et al., 2020). Among the subset of participants with Alzheimer's disease, lower adherence to dietary guidelines was associated with poorer performance on memory tests (Fieldhouse et al., 2020). Consuming a healthy, balanced diet is therefore recommended to help prevent against cognitive decline (World Health Organization, 2019).

Rates of Healthy and Unhealthy Eating

Despite these known benefits of healthy eating and risks of unhealthy eating, many people do not eat a healthy diet or follow government dietary recommendations (Ministry of Health, 2020; Office of Disease Prevention and Health Promotion, 2017; University of Otago and Ministry of Health, 2011). For example, a 2008/9 nutrition survey of 4,721 New Zealanders aged 15 and above assessed self-reported eating patterns and found that on average adults consumed a higher than recommended amount of saturated fat, sugary drinks, and processed meat (Ministry of Health, 2020; University of Otago and Ministry of Health, 2011). Saturated fat intake had declined since 1997 but still made up 13.1% of daily energy intake for both males and females, higher than the recommendation of 10% or less (Ministry of Health, 2020; University of Otago and Ministry of Health, 2011). Despite recommendations to avoid processed meat, 41.8% reported eating processed meat 1-2 times per week and 20.4% reported eating processed meat 3-4 times per week (University of Otago and Ministry of Health, 2011). The survey also identified that approximately 40% of males and 28% of females did not consume the recommended 3 servings of vegetables a day and that this had not changed since a previous 1997 survey, although the proportion of people eating the recommended 2 servings of fruit a day had increased since 1997 (University of

Otago and Ministry of Health, 2011). The 2018/19 New Zealand Health Survey of 13,752 New Zealanders aged 15 and above found that only one third of participants reported consuming the recommended amounts of both fruit and vegetables and that this had decreased since 2011/12 (Ministry of Health, 2019b). The proportion of adults consuming the recommended fruit and vegetable servings was higher among participants who identified as European/Other (35.3%) and lower among those identifying as Māori (28%), Pacific (26.4%), and Asian (21.5%) (Ministry of Health, 2019b). According to the World Health Organization (2017c), 1.7 million deaths worldwide each year can be attributed to low fruit and vegetable consumption alone. Thus, many people around the world – including in New Zealand - are at risk of negative outcomes resulting from an unhealthy diet. The World Health Organization recommends that individuals be supported to follow healthy eating recommendations in order to reduce the disease burden of obesity (World Health Organization, 2020b). Therefore, there is a need to understand what factors predict the consumption of healthy and unhealthy diets in order to identify at-risk individuals and to inform healthy eating interventions.

Implicit Identity as a Predictor of Eating Behaviour

Many different variables have been identified as predictors of eating behaviours, including social cognition models such as the Theory of Planned Behaviour (Ajzen, 1991; Ajzen & Madden, 1986); individual difference variables such as personality (Weston et al., 2020); and demographic factors such as income (Puddephatt et al., 2020). More recently, research has begun to investigate the influence of implicit variables, which are believed to operate subconsciously to affect behaviour (Evans, 2008; Hofmann et al., 2008; Sheeran et al., 2013; see section on Implicit Identity). One implicit variable which has been researched in a variety of domains, but is yet to be studied in relation to eating behaviour, is implicit identity. In this section I will define the concepts of identity and implicit identity and explain how implicit identity is measured. I will then discuss why research on implicit identity as a predictor of eating behaviour is needed.

Definition of Identity

In identity theories, identity refers to how a person sees themselves with reference to certain situations and social roles (Burke & Stets, 2009; Schwartz et al., 2011; Stryker, 2007; Stryker & Burke, 2000). People gain identities (e.g. father, mother, teacher, artist) through their culture, socialization processes, and their perceptions of how others see them, and these identities are strengthened through social networks (Burke & Stets, 2009; Schwartz et al., 2011; Stryker, 2007; Walker & Lynn, 2013). Each person has multiple identities which differ in importance to the individual as well as in salience in different situations (Brenner et al., 2014; Burke & Stets, 2009; Schwartz et al., 2011; Stryker, 2007; Stryker & Burke, 2000). People can also have "possible identities", or identities they would like to hold in the future, which can influence their current goals and actions (Schwartz et al., 2011). An identity comes with certain behavioural standards, and people are motivated to behave in accordance with these standards in order to confirm their identity (Burke, 2006; Burke & Stets, 2009; Schwartz et al., 2011; Stryker & Burke, 2000). For instance, research has shown that individuals with a high identity for exercise report more exercise behaviours, and individuals with a high identity for healthy eating report more healthy eating behaviours, compared to individuals who do not see themselves as exercisers or healthy eaters (Strachan & Brawley, 2008). In response to a challenge to their identity (from reading a vignette about failing to perform their usual identity-consistent behaviours), high-identity participants reported more negative affect and less positive affect (Strachan & Brawley, 2008). They also reported stronger intentions to behave consistently with their identity in the future (Strachan & Brawley, 2008). This finding supports identity as a predictor of behaviours, including eating behaviours, and illustrates how failure to behave in an identity-consistent manner leads to negative affect and increases the likelihood of behaving in accordance with one's identity in the future.

Identity is usually measured through self-report questionnaires, such as asking participants to rate on a scale their level of agreement with statements like "I am someone who eats in a nutritious manner" (Blake et al., 2013). A meta-analysis on identification with a range of different behaviours found that self-reported (explicit) identity towards a behaviour can account for 9% of the variance in intentions to perform that behaviour, even after controlling for past behaviour, attitudes, subjective norms, and perceived behavioural control (Rise et al., 2010). This suggests that explicit identity makes a significant independent contribution to predicting behaviour that goes above and beyond the influence of other, well-established, predictors. Explicit identification with a behaviour has been found to predict both intentions to perform that behaviour and actual performance of the behaviour in areas such as speeding, environmental activism, recycling, addiction recovery, alcohol consumption, and exercise (Buckingham et al., 2013; Elliott, 2010; Fielding et al., 2008; Foster et al., 2014; Nigbur et al., 2010; Rhodes et al., 2016; Schutte & McNeil, 2015; Strachan & Brawley, 2009).

Research on self-reported identity has provided evidence for an association between identity and eating behaviour (Allom & Mullan, 2012; Blake et al., 2013; Carfora et al., 2016b; Carfora et al., 2017; Johnson, 2011; Malek et al., 2017; McCarthy et al., 2017). For instance, Carfora et al. (2016b) measured components of the Theory of Planned Behaviour (attitudes, subjective norms, perceived behavioural control, and behavioural intentions) as well as explicit identity and self-reported past behaviour. Four weeks later they measured fruit and vegetable intake over the past month. Identity predicted fruit and vegetable intake directly as well as indirectly through intentions (Carfora et al., 2016b). In another study, Strachan and Brawley (2009) found that self-reported healthy eater identity was a significant predictor of fruit and vegetable consumption measured two weeks later. However, self-reported healthy eater identity did not predict junk food consumption; it may be that identity as a healthy eater only predicts the consumption of healthy foods and not abstinence from unhealthy foods. This suggests that identity measures only predict behaviours that directly correspond to that aspect of identity.

Implicit Identity

In addition to self-reported (explicit) identity, implicit identity has also been identified as a behavioural predictor. While explicit identity refers to how a person consciously perceives themselves, implicit identity refers to self-perceptions and identities that are below the level of conscious awareness (Frings et al., 2016; Schwartz et al., 2011). According to dual-process theories, behaviour is under the influence of two distinct systems: an explicit system, which works slowly to generate controlled, rational decisions and an implicit system, which works quickly and is based on patterns of cognitive associations developed through experience (Evans, 2003, 2008; Greenwald & Banaji, 1995; Hofmann et al., 2008; Sheeran et al., 2013; Strack & Deutsch, 2004). Which system successfully produces behaviour depends on the relative strength of activation from each system, as well as situational and dispositional moderators such as trait self-control, working memory capacity, habit strength, and cognitive load (Hofmann et al., 2008). The implicit system is believed to work automatically and unconsciously, meaning that people are largely unaware of cognitions, emotions, and motivations that are processed via the implicit system (Evans, 2008; Hofmann et al., 2008; Sheeran et al., 2013). It is important to note that the explicit system does not necessarily produce “correct” responses, nor does the implicit system always produce “incorrect” responses; for instance, the reflective system could be operating based on faulty rules (Evans & Stanovich, 2013). There is some disagreement between theories as to the exact nature of the systems and the ways that they work together. For instance, some theorists believe that the two systems operate at the same time, whereas others argue that the implicit system is the default process unless overridden by the explicit system (Evans & Stanovich, 2013; Smith & de Coster, 2000). Despite these differences, overall there is considerable support for the existence of two distinct forms of processing (Evans & Stanovich, 2013). Thus, while explicit identity refers to conscious self-perceptions that a person is aware of and able to report, implicit identity can be seen as automatic cognitive associations between the self and other concepts that have developed through repeated patterns of mental activation and that a person may be unaware of (Greenwald et al., 2002; Strack & Deutsch, 2004).

A range of different terms are used to describe these two systems (Greenwald & Banaji, 1995; Strack & Deutsch, 2004). In this thesis, the terms 'implicit' and 'explicit' will be used to differentiate between the two systems. Thus, explicit eating-related identity refers to identification with healthy or unhealthy eating that participants are consciously aware of and able to report. Implicit eating-related identity refers to automatic cognitive associations between the self and healthy or unhealthy eating that people are not consciously aware of.

Measurement of Implicit Identity

Identity IAT. Implicit identity is usually measured with an identity Implicit Association Test (IAT). The IAT is a computer task which was originally designed to measure implicit attitudes (positive or negative evaluations) using response times and error rates (Greenwald et al., 1998). In an IAT participants use two response keys to rapidly categorise items as belonging to one of two opposing categories and one of two evaluative dimensions, and in an identity IAT these evaluative dimensions are 'self' (or 'me') and 'others' (or 'not me') (Nosek et al., 2002). Stimuli related to the target categories and evaluative dimensions appear onscreen one at a time and participants are instructed to press the correct response key for each word as quickly and accurately as possible. At first, one category and evaluative dimension are paired on one response key, and the other category and evaluative dimension are paired on a second response key. The category and evaluative dimension pairings are then switched halfway through the task. The IAT assumes that it is easier to respond when the category and evaluative dimension that are strongly associated with each other are paired on the same response key, and that responses on these trials will be faster and more accurate than when the paired category and evaluative dimension are weakly associated. For example, Stout et al. (2011) used an identity IAT to measure implicit identification with maths. In this IAT the opposing categories were 'math' and 'English' and the evaluative dimensions were 'me' and 'not me'. The IAT blocks, which were counterbalanced across participants, were math + me/English + not me and math + not me/English + me. Faster and more accurate responses when 'math' and 'me' were paired on one response key and 'English' and 'not me' were paired on another response key indicated stronger implicit identification with math compared to English.

This thesis used the same method to measure implicit identification with healthy and unhealthy eating. In this case the opposing categories were 'healthy eating' and 'unhealthy eating', while the evaluative dimensions were 'self' and 'others'. If a person categorised 'healthy food' and 'self' items faster and more accurately when they were paired on the same response key compared to when 'unhealthy food' and 'self' were paired on the same response key, this indicated stronger implicit identification with healthy food than with unhealthy food.

Reliability and Validity of the IAT. The majority of research on the reliability and validity of the IAT has used the original form of the IAT, which measures implicit attitudes instead of implicit identity. This research generally supports the IAT as a valid and useful measure of implicit attitudes. Importantly, research has shown that IAT scores measure constructs that are related to – but different from – explicit measures (Hofmann et al., 2005; Nosek, 2005; Nosek & Smyth, 2007). For example, Nosek and Smyth (2007) administered

IATs along with self-report (explicit) attitude scales measuring attitudes towards a variety of targets (e.g. flowers/insects, Democrats/Republicans, humanities/science). Data analysis comparing a series of structural equation models found that a model specifying implicit and explicit attitudes as correlated but distinct factors was the best fit for the data (Nosek & Smyth, 2007).

Although implicit measures such as the IAT are generally seen as resistant to self-presentation bias, it is possible that some people may work out the purpose of the measure and be able to alter their responses, such as by purposefully responding more slowly on certain trials (Kim, 2003). However, research suggests that participants are generally unable to fake responses on the IAT unless they are explicitly taught how to do this (Asendorpf et al., 2002; Banse, 2001; Kim, 2003). The finding that the IAT is resistant to faking supports the assumption that it measures subconscious, automatic, and uncontrollable processes. IAT scores are therefore believed to reflect genuine implicit responses.

Scores on the original (attitudes) IAT are significant predictors of a variety of behaviours, supporting the predictive validity of the IAT (Greenwald et al., 2009; Kurdi et al., 2019; but see also Oswald et al., 2013). For example, a field study by Agerström and Rooth (2011) found that implicit attitudes towards obesity were associated with workplace hiring decisions. The researchers submitted job applications to real job vacancies. Two applications were submitted to each vacancy, one including a picture of an obese individual and one including a picture of a normal-weight individual. Several months later, after the hiring decisions had been made, the hiring managers were asked to complete an obesity IAT as well as self-report measures on hiring preferences. IAT scores, but not self-reported hiring preferences, predicted which applicants had been invited for a job interview. Specifically, managers who held negative implicit attitudes towards obesity were less likely to have invited the obese applicant for an interview (Agerström & Rooth, 2011). However, it should be noted that the extent to which the IAT predicts real-world behaviour is a subject of debate within the literature.

In the domain of eating behaviour research, several studies have found that implicit attitudes towards foods, as measured by the IAT, can predict eating behaviours (Goldstein et al., 2014; Houben et al., 2010, 2012; Mai et al., 2015; Prestwich et al., 2011). For example, de Bruijn et al. (2012) gave participants an IAT measuring positive and negative attitudes towards fruits and utensils. Participants also completed self-report measures on fruit consumption habit strength and on typical fruit intake. Positive implicit attitudes towards fruit were associated with a higher self-reported intake of fruits (de Bruijn et al., 2012). Pavlović et al. (2016) conducted two studies in which participants completed an IAT measuring implicit attitudes towards sweets and fruits, as well as self-report measures of explicit attitudes. In the first study, participants who held more positive implicit attitudes towards sweets (relative to fruits) consumed more chocolate in a taste-test paradigm; however, explicit attitudes were not associated with chocolate consumption. In the second study, IAT scores predicted intake of fruits and sweets as measured by a food diary.

Predictive Ability of the Identity IAT. This modification of the IAT to measure implicit identity has also been found to predict a range of behaviours, including political policy preference (Hawkins & Nosek, 2012); criminal behaviour (Rivera & Veysey, 2018); spontaneous shy behaviours (Asendorpf et al., 2002); personality-consistent behaviours (Back et al., 2009); and self-harm (Banaji & Nock, 2007). For instance, Egloff and Schmukle (2002) developed an identity IAT to measure self-identity with anxiety using stimuli related to the self (e.g. ‘me’), others (e.g. ‘they’), anxiety (e.g. ‘nervous’), and calmness (e.g. ‘relaxed’). Participants who showed stronger implicit associations between ‘self’ and ‘anxiety’ were rated as appearing more anxious after receiving negative feedback on a performance test. They also showed a greater decrease in performance on the test after receiving the negative feedback compared to participants who did not implicitly identify with anxiety (Egloff & Schmukle, 2002). In another study, Perugini and Leone (2009) used an identity IAT with the categories ‘me’, ‘others’, ‘moral’, and ‘immoral’ to measure moral self-identification. Explicit measures included a self-report questionnaire measuring morality and items measuring socially desirable responding. IAT scores, but not the explicit measures, predicted whether participants cheated when reporting the outcome of a dice roll and whether they gave back an undue lottery ticket (Perugini & Leone, 2009).

Implicit Identity as Predictor of Health Behaviours

The majority of implicit identity research in domain of health psychology has focused on alcohol consumption. Two types of IAT have been used to study implicit identity in this area. The Alcohol Identity IAT compares responses to the target categories of ‘alcohol’ and ‘non-alcohol’ using pictures of alcoholic beverages and water as stimuli, while the Drinker Identity IAT compares responses to the target categories of ‘drinker’ and ‘non-drinker’ using words such as ‘drinker’ and ‘sober’ as stimuli (Gray et al., 2011; Lindgren et al., 2017; Lindgren, Neighbors, et al., 2013).

Although less research has been conducted using the Alcohol Identity IAT, there is support for its ability to predict drinking-related outcomes (Lindgren et al., 2017). Gray et al. (2011) administered this measure to 141 undergraduate students, then measured self-reported risky drinking behaviours 3 and 6 months later. Controlling for gender and baseline alcohol consumption, baseline IAT scores were positively associated with risky drinking behaviours at 3 and 6 months. Caudwell and Hagger (2014) also used the Alcohol Identity IAT, along with a survey on pre-drinking motives, to predict self-reported alcohol consumption and alcohol-related harm. Contrary to hypotheses, the IAT did not predict the amount of alcohol typically consumed during a pre-drinking session; however, it did predict alcohol-related harm. The authors concluded that the IAT, which measures general implicit associations with alcohol, may not have been specific enough to predict typical pre-drinking consumption of alcohol (Caudwell & Hagger, 2014).

More research has been conducted using the Drinker Identity IAT, and this research generally supports the measure's predictive ability (Lindgren et al., 2017). Lindgren, Neighbors, et al. (2013) administered 5 alcohol-related implicit measures, including the Drinker Identity IAT, to a sample of 300 undergraduate students. They also measured a variety of explicit predictors, including explicit identity. Outcome measures were self-reported typical drinking, alcohol-related problems, and alcohol cravings. Participants completed all measures in one session, and a subset of the sample were invited to return a week later to complete the measures again in order to assess test-retest reliability. Of the alcohol-related implicit measures, the Drinker Identity IAT had the strongest correlations with all outcome measures and also had the highest internal consistency and test-retest reliability scores. The Drinker Identity IAT predicted all three outcome measures even after controlling for explicit identity. In another study, Lindgren, Foster, et al. (2013) administered the Drinker Identity IAT and two other implicit measures (alcohol approach and alcohol coping) to 243 undergraduate students. Drinker Identity IAT scores predicted the outcomes of self-reported alcohol use, alcohol-related problems, and risk for an alcohol use disorder, even after controlling for gender and the other implicit measures. Several other studies have also found the Drinker Identity IAT to predict drinking-related outcomes (Frings et al., 2016; Lindgren, Gasser, et al., 2016; Lindgren, Neighbors, et al., 2016; Lindgren et al., 2015; Montes et al., 2018).

However, some studies have found mixed results. In two studies using undergraduate student samples, Janssen et al. (2018) found that implicit drinker identity was positively associated with alcohol consumption and risk of an alcohol use disorder. However, in Study 2, when participants were followed up after 3 months, implicit drinker identity did not predict time 2 consumption or risk after controlling for baseline consumption. This is in contrast to the findings of Gray et al. (2011) using the Alcohol Identity IAT, who did find significant prediction of drinking outcomes even after controlling for baseline consumption. These different findings may reflect differences in the type of implicit measure used or in the outcome measures used in the two studies. Further research is needed to clarify whether implicit identity is a useful predictor of drinking outcomes after considering prior behaviour.

Implicit Identity and Eating Behaviour

There is very little research examining the influence of implicit food-related identity on eating behaviours. One study by Eschenbeck et al. (2016) examined the relationship between implicit identification with healthy and unhealthy foods, distraction, and food choice. After completing an identity IAT for healthy and unhealthy food and questions on food preferences and usual diet, participants completed two food-related tasks. First, participants completed a taste test for soft drinks versus water under conditions of high distraction, and secondly participants completed a snack choice (fruit or an unhealthy snack) under conditions of low distraction. In the snack choice, where participants were not distracted, only the explicit measures predicted snack choice; in the taste test, when participants were distracted, only implicit identity predicted drink consumption. The authors suggested that implicit measures are most predictive of food and beverage consumption when individuals are distracted and so less likely to consciously think about their choices. However, there are several problems with this study. For instance, all participants completed the activities in the same order without counterbalancing. Which food choice measure was paired with each distraction condition was also not counterbalanced. In addition, this study used a laboratory situation which may not generalise to behaviour in everyday situations or to a greater variety of foods and drinks.

Two further studies have looked at implicit identification and obesity. Craeynest et al. (2006) compared implicit identification with high- and low-fat foods in obese and normal-weight children. Children without obesity showed stronger implicit identification with low-fat foods compared to high-fat foods, while children with obesity did not show a significant difference in the strength of implicit identification with high- and low-fat foods. While this study found an association between weight and implicit identity, it did not look specifically at eating behaviours. Another study by Carels et al. (2011) found that among obese individuals taking part in a weight loss program, implicit identification with thinness predicted less weight loss at week 6. Individuals who implicitly identified as thin may have been less motivated to engage in weight loss strategies. However, this study looked at weight loss as an outcome, rather than examining specific eating behaviours.

There is a current lack of research on the relationship between eating-related implicit identity and eating behaviours. However, as previously discussed, explicit (self-reported) identity has been identified as a significant predictor of eating behaviour. In addition, given that research supports implicit attitudes as a predictor of healthy and unhealthy eating, it seems likely that other implicit variables – such as implicit identity – would also be associated with eating-related behaviours. Research is therefore needed to examine whether implicit identity is indeed able to predict eating behaviours.

It is important to note that health behaviours such as eating can be differentiated into two categories: performance of health-promoting behaviours and avoidance of health-compromising behaviours (Conner & Norman, 2005). Eating behaviour encompasses both of these categories. Healthy eating involves both choosing health-promoting foods and avoiding health-compromising foods (McDermott, Oliver, Svenson, et al., 2015). Conversely, an unhealthy diet can involve both overconsumption of health-compromising foods and insufficient consumption of health-promoting foods. Predictors of health-promoting and health-compromising behaviours can differ (Azeredo et al., 2016; Strachan & Brawley, 2009). For example, McDermott, Oliver, Svenson, et al. (2015) found that PBC is a stronger predictor of consuming health-promoting foods than avoiding health-compromising foods, possibly indicating that people's perceptions of their control are less accurate for the behaviour of avoiding health-compromising foods than for consuming health-promoting foods. Research is therefore needed to assess the ability of implicit identity to predict both healthy and unhealthy eating-related behaviours.

Summary

To summarise, implicit identity refers to cognitive associations between the self and other concepts which are unable to be consciously reported. Implicit identity has been shown to predict behaviour in a range of domains, including health behaviours such as alcohol consumption, but there has been little research on implicit identity and eating. Nevertheless, it seems likely that implicit identity would be a useful predictor of eating behaviours. Implicit attitudes have been shown to predict eating behaviours, indicating that implicit variables are able to predict eating. In addition, self-reported identity has been shown to predict eating outcomes; however, these measures may not capture aspects of identity that are below conscious awareness. Research is therefore needed to assess whether implicit eating-related identity is indeed a significant predictor of healthy and unhealthy eating behaviours.

Self-Report Predictors of Eating Behaviour

In this section I will discuss why implicit identity may be able to improve the prediction of healthy and unhealthy eating over and above the explanatory ability of established predictors of eating behaviour. I will first summarise several well-established predictors of eating behaviour. I will then outline limitations of these predictors and explain how including implicit identity as a predictor may help overcome these limitations and extend our understanding of eating behaviour.

Attitudes

Attitudes refer to people's positive or negative evaluations of a behaviour; people are more likely to perform a behaviour if they feel positively about it (Ajzen, 1991; Ajzen & Madden, 1986). Attitudes are typically studied as part of the Theory of Planned Behaviour (TPB), a social cognition theory which includes attitudes, subjective norms, perceived behavioural control, and behavioural intentions as predictors of behaviour (Ajzen, 1991; Ajzen & Madden, 1986). In this theory, attitudes, norms, and perceived behavioural control predict intentions, while intentions and perceived behavioural control are direct predictors of behaviour. Attitudes have been identified as a predictor of a range of eating-related intentions, including intention to consume fruit (Blanchard et al., 2009; Canova et al., 2020); intention to eat novel foods (Menozzi et al., 2017); intention to engage in healthy eating (Conner et al., 2002; Louis et al., 2007; Povey et al., 2000); intention to consume fast food (Dunn et al., 2011); and intention to adhere to food group recommendations (Malek et al., 2017). A systematic review of 22 studies found that the average correlation between attitudes and dietary intention was 0.61 (McDermott, Oliver, Simnadis, et al., 2015). Attitudes have also been shown to directly predict fruit and vegetable intake (Noia & Cullen, 2015).

Subjective Norms

Subjective norms, another predictor within the TPB, refer to whether a person believes significant others support a certain behaviour (Ajzen, 1991; Ajzen & Madden, 1986). According to the theory, people are more likely to perform a behaviour if they believe that their friends and family think they should do so (Ajzen, 1991; Ajzen & Madden, 1986). As with attitudes, subjective norms are typically studied as a predictor of behavioural intentions within the TPB and predict a range of eating-related intentions including intention to consume fruit (Canova et al., 2020); intention to consume fast food (Dunn et al., 2011); intention to eat healthily (Louis et al., 2007; Povey et al., 2000); and intention to adhere to food group recommendations (Malek et al., 2017). A systematic review of 22 studies found that the average correlation between subjective norms and dietary intention was 0.35 (McDermott, Oliver, Simnadis, et al., 2015). Subjective norms have also been found to directly predict fruit and vegetable intake (Stok et al., 2015; Wengreen et al., 2017).

Habit

A behaviour becomes habitual when it has been repeatedly performed in the presence of a cue until it becomes an automatic response to that cue (Orbell & Verplanken, 2010; Riet et al., 2011; Verplanken & Orbell, 2003). Forming habits can help increase desirable behaviours such as healthy eating by making them automatic, which increases the performance of the behaviour even when cognitive resources such as willpower are depleted; however, if an undesirable behaviour such as unhealthy eating becomes a habit, this can make the behaviour harder to resist (Lin et al., 2016; Neal et al., 2013; Neal et al., 2011). In addition, habitual behaviours are less affected by short-term changes to goals and rewards (Wood & Rünger, 2016). On average there is a moderate to strong correlation between dietary habits and the corresponding behaviour (Gardner et al., 2011). Several studies have found that fruit consumption habit predicts both intentions to consume and consumption of fruit (Brug et al., 2006; de Bruijn, 2010; de Bruijn et al., 2007; de Vries et al., 2014). Habit strength has also been linked to caloric intake from unhealthy snacks (Verhoeven et al., 2012); saturated fat intake (de Bruijn et al., 2008); meat consumption (Rees et al., 2018); and soft drink consumption (de Bruijn & van den Putte, 2009; Judah et al., 2020).

Although habits share some features, such as automaticity, with implicit predictors, they can be seen as a separate mechanism that is different to other implicit processes due to their representation in procedural memory (Riet et al., 2011; Squire & Zola-Morgan, 1991; Verplanken & Orbell, 2003; Wood & Rünger, 2016). That is, habits refer to an automatic behaviour in response to a cue, while implicit predictors such as implicit identity refer to automatic patterns of cognitive association. In addition, habits are typically assessed via self-report measures (Wood & Rünger, 2016), which means that they are subject to several of the same limitations as self-reported explicit predictors. Consequently, habit strength will not be categorised as an implicit predictor in this thesis.

Limitations of Self-Report Measures

As discussed, there are several known and well-researched predictors of eating behaviour, including self-control, habit strength, attitudes, and subjective norms, as well as explicit identity, which are typically measured using self-report questionnaires. However, these variables are far from perfect predictors of behaviour. For example, the Theory of Planned Behaviour is generally accepted as one of the best social cognition models but explains less than half the variance in behaviour (Armitage & Conner, 2000; Li et al., 2019; McDermott, Oliver, Simnadis, et al., 2015; Ogden, 2003; Sutton, 1998). It is true that even a small effect size can have a significant effect on behavioural outcomes (Sutton, 1998), but there are still large gaps in the prediction of behaviour. There are several issues with these known predictors of behaviour that likely reduce their predictive ability.

Differences in Meaning. One issue is that people may differ in what they mean when they report on a variable such as identity. Ridner et al. (2010) illustrated this problem when they found that 20% of people who reported that they identify as a non-smoker also reported having smoked during the past month, which is different to how medical professionals define a non-smoker. Other research has also found discrepancies between self-reports of identity and behaviour (Choi et al., 2010; Igartua & Thombs, 2009; Waters et al., 2006). This could conceivably also be an issue in eating research; when asking people if they self-identify as a healthy eater, people could have varying ideas of what being a healthy eater is. If people have different beliefs about what an identity or other construct means, this could lead to reduced accuracy of self-report measures.

Reporting Biases. A second issue is that self-report measures may be affected by social desirability bias, which can lead participants to over-report desirable behaviours and under-report undesirable behaviours (Krumpal, 2013; Larson, 2019). This may occur because people select answers they think will look good to the researchers, or because they select answers based on how they would like to act rather than how they actually act (Larson, 2019; Paulhus, 1984). Evidence of social desirability bias when using self-report measures has been found in many different domains (Adams et al., 2005; Brenner & DeLamater, 2014; Davis et al., 2009; Heitmann & Lissner, 2005; Rasmussen et al., 2018; Wheeler et al., 2019), including in the area of eating behaviour (Hebert et al., 1997; Miller et al., 2008).

Dual-Process Theories. A third issue is that according to dual-process theories, people may not be aware of all their thoughts and feelings, and are therefore unable to report on these variables with full accuracy (Evans, 2003, 2008; Hofmann et al., 2008; Sheeran et al., 2013; Strack & Deutsch, 2004). As previously discussed, dual-process theories propose that behaviour is influenced by both an explicit system, which involves conscious knowledge and decisions, and an implicit system, which involves subconscious cognitive associations (Evans, 2003, 2008; Hofmann et al., 2008; Sheeran et al., 2013; Strack & Deutsch, 2004). The use of self-report measures fails to consider the influence of these automatic and subconscious cognitive processes (Conner & Norman, 2005; Schwartz et al., 2011). If behaviour can indeed result from the automatic system then studying explicit behavioural predictors using self-report measures is not sufficient. Research is also needed on implicit variables in order to capture the influence of the automatic system and provide a more complete understanding of the prediction of eating behaviour.

Importance of Implicit Predictors. Due to these limitations of known self-report predictors of behaviour, some authors have argued that it is beneficial to extend current theories and research to include both explicit and implicit predictors. For instance, Conner (2015) argued that the TPB should be extended to include implicit versions of the constructs (for instance, implicit attitudes as well as explicit attitudes). Similarly, other authors argue that it is beneficial to use both implicit and explicit measures of identity, as people may be unaware of identity processes (Schwartz et al., 2011). Implicit measures are designed to measure responses, such as cognitions, that are below a person's conscious awareness. This avoids social desirability bias while tapping into automatic processes, which are not measured by self-report items, and this helps improve behavioural prediction (Schnabel et al., 2008). It could also help to overcome measurement problems associated with differing definitions of a behaviour. Taking the smoking example from Ridner et al. (2010), a person who has smoked recently may be more likely to implicitly associate themselves with cigarettes than a person who has never smoked, even if both people would explicitly categorise themselves as a 'non-smoker'. Finally, the use of an implicit measure of identity may help to overcome the problem of circularity between explicit identity and many measures of eating behaviour. Many eating behaviour measures rely on people's self-report, and recall of eating behaviours may well be influenced by people's explicit eating-related identities, thus inflating the observed explicit identity-behaviour relationship. Implicit measures of eating-related identity could help avoid this limitation.

Aims of this Thesis

Implicit measures, such as implicit attitudes and implicit identity, offer the opportunity to extend our understanding and prediction of behaviour by measuring automatic processes while avoiding social desirability biases. Although implicit attitudes have been shown to predict eating behaviours, there is a lack of research on implicit identity as a predictor of healthy and unhealthy eating. Should implicit identity be a significant predictor of eating behaviour, it could be a valuable tool in identifying people in need of help to change unhealthy eating patterns and could be a possible target for eating behaviour change interventions. It would also provide additional support for dual-process theories and for the IAT (and its variants) as useful measures of implicit variables. While implicit identity has been studied as a predictor of many different behaviours, there is a lack of research on implicit identity as a predictor of eating behaviours. However, the findings that self-report identity predicts eating behaviour and that other implicit variables predict eating behaviour suggest that implicit identity may well be able to predict outcomes in this domain. This thesis therefore investigated whether implicit eating-related identity could indeed predict eating behaviours. A series of five studies were conducted. Chapter Two will present the rationale, hypotheses, method, and results of the first three studies. Chapter Three will present the rationale, hypotheses, method, and results of the final two studies. Finally, Chapter Four will present a general discussion of the results from all five studies, including implications of this research, strengths and weaknesses of the research, and directions for future research.

Chapter 2: Studies 1-3

Studies 1-3 investigated whether implicit identity predicts eating-related behaviours across three different populations and using three different methods. Study 1 used a sample of American adults recruited through Mechanical Turk, who completed a cross-sectional survey. The results of this study were unclear, with both significant and non-significant findings. Two additional studies were therefore conducted to further investigate the relationship between implicit identity and eating-related outcomes using different samples and methods. Study 2 used a community sample of New Zealand adults who completed an initial survey followed by a second survey 3 months later. Study 3 used a sample of New Zealand students who completed an initial survey followed by a 7-day food diary.

Single-Category Implicit Association Test

In all three studies, implicit identity was measured using two Single-Category Implicit Association Tests (SC-IATs). As discussed in the previous chapter, an identity IAT measures the strength of automatic identification with one category relative to the strength of automatic identification with an opposing category. The SC-IAT is a modification of the traditional IAT, and is able to measure automatic evaluations of one category without reference to a second category (Karpinski & Steinman, 2006). This is useful for the measurement of eating-related identity because it is possible to identify with both healthy and unhealthy eating simultaneously; for example, a person could identify with eating both fruit and chocolate. For example, Strachan and Brawley (2009) found that explicit identification with healthy eating predicted fruit and vegetable intake but not junk food consumption, supporting the idea that identification with healthy and unhealthy eating are two separate concepts that are best measured independently of each other. SC-IATs were therefore used in order to measure implicit identification with healthy eating separately from implicit identification with unhealthy eating. SC-IATs show good predictive validity as well as acceptable reliability for an implicit measure (Karpinski & Steinman, 2006). In addition, scores on SC-IATs correlate significantly with scores on the original IAT, and the SC-IAT has been found to predict a greater percentage of variance in certain behaviours (e.g. soft drink preference) than the original IAT (Karpinski & Steinman, 2006). For a description of the SC-IATs used in Studies 1-3, see the Study 1 Measures section.

Other Predictors of Eating Behaviour

As well as measuring healthy and unhealthy implicit identity, Studies 1-3 also measured several demographic variables and self-report predictors of eating behaviour. As discussed in Chapter 1, subjective norms, attitudes, explicit identity, and habit strength are all well-established predictors of eating-related outcomes (Ajzen, 1991; Ajzen & Madden, 1986; Blake et al., 2013; Carfora et al., 2017; de Bruijn, 2010; Noia & Cullen, 2015; Verhoeven et al., 2012; Wengreen et al., 2017). Research has also found that the demographic variables of age and sex are associated with differences in eating-related outcomes (Olsen et al., 2015; Thompson et al., 2011; Wardle et al., 2004). In addition, BMI has been associated with differences in eating-related outcomes (Ohkuma et al., 2015; Price et al., 2015). Consequently, these variables were measured to assess whether implicit identity was able to predict eating-related outcomes over and above the influence of demographic variables and established predictors of eating behaviour. Age, sex (Study 1) or gender (Studies 2-3), and BMI were all measured in Studies 1-3. Studies 1 and 3 measured attitudes towards healthy eating, subjective norms around healthy eating, and both healthy and unhealthy eating habit strength. Study 2 was conducted as part of a wider community study on health and wellbeing, and the prediction of implicit identity was not a primary goal of this study. Study 2 therefore contained different measures of habit strength and attitudes towards healthy eating and did not measure subjective norms.

Eating Behaviour Measures

Several different outcome measures were used across the three studies. All three studies include self-report scales measuring past eating behaviour and perceived behavioural control (PBC) for healthy eating. PBC is a concept from the Theory of Planned Behaviour (TPB) and refers to a person's perceptions of their control over a behaviour such as healthy eating (Ajzen, 1991; Ajzen & Madden, 1986). PBC has been found to significantly and directly predict eating behaviour (Dunn et al., 2011; McDermott, Oliver, Simnadis, et al., 2015; Povey et al., 2000). It was expected that if implicit identity affects eating behaviour via the impulsive system, having a healthy implicit identity should make healthy eating feel more attainable while having an unhealthy implicit identity should make healthy eating feel less attainable. Perceived behavioural control was therefore treated as an outcome variable in all three studies. Study 1 also included a hypothetical behavioural choice measure and self-report scales measuring retrospective recall of food intake. Study 2 used an alternative retrospective recall measure that asked participants to report on their consumption of seven different food types the previous day. Study 3 used a week-long food diary that measured the consumption of the same seven food types but asked participants to report their daily consumption at the end of each day, rather than asking participants to recall what they ate yesterday. This allows the assessment of whether implicit identity is able to predict different types of eating-related outcome.

Each study used a different design. Study 1 used a cross-sectional design, with all predictors and outcomes measured at one time point. Study 2 used a prospective design, with all outcomes measured 3 months after the predictor variables were measured. In Study 3 the self-report scales measuring past eating behaviour and PBC were part of a cross-sectional baseline survey which also included the predictor measures; following this, a 7-day food diary was used. The use of different study designs allows for the assessment of whether implicit identity is able to predict eating-related outcomes at several different time points.

Potential Moderator Variables

Self-Control

Several different factors may influence the relationship between implicit predictors and behavioural outcomes. One such factor is self-control. Self-control refers to the ability to regulate behaviour and achieve goals by resisting or changing immediate urges, desires, and impulses (Carver & Scheier, 1990; Dohle et al., 2018; Muraven & Baumeister, 2000; Tangney et al., 2004). According to Muraven and Baumeister (2000), self-control strength can be affected by situational factors such as tiredness, hunger, and recent exertion of self-control; however, there are also stable differences in the level of trait self-control between individuals. Self-control increases performance of desirable behaviours and reduces instances of undesirable behaviour (de Ridder et al., 2012), and can predict outcomes such as school and work performance, interpersonal behaviours, eating, weight control, addictive behaviours, and pain tolerance (de Ridder et al., 2012; Keller & Siegrist, 2014; Schmeichel & Zell, 2007). Self-control can therefore explain and predict eating behaviours, as healthy eating and dieting require people to exert self-control in order to resist urges to eat palatable but less healthy foods (Dohle et al., 2018). For instance, Hofmann et al. (2014) found that compared to those with low inhibitory control abilities, dieters with high inhibitory control scores were more likely to attempt to resist desired foods and were more successful at doing so.

Individuals high in self-control have the capacity to override impulses arising from implicit attitudes, meaning that implicit variables are less predictive of their behaviour. There is a lack of research on self-control as a moderator of the relationship between implicit identity and eating behaviour. However, evidence for self-control as a moderator between implicit variables and eating behaviour has been found in research on implicit attitudes. For example, Haynes et al. (2015) used an IAT-based task to strengthen positive or negative implicit attitudes towards unhealthy foods. Although training condition did not predict snack consumption overall, there was a significant interaction with self-control. Participants with high self-control were not affected by the intervention, while the intervention was successful for participants with low self-control. Self-control is typically reduced by high cognitive load (Baumeister et al., 1998), so if self-control is a significant moderator of the implicit attitudes-behaviour relationship then implicit attitudes should be a stronger predictor under conditions of high cognitive load. In support of this, implicit affective attitudes predicted snack choice under high cognitive load but were only a marginally significant predictor under low cognitive load (Trendel & Werle, 2016). Other research has also indicated that self-control significantly moderates the relationship between implicit attitudes and behaviour. For example, Hofmann and Friese (2008) found that implicit attitudes towards candy were more predictive of candy consumption among participants who had consumed alcohol compared to participants who had consumed juice, presumably because intoxication reduces effortful self-regulatory ability. Overall, then, research suggests that implicit attitudes are a stronger predictor when self-control is low.

If low self-control strengthens the behavioural prediction of implicit variables then self-control should also moderate the relationship between implicit identity and eating behaviour. Trait self-control was therefore measured in Studies 1-3 in order to assess whether the relationship between implicit identity and eating behaviour depends on participants' levels of self-control. It was hypothesised that implicit identity would be more predictive of eating-related outcomes among participants with low trait self-control.

Stress

Stress has also been shown to predict eating behaviour. Surveys of university students found that perceived stress was associated with self-reported changes in appetite (Kandiah et al., 2006) and increased consumption of a range of unhealthy foods (Errisuriz et al., 2016). Among adolescents, stress is associated with both increased unhealthy eating behaviours (e.g. fatty food intake) and decreased healthy eating behaviours (e.g. fruit and vegetable consumption) (Cartwright et al., 2003). Other research has also found that stress is associated with greater consumption of fatty and sweet foods (Habhab et al., 2009); with greater intake of palatable non-nutritious foods (Groesz et al., 2012); and with self-reported increases in snacking (Oliver & Wardle, 1999). One possible explanation for the relationship between stress and eating behaviour is that people turn to ‘comfort foods’ to buffer against any negative impacts of stress on their mood (Finch & Tomiyama, 2015). Another mechanism by which stress may influence eating behaviour is by depleting self-control resources (Muraven & Baumeister, 2000), which may prevent people from overcoming the temptation of palatable but unhealthy foods (Dohle et al., 2018).

As discussed previously, implicit identity may be more predictive of behaviour when self-control is low. High stress levels may therefore increase the predictive ability of implicit identity by temporarily decreasing state self-control strength. Study 3 therefore measured stress as a potential moderator of the relationship between implicit identity and eating behaviours. It was expected that implicit identity was a better predictor of eating-related outcomes among participants who reported more stress.

Hypotheses for Studies 1-3

Based on other implicit research, it was expected that the two SC-IATs would be significant predictors of eating behaviour (Carels et al., 2011; de Bruijn et al., 2012; Houben et al., 2010, 2012; Lindgren, Foster, et al., 2013; Stout et al., 2011). Specifically, it was expected that each identity would be most predictive of the corresponding behaviour (i.e. healthy implicit identity would be most predictive of healthy eating, and unhealthy implicit identity would be most predictive of unhealthy eating). In addition, self-control (Studies 1-3) and stress (Study 3) were expected to be moderators for the relationship between implicit identity and eating behaviour.

H_1: implicit identity as a healthy eater will predict greater healthy eating behaviours and stronger PBC for healthy eating.

H_2: implicit identity as an unhealthy eater will predict greater unhealthy eating behaviours and weaker PBC for healthy eating.

H_3: implicit identity will interact with self-control to predict eating behaviour; implicit identity will be a stronger predictor of eating behaviour and PBC when self-control is low.

H_4: implicit identity will interact with stress to predict eating behaviour; implicit identity will be a stronger predictor of eating behaviour and PBC when stress is high.

Study 1

Method

Participants

Two hundred participants were recruited for a study on "personality and health behaviours" through Amazon's Mechanical Turk (MTurk) and were paid US$2 on completion of the study. Participants were required to be American, over 18 years of age, fluent in English, and to have Masters status on MTurk. Masters status is given by Amazon to high-performing MTurk workers and was used to reduce potential limitations such as participant inattention (Amazon Mechanical Turk Inc., n.d.; Buhrmester et al., 2018). A total of eight participants were excluded for having large amounts of missing data (completing only the demographic questions), while two participants were excluded for not completing the implicit identity measure and another eight participants were excluded for having the same IP address, indicating the same person may have completed the study multiple times. Finally, 23 participants were excluded for having a high error rate on the IAT (an error rate of 20% or higher) (Karpinski & Steinman, 2006). In addition, 14 participants with BMIs under 18.5 (*n* = 4) or over 40 (*n* = 10) were excluded from analysis[1]. A BMI of between 18.5 and 24.9 is considered a normal weight; a BMI below 18.5 is considered underweight; between 25.0 and 29.9 is considered overweight; and 30.0 and above is considered obese (World Health Organization, 1998). It is common to exclude obese participants as there is evidence to suggest that obese participants respond differently to food-related stimuli (Cornier et al., 2013; Stice et al., 2016); we also decided to exclude underweight participants for the same reason (Frank et al., 2012). A further 34 participants had a BMI between 30 and 40 and ideally would have been excluded, but were retained to avoid excluding too many participants.

This left 145 participants for analysis. Descriptive statistics for these participants are included in Table 1. One participant did not report their age. Three participants reported improbable values for height and/or weight and were treated as missing values on BMI. Ages ranged from 24 to 72 and BMI ranged from 18.61 to 39.10.

[1] When analyses were repeated with these participants included, results for implicit variables were unchanged (see Data Analysis and Results sections).

Table 1
Study 1 Description of Sample

		N (%)
Sex	Males	70 (48.3%)
	Females	74 (51.0%)
Education	High school or other	40 (27.6%)
	Associate's degree	29 (20.0%)
	Bachelor's degree	54 (37.2%)
	Master's degree	19 (13.1%)
	PhD/doctorate	3 (2.1%)
Ethnicity	White/Caucasian	110 (75.9%)
	Black/African American	14 (9.7%)
	Hispanic/Latino American	4 (2.8%)
	Asian American	13 (9.0%)
	Other	4 (2.8%)
		M (SD)
	Age	41.30 (10.86)
	BMI	26.48 (4.83)

Note: N = 145. BMI = body mass index.

Measures

Participants reported their date of birth (used to calculate age), sex (response options: male or female), highest educational qualification, and ethnicity.

Body Mass Index (BMI). Height was reported in inches and weight was reported in pounds. BMI was calculated using the height and weight information provided by participants using the formula: {BMI = [weight x (height x height)] x 703}(U.S. Department of Health & Human Services, 2014a).

Single-Category Implicit Association Tests. Two SC-IATs were used to measure implicit eating-related identity, one for healthy eating and one for unhealthy eating (Karpinski & Steinman, 2006). The SC-IATs were coded in Inquisit 5 (Inquisit, 2016). In each SC-IAT, the response categories ("self", "other", and "healthy food" or "unhealthy food"; see Table 2) were listed at the top of the screen. In the healthy eating SC-IAT, "self" was always listed on the left side, indicating that participants should respond to self-related words using the left response key. "Other" was always listed on the right side, indicating that participants should respond to other-related words using the right response key. The category “healthy eating” was paired on the left response key with “self” for half the task and on the right response key with “other” for half the task. The order of the pairings was counterbalanced across participants. The unhealthy eating SC-IAT followed the same procedure but using the category “unhealthy eating” rather than “healthy eating”. The order of the two SC-IATs (that is, whether the healthy food SC-IAT or the unhealthy food SC-IAT occurred first) was counterbalanced. This led to eight different possible combinations of blocks which participants were randomly assigned to (see Table 3).

In the SC-IATs, food-related, self-related, and other-related words appeared in a random order in the centre of the screen in white, and were responded to using the left “E” key or the right “I” key of the keyboard. If an incorrect response was made, a red X appeared and participants had to press the correct key before the next word would appear. Each SC-IAT consisted of two stages (food-related words on the left side, and food-related words on the right side), and following the recommendation of Karpinski and Steinman (2006) each stage consisted of 24 practice trials followed by 72 test trials. Only the test trials were used in data analysis. For each SC-IAT, a D score was calculated for each participant by subtracting the response time for eating + self trials from the response time for eating + other trials and dividing this sum by the pooled standard deviation (Greenwald et al., 2003; Karpinski & Steinman, 2006). An error penalty was not added to trials with incorrect responses as participants were required to correct their response before the next trial, providing an inbuilt time penalty (Greenwald et al., 2003). A positive D score on the healthy eating SC-IAT indicated implicit self-identification with healthy foods, and a positive D score on the unhealthy eating SC-IAT indicated implicit self-identification with unhealthy foods.

Table 2
Single-Category Implicit Association Test Stimuli

Self	Other	Healthy Food	Unhealthy Food
Me	Them	Apple	Chips
Mine	Others	Carrot	Chocolate
My	Theirs	Strawberries	Ice-cream
Myself	They	Salmon	Cake
I	Him	Salad	Pizza
Self	Her	Rice	Hamburger

Table 3
Single-Category Implicit Association Test Block Combinations

	1st SC-IAT				2nd SC-IAT			
Order	*24 practice trials*	*72 trial tests*	*24 practice trials*	*72 test trials*	*24 practice trials*	*72 test trials*	*24 practice trials*	*72 test trials*
1	L: Healthy + Self R: Other		L: Healthy + Other R: Self		L: Unhealthy + Self R: Other		L: Unhealthy + Other R: Self	
2	L: Healthy + Self R: Other		L: Healthy + Other R: Self		L: Unhealthy + Other R: Self		L: Unhealthy + Self R: Other	
3	L: Healthy + Other R: Self		L: Healthy + Self R: Other		L: Unhealthy + Self R: Other		L: Unhealthy + Other R: Self	
4	L: Healthy + Other R: Self		L: Healthy + Self R: Other		L: Unhealthy + Other R: Self		L: Unhealthy + Self R: Other	
5	L: Unhealthy + Self R: Other		L: Unhealthy + Other R: Self		L: Healthy + Self R: Other		L: Healthy + Other R: Self	
6	L: Unhealthy + Self R: Other		L: Unhealthy + Other R: Self		L: Healthy + Other R: Self		L: Healthy + Self R: Other	
7	L: Unhealthy + Other R: Self		L: Unhealthy + Self R: Other		L: Healthy + Self R: Other		L: Healthy + Other R: Self	
8	L: Unhealthy + Other R: Self		L: Unhealthy + Self R: Other		L: Healthy + Other R: Self		L: Healthy + Self R: Other	

Note: L = left response key, R = right response key. SC-IAT = Single-Category Implicit Association Test.

Explicit Identity. Explicit self-identity was measured using the healthy eater subscale of the Eating Identity Type Inventory (Blake et al., 2013). This subscale measures healthy eater identity using three items ("I am a healthy eater", "I am someone who eats in a nutritious manner", and "I am someone who is careful about what I eat"). The healthy eater subscale has been shown to have good reliability and validity (Blake et al., 2013). Participants responded to these statements using a 5-point Likert scale ranging from strongly disagree to strongly agree. Cronbach's alpha in the current study was .94.

Habit. Habit strength was measured using the Self-Report Habit Index, a widely-used scale which measures the components of repetition, controllability, awareness, efficiency, and identity, and has good reliability and validity (Gardner et al., 2011; Verplanken & Orbell, 2003). The index contains twelve items, for example "X is something I do frequently" and "X is something I do without thinking", and participants rate their agreement with these statements using a 7-point Likert scale. Participants completed the measure twice, once for the behaviour of healthy eating and once for the behaviour of eating high-calorie snacks. Cronbach's alpha in the current study was .98 for healthy habit and .97 for unhealthy habit.

Attitudes. Attitudes were measured using five items where participants rated their perceptions of healthy eating using 7-point semantic differential scales (e.g. "for me, healthy eating is……good/bad") (Conner et al., 2002). These items have previously shown good internal consistency and acceptable test-retest reliability (Conner et al., 2002). Higher scores indicated positive attitudes towards healthy eating. Cronbach's alpha in the current study was .83.

Subjective Norms. Subjective norms were measured using one item: "people who are important to me think I should eat a healthy diet" (Conner et al., 2002). Participants rated their agreement with this statement on a 7-point scale where higher scores indicated stronger norms for healthy eating.

Self-Control. Self-control was measured using the Brief Self-Control Scale (Tangney et al., 2004). This scale consists of 13 statements, such as “I am good at resisting temptation”, which participants respond to using a 5-point Likert scale from “not at all like me” to “very much like me”. It is best used as a unidimensional measure of overall trait self-control (Lindner et al., 2015), which is how it was used in this study. It has previously shown good internal reliability and validity and is able to predict performance on behavioural tests of self-control (Schmeichel & Zell, 2007; Tangney et al., 2004), and is widely used in self-control research (de Ridder et al., 2012). Higher scores indicate greater self-control. Cronbach’s alpha in the current study was .91.

Past Eating Behaviour. Participants were asked to recall their eating behaviour over the past 2 weeks (Kuijer & Boyce, 2012, 2014; Wood Baker et al., 2003). The items asked: ‘In the past 2 weeks, on how many days did you ….’ followed by five items, for example ‘eat in a balanced way with a lot of fruit and vegetables’ and ‘eat snack food (e.g., potato chips, desserts, sweets, candy bars, etc)’. Previous research has found strong correlations between these items and a 2-week diary measure of the same behaviours (Kuijer & Boyce, 2012). All items were scored on a 5-point scale (1 = every day, 5 = less than once a week) and were scored in such a way that a higher score on the summed scale indicates healthier eating behaviour (Cronbach’s alpha = .67). In addition, a single item was used in which participants were asked to rate how healthy they thought their eating had been over the past 2 weeks using a 7-point scale from ‘not very healthy’ to ‘very healthy’. Higher scores indicated greater healthy eating.

Fat Consumption. Consumption of high-fat foods was measured using the Block fat screener (Block et al., 2000). Participants were asked to report how many times over the past month they ate 17 different high-fat foods, e.g. “bacon or breakfast sausage” (Block et al., 2000). Responses were made on a 5-point Likert scale from “once a month or less” to “5+

times a week", with higher scores indicating greater consumption of fatty foods over the past month.

Fruit and Vegetable Consumption. Fruit and vegetable consumption was measured with the Block Fruit and Fibre screener (Block et al., 2000). Participants were asked to report how many times over the past month they ate 10 different fruits, vegetables, and high-fibre foods, e.g. "green salad" (Block et al., 2000). Responses were made on a 5-point Likert scale from "less than once a week" to "2+ times a day".

Menu Choice. Participants were presented with a hypothetical sandwich menu and were asked to choose the sandwich that they would most like to eat, based on sandwich menu measures by Hoyt et al. (2014) and Castañeda (2015). The menu listed six sandwiches along with a brief description of each. Three sandwiches were designed to be healthy choices and had descriptions mentioning salads and low-fat or lite sauces. The other three sandwiches were designed to be less healthy choices and did not mention being low-fat or lite. The six sandwiches and the number and percentage of participants who chose that sandwich are shown in Table 4. Participant responses were coded as 1 (unhealthy) or 2 (healthy). Fifty-four participants (37.2%) chose an 'unhealthy' sandwich and 91 participants (62.8%) chose a 'healthy' sandwich.

Table 4
Study 1 Sandwich Menu Choices

Sandwich	Healthy/Unhealthy	*N* (%)
Turkey	Healthy	52 (35.9%)
Italian B.M.T.	Unhealthy	22 (15.2%)
Roast beef	Healthy	29 (20.0%)
Chicken and bacon melt	Unhealthy	25 (17.2%)
Veggie delite	Healthy	10 (6.9%)
Veggie patty	Unhealthy	7 (4.8%)

Perceived Behavioural Control. Perceived behavioural control (PBC) was measured using four items in which participants reported how difficult or easy they found behaviours such as ‘eating in a balanced way with a lot of fruit and vegetables’ (1 = very difficult, 5 = very easy) (Kuijer & Boyce, 2014). Higher scores indicate greater PBC. Cronbach’s alpha in the current study was .75.

Procedure

This study received approval from the University of Canterbury Human Ethics Committee (HEC 2018/01). The IAT was hosted on millisecond.com and the other questions were hosted on Qualtrics. Participants read a description of the study on Mechanical Turk and those who were interested could click on a link to the Qualtrics survey. They were then shown an information sheet and asked whether they consented to participate; those who did not consent were automatically taken to the end of the survey. Those who did consent first answered demographic questions (age, sex, education, ethnicity, and height and weight). They were then given a link to take the IAT. At the end of the IAT they were given a random eight-digit code, which they were asked to enter back into the Qualtrics survey to enable their data to be matched anonymously. After finishing the IAT and entering their code into Qualtrics, participants completed the rest of the survey (remaining predictor variables, self-control and eating behaviour measures). At the end of the study, participants were shown a debriefing sheet and were given a four-digit code to enter into Mechanical Turk in order to receive payment.

Data Analysis

Prior to analysis, relevant assumptions (absence of outliers, normal distributions, and linear relationships between variables) were checked (Newton & Rudestam, 2013; Tabachnick & Fidell, 2014). There was one missing value for norms and one missing value for attitudes. Given the small number of missing values and the fact they were missing at random, participants with missing values were excluded from analyses using these variables (Newton & Rudestam, 2013; Tabachnick & Fidell, 2014). Norms and attitudes both had negatively skewed distributions; normality was considered a problem if skew and/or kurtosis statistics had a z score greater than 3.29 (Tabachnick & Fidell, 2014). In addition, norms had three univariate outliers, defined as a case with a z-score greater than 3.29 (Tabachnick & Fidell, 2014). Data transformations were used on norms and attitudes to create approximately normal distributions and lessen the impact of outliers (Tabachnick & Fidell, 2014). Multivariate outliers, defined as cases with a significant Mahalanobis distance using an alpha of .001 and a Cook's distance larger than 1, were also checked before running each regression (Tabachnick & Fidell, 2014). No multivariate outliers were present.

Bivariate correlations, hierarchical multiple regression analyses, and logistic regression analyses were conducted using IBM SPSS version 25. A separate regression with was run to predict each outcome variable (past eating behaviour scale and single item, menu choice, fat consumption, fruit and vegetable consumption, fibre consumption, and PBC). Hierarchical multiple regression analyses were used to predict all outcome variables except for the binary outcome of menu choice for which a logistic regression was used. Alpha was set at .05, and bootstrapped 95% confidence intervals with 2000 samples were calculated for each analysis. Bootstrapped coefficients, standard errors, significance levels, and confidence intervals are reported for each predictor. Age, sex, and BMI were entered in the first step. Known predictors of eating behaviour (attitudes, subjective norms, and habit strength) were entered at step two. Finally, healthy and unhealthy implicit identity D scores were added in step 3. Due to the high correlation between explicit healthy identity and healthy habit (r = .80, $p < .05$), explicit identity was not included in the regressions in order to avoid multicollinearity (Tabachnick & Fidell, 2014). Explicit identity was chosen for exclusion because the habit scale includes some items which measure identity. Post-hoc power analyses conducted in G*Power (Faul et al., 2007) determined that the sample size of 145 had sufficient power (99.6%) to detect a moderate effect size ($f^2 = 0.15$); a meta-analysis by Greenwald et al. (2009) found, on average, moderate effect sizes for implicit-criterion associations. However, the study was underpowered (39.4%) to detect a small effect size ($f^2 = 0.02$).

Moderation analyses were conducted using IBM SPSS version 25. Two analyses were conducted for each outcome variable, one for self-control as a moderator for the relationship between healthy implicit identity and the eating-related measures and one for self-control as a moderator for the relationship between unhealthy implicit identity and the eating-related measures. First, a regression was conducted with sex, BMI, healthy and unhealthy habit strength, attitudes, subjective norms, and implicit identity included in steps 1-3 and self-control added in step 4 to test whether adding self-control to the model improved the prediction of eating-related behaviours. Finally, the interaction term (self-control*healthy implicit identity or self-control*unhealthy implicit identity) was added in step 5. Bootstrapped 95% confidence intervals with 2000 samples were calculated for the interaction term. Significant interaction effects were followed up with simple slope analyses at low (one standard deviation below the mean), average (at the mean) and high (one standard deviation over the mean) levels of the moderator).

Given the pattern of correlations between unhealthy implicit identity, PBC, and past eating behaviour (scale), an unplanned exploratory analysis was conducted to test whether PBC was a mediator between unhealthy implicit identity and past eating behaviour. This analysis was conducted in Process (Hayes, 2018). Bootstrapped 95% confidence intervals with 2000 samples were calculated for the indirect effect.

Each analysis was repeated using the non-transformed variables for attitudes and norms (Newton & Rudestam, 2013). This did not affect the significance of healthy or unhealthy implicit identity in any of the analyses. Results are therefore reported for non-transformed variables. Each analysis was also repeated with participants with all BMIs included (N = 159; BMI range = 16.25-55.63). This also did not affect the significance of implicit identity as a predictor.

Results

Correlations

Scale means and standard deviations and bivariate correlations between the predictor and outcome variables are shown in Table 5. There was one missing value for past eating behaviour (single item), norms, and attitudes. Healthy implicit D scores ranged from -0.79 to 0.77 and unhealthy implicit D scores ranged from -1.07 to 0.86. Implicit healthy and unhealthy identities were positively correlated with each other. In addition, unhealthy implicit identity was negatively correlated with healthy past eating behaviour (scale) and with PBC for healthy eating. All other predictor variables (attitudes, norms, healthy and unhealthy habit, and healthy explicit identity) were associated with the scale and single item measures of past eating behaviour. Attitudes also showed positive correlations with fruit, vegetable, and fibre intake and PBC, and a negative correlation with fat intake. Healthy explicit identity and healthy habit showed a similar pattern of correlations, but were also positively correlated with menu choice. Unhealthy habit strength was negatively correlated with menu choice and PBC, as well as positively correlated with fat intake. The moderator variable of self-control was positively associated with both measures of past eating behaviour as well as fruit, vegetable, and fibre intake, menu choice, and PBC, and negatively correlated with fat intake. Past eating behaviour (single item), fat intake, and PBC were all significantly correlated with each other, while menu choice and past eating behaviour (scale) were correlated with all outcome measures except for fruit, vegetable, and fibre consumption.

Table 5

Study 1 Correlations, Means, and Standard Deviations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. H implicit identity	1.00																
2. U implicit identity	.21**	1.00															
3. Age	-.07	-.11	1.00														
4. Sex	-.02	-.01	.28**	1.00													
5. BMI	-.12	.05	.06	.01	1.00												
6. Attitudes	.03	-.11	.07	.03	-.16	1.00											
7. Norms	-.08	-.01	.01	.16	.04	.40**	1.00										
8. Explicit identity	-.09	-.11	-.04	.00	-.22**	.63**	.28**	1.00									
9. H habit	.03	-.03	.01	.05	.24**	.70**	.24**	.79**	1.00								
10. U habit	.05	.05	.02	-.06	.22**	-.47**	-.16	-.62**	-.63**	1.00							
11. Self-control	-.03	-.12	.10	.04	-.25**	.51**	.16	.58**	.60**	-.53**	1.00						
12. Past EB (scale)	-.11	-.21*	.00	-.03	-.23**	.57*	.22**	.70**	.63**	-.68**	.51**	1.00					
13. Past EB (1 item)	-.04	-.16	-.07	-.01	-.13	.64**	.28**	.81**	.79**	-.60**	.55**	.66*	1.00				
14. PBC	.03	-.19*	.03	-.08	-.38**	.57**	.12	.67**	.72**	-.66**	.66**	.66**	.66**	1.00			
15. Menu choice	.03	.01	-.00	.15	-.12	.13	.05	.22**	.33**	-.22**	.26**	.20*	.26*	.29**	1.00		
16. FVF consumption	-.02	-.02	.01	.01	.07	.22**	.14	.23**	.24**	-.04	.18*	.14	.28**	.19*	.05	1.00	
17. Fat consumption	-.00	.14	-.05	-.09	.07	-.26**	-.05	-.26**	-.30**	.32**	-.18*	-.41**	-.20*	-.28**	-.28**	.16*	1.00
M	-0.07	-0.23	41.30		26.48	5.56	5.95	3.33	3.93	3.40	3.65	3.81	4.54	3.35		13.93	6.23
SD	0.32	0.37	10.86		4.83	1.00	1.34	0.97	1.63	1.57	0.78	0.64	1.56	0.91		20.87	8.65

Note: H = healthy, U = unhealthy, BMI = body mass index, EB = eating behaviour, PBC = perceived behavioural control, FVF = fruit/vegetable/fibre consumption. Sex coded as 1 = male, 2 = female. Menu choice coded as 1 = unhealthy, 2 = healthy.

* $p < .05$. ** $p < .01$.

Regression Models

Regression models were conducted to see if implicit identity could predict each outcome variable over and above the influence of age, sex, BMI, healthy and unhealthy habit, attitudes, and subjective norms. Results from the regression analyses are presented in Tables 6-8.

Attitudes, healthy and unhealthy habit, and unhealthy implicit identity were all significant predictors of the scale measure of past eating behaviour. Participants reported healthier eating when they had more positive attitudes towards healthy eating, a stronger healthy eating habit, a weaker unhealthy eating habit, and less implicit identification with unhealthy eating. Healthy and unhealthy habit were significant predictors of the single-item measure. Participants reported healthier past eating behaviour when they had stronger healthy eating habit and a weaker unhealthy eating habit.

Unhealthy habit was the only significant predictor of fat consumption; participants reported greater fat consumption when they had stronger unhealthy eating habits. There were no significant predictors of fruit, vegetable, and fibre consumption. Healthy habit was the only significant predictor of menu choice; participants were more likely to choose a healthy sandwich option when they had a stronger healthy eating habit.

Sex, BMI, healthy and unhealthy habit, and unhealthy implicit identity were all significant predictors of PBC. Participants reported stronger PBC for healthy eating when they were male, had a lower BMI, had a stronger healthy eating habit and a weaker unhealthy eating habit, and had less implicit identification with unhealthy eating.

Table 6

Study 1 Regression Analyses Predicting Past Eating Behaviour

		Past eating behaviour (scale)						Past eating behaviour (single item)					
		R^2change	*b*	*SE*	*p*	95% CI		R^2change	*b*	*SE*	*p*	95% CI	
						LL	*UL*					*LL*	*UL*
Model 1	Constant	.06, *p* = .044	4.64	0.37	< .001	3.95	5.39	.02, *p* = .390	6.01	0.94	< .001	4.30	7.92
	Age		0.00	0.01	.704	0.01	0.01		-0.01	0.01	.422	-0.04	0.02
	Sex		-0.08	0.11	.463	-0.28	0.13		0.02	0.27	.934	-0.49	0.55
	BMI		-0.03	0.01	.005	-0.05	-0.01		-0.04	0.03	.179	-0.10	0.02
Model 2	Constant	.49, *p* < .001	3.69	0.36	< .001	2.99	4.42	.64, *p* < .001	1.53	0.96	.113	-0.08	3.69
	Age		0.00	0.00	.699	-0.01	0.01		-0.01	0.01	.095	-0.03	0.00
	Sex		-0.12	0.08	.144	-0.27	0.04		-0.07	0.15	.630	-0.38	0.21
	BMI		-0.01	0.01	.343	-0.02	0.01		0.03	0.02	.146	-0.01	0.06
	Attitudes		0.13	0.06	.029	0.01	0.24		0.20	0.14	.154	-0.10	0.46
	Norms		0.01	0.04	.785	-0.05	0.09		0.06	0.09	.497	-0.11	0.23
	H Habit		0.07	0.04	.034	0.01	0.14		0.57	0.07	< .001	0.43	0.70
	U Habit		-0.18	0.03	< .001	-0.23	-0.12		-0.19	0.07	.008	-0.33	-0.05
Model 3	Constant	.03, *p* = .006	3.70	0.34	< .001	2.99	4.37	.01, *p* = .058	1.53	0.96	.111	-0.11	3.67
	Age		0.00	0.00	.936	-0.01	0.01		-0.02	0.01	.059	-0.03	0.00
	Sex		-0.11	0.08	.147	-0.27	0.04		-0.07	0.15	.640	-0.38	0.20
	BMI		-0.01	0.01	.287	-0.02	0.01		0.03	0.02	.164	-0.01	0.06
	Attitudes		0.12	0.05	.034	0.01	0.22		0.18	0.13	.187	-0.11	0.43
	Norms		0.01	0.03	.788	-0.05	0.08		0.06	0.08	.475	-0.10	0.23
	H Habit		0.08	0.03	.014	0.02	0.15		0.57	0.07	< .001	0.43	0.71
	U Habit		-0.17	0.03	< .001	-0.22	-0.12		-0.18	0.07	.012	-0.32	-0.04
	H implicit identity		-0.17	0.12	.139	-0.40	0.05		-0.13	0.27	.644	-0.67	0.41
	U implicit identity		-0.25	0.10	.011	-0.44	-0.05		-0.46	0.24	.057	-0.92	0.02
	R^2total	.58, *p* < .001						.68, *p* < .001					

Note: Number of bootstrap samples = 2000. H = healthy, U = unhealthy, BMI = body mass index, *LL* = lower limit, *UL* = upper limit.

Table 7

Study 1 Regression Analyses Predicting Menu Choice and PBC

		Menu Choice								PBC					
		-2LL	χ^2	R^2	*b*	*SE*	*p*	95% CI		R^2change	*b*	*SE*	*p*	95% CI	
								LL	*UL*					*LL*	*UL*
Model 1	Constant	181.36	5.33, p = .149	.05	1.16	1.27	.343	-1.13	3.88	.16, p < .001	5.24	0.52	< .001	4.23	6.25
	Age				-0.01	0.02	.665	-0.05	0.03		0.01	0.01	.278	-0.01	0.02
	Sex				0.68	0.39	.060	-0.04	1.47		-0.22	0.15	.161	-0.52	0.07
	BMI				-0.05	0.04	.166	-0.13	0.02		-0.07	0.02	< .001	-0.10	-0.04
Model 2	Constant	164.73	16.62, p = .002	.20	0.88	2.17	.664	-3.57	4.94	.47, p < .001	3.74	0.52	< .001	2.73	4.78
	Age				-0.01	0.02	.628	-0.05	0.03		0.01	0.01	.150	-0.00	0.02
	Sex				0.73	0.43	.064	-0.07	1.66		-0.24	0.10	.019	-0.44	-0.05
	BMI				-0.02	0.05	.680	-0.11	0.08		-0.04	0.01	.003	-0.06	-0.01
	Attitudes				-0.53	0.30	.045	-1.20	-0.00		0.13	0.06	.045	0.01	0.26
	Norms				0.01	0.18	.979	-0.32	0.39		-0.03	0.03	.280	-0.10	0.03
	H Habit				0.64	0.21	.001	0.31	1.15		0.21	0.05	< .001	0.11	0.30
	U Habit				-0.04	0.17	.804	-0.36	0.29		-0.19	0.04	< .001	-0.27	-0.11
Model 3	Constant	164.69	0.05, p = .976	.20	0.88	2.25	.666	-3.66	5.23	.02, p = .012	3.71	0.49	< .001	2.77	4.67
	Age				-0.01	0.02	.653	-0.06	0.03		0.01	0.00	.192	-0.00	0.01
	Sex				0.73	0.45	.067	-0.10	1.68		-0.24	0.10	.014	-0.44	-0.05
	BMI				-0.02	0.05	.696	-0.11	0.08		-0.04	0.01	.004	-0.06	-0.01
	Attitudes				-0.53	0.32	.054	-1.25	-0.00		0.11	0.06	.081	-0.01	0.23
	Norms				0.01	0.19	.959	-0.34	0.45		-0.03	0.03	.423	-0.10	0.04
	H Habit				0.64	0.23	.001	0.30	1.20		0.21	0.05	< .001	0.12	0.30
	U Habit				-0.04	0.17	.782	-0.38	0.30		-0.19	0.04	< .001	-0.27	-0.11
	H implicit identity				0.12	0.73	.860	-1.18	1.68		0.10	0.13	.443	-0.17	0.35
	U implicit identity				0.04	0.59	.940	-1.10	1.26		-0.39	0.13	.002	-0.64	-0.16
	R^2total									.66, p < .001					

Note: Number of bootstrap samples = 2000. H = healthy, U = unhealthy, BMI = body mass index, PBC = perceived behavioural control, *LL* = lower limit, *UL* = upper limit. χ^2 tests each model against the previous model; Model 1 is tested against a null model containing no predictors. R^2 for menu choice is Nagelkerke's R^2.

Table 8

Study 1 Regression Results Predicting Block Fruit/Fibre and Fat Screeners

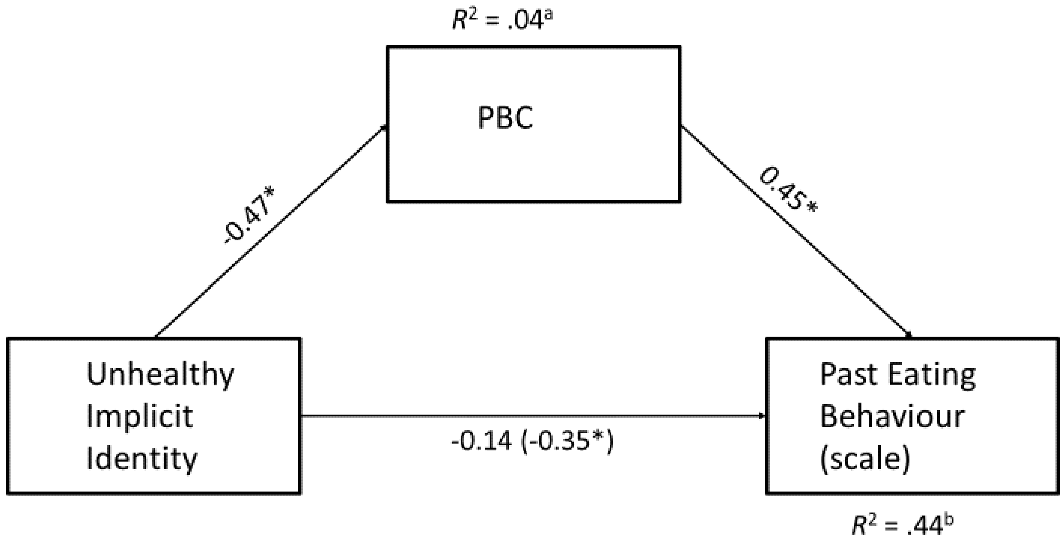
		Fruit/vegetable/fibre consumption						Fat Consumption					
		R^2change	*b*	*SE*	*p*	95% CI		R^2change	*b*	*SE*	*p*	95% CI	
						LL	*UL*					*LL*	*UL*
Model 1	Constant	.01, *p* = .801	11.21	3.28	<.001	4.82	17.99	.02, *p* = .542	20.422	5.63	.001	9.28	31.22
	Age		0.03	0.05	.628	-0.08	0.13		-0.02	0.07	.777	-0.16	0.12
	Sex		-0.47	1.04	.663	-2.45	1.54		-1.59	1.55	.312	-4.53	1.44
	BMI		0.08	0.11	.449	-0.12	0.30		0.14	0.15	.374	-0.15	0.45
Model 2	Constant	.08, *p* = .019	-1.26	5.02	.793	-9.82	10.21	.13, *p* < .001	25.08	6.73	<.001	12.10	38.83
	Age		0.02	0.06	.752	-0.09	0.12		-0.01	0.07	.881	-0.14	0.13
	Sex		-0.57	1.01	.582	-2.47	1.39		-1.55	1.50	.306	-4.33	1.46
	BMI		0.13	0.12	.293	-0.10	0.36		-0.04	0.16	.820	-0.35	0.28
	Attitudes		0.64	0.83	.436	-1.12	2.14		-0.81	0.92	.370	-2.71	0.98
	Norms		0.26	0.41	.533	-0.56	1.07		0.43	0.54	.426	-0.66	1.48
	H Habit		1.00	0.56	.075	-0.08	2.10		-0.70	0.68	.317	-2.10	0.55
	U Habit		0.82	0.46	.074	-0.09	1.73		1.27	0.59	.033	-0.00	2.34
Model 3	Constant	.00, *p* = .914	-1.23	5.07	.798	-9.99	10.14	.01, *p* = .355	25.30	6.68	<.001	12.19	38.42
	Age		0.02	0.06	.806	-0.09	0.12		-0.00	0.07	.951	-0.13	0.14
	Sex		-0.57	1.01	.579	-2.46	1.39		-1.55	1.50	.301	-4.28	1.53
	BMI		0.12	0.12	.293	-0.11	0.36		-0.06	0.16	.760	-0.38	0.27
	Attitudes		0.63	0.85	.464	-1.18	2.15		-0.65	0.94	.476	-2.62	1.08
	Norms		0.26	0.42	.538	-0.54	1.10		0.38	0.53	.463	-0.64	1.42
	H Habit		1.01	0.57	.076	-0.09	2.12		-0.74	0.66	.267	-2.05	0.49
	U Habit		0.83	0.46	.073	-0.08	1.74		1.26	0.56	.027	0.08	2.28
	H implicit identity		-0.34	1.70	.836	-3.60	3.15		-0.74	2.23	.739	-4.97	3.65
	U implicit identity		-0.44	1.50	.761	-3.40	2.44		2.79	1.89	.139	-1.07	6.35
	R^2total	.09, *p* = .162						.16, *p* = .005					

Note: Number of bootstrap samples = 2000. H = healthy, U = unhealthy, BMI = body mass index, *LL* = lower limit, *UL* = upper limit.

Exploratory Analysis

As shown in Table 5, unhealthy implicit identity was significantly related to the scale measure of past eating behaviour (r = -.21, p < .05) and PBC (r = -.19, p < .05) (see also Tables 6 and 7), and PBC was significantly related to the scale measure of past eating behaviour (r = .66, p < .001). It was therefore hypothesised that PBC may be a mediating variable for the association between unhealthy implicit identity and past eating behaviour. Given this possibility, an exploratory mediation analysis was conducted. The results of this analysis are shown in Figure 1. The significant relationship between unhealthy implicit identity and past eating behaviour ceased to be significant when controlling for PBC. The bootstrapped indirect effect (b = -0.21; SE = 0.10; 95% CI [-0.43, -0.03]) was significant (i.e., the 95% confidence interval did not include zero) showing that PBC was a significant mediator of the relationship between unhealthy implicit identity and past eating behaviour (scale). High unhealthy implicit identity predicted less PBC for healthy eating, which then predicted less healthy eating behaviours over the past two weeks.

Figure 1
Unstandardized Regression Coefficients for the Relationship Between Unhealthy Implicit Identity and Past Eating Behaviour (Scale) as Mediated by PBC



Note: PBC = perceived behavioural control.
[a] Effect size for the effect of unhealthy implicit identity on PBC. [b] Effect size for the effect of unhealthy implicit identity and PBC on past eating behaviour (scale).
* $p < .05$.

Moderation Analyses

Results for the interaction between self-control and unhealthy implicit identity are presented in Table 9 and results for the interaction between self-control and healthy implicit identity are presented in Table 10. Self-control was a significant predictor of PBC for healthy eating, but not for any of the other outcome variables. Moreover, self-control was not a significant moderator for the relationship between healthy or unhealthy implicit identity and any of the outcome variables.

Table 9

Study 1 Moderation Analyses for Unhealthy Implicit Identity and Self-Control

	Model 3	Model 4	Model 5	Self-control [a]					Interaction [b]				
	R^2	R^2change	R^2change	*b*	*SE*	*p*	95% CI		*b*	*SE*	*p*	95% CI	
							LL	*UL*				*LL*	*UL*
Past EB (scale)	.58, *p* < .001	.00, *p* = .587	.00, *p* = .713	0.03	0.07	.618	-0.10	0.16	-0.05	0.13	.704	-0.29	0.24
Past EB (1 item)	.68, *p* < .001	.00, *p* = .304	.00, *p* = .618	0.14	0.14	.339	-0.15	0.41	0.15	0.36	.691	-0.58	0.84
PBC	.66, *p* < .001	.03, *p* < .001	.00, *p* = .830	0.28	0.08	.003	0.11	0.44	-0.04	0.17	.825	-0.36	0.29
FVF intake	.09, *p* = .162	.01, *p* = .272	.01, *p* = .400	0.96	0.97	.320	-1.03	2.87	1.61	1.95	.388	-2.42	5.38
Fat intake	.16, *p* = .005	.00, *p* = .422	.01, *p* = .267	0.96	1.30	.457	-1.41	3.72	2.94	2.64	.261	-2.76	7.61
	χ^2	χ^2	χ^2	*b*	*SE*	*p*	95% CI		*b*	*SE*	*p*	95% CI	
							LL	*UL*				*LL*	*UL*
Menu Choice	22.00, *p* = .009	1.10, *p* = .295	3.38, *p* = .066	0.35	0.40	.323	-0.39	1.21	-1.42	0.95	.064	-3.56	0.09

Note: EB = eating behaviour, PBC = perceived behavioural control, FVF = fruit/vegetable/fibre, *LL* = lower limit, *UL* = upper limit. Model 3: Sex, BMI, attitudes, subjective norms, habit strength, and implicit identity. Model 4: Self-control added. Model 5: Interaction between self-control and implicit identity added. χ^2 tests compare each model to the previous model, with Model 3 compared to an intercept-only model.

[a] Regression estimates for self-control from Model 4. [b] Regression estimates for the interaction from Model 5.

Table 10

Study 1 Moderation Analyses for Healthy Implicit Identity and Self-Control

	Model 3	Model 4	Model 5	Self-control [a]					Interaction [b]				
	R^2	R^2change	R^2change	b	SE	*p*	95% CI		*b*	*SE*	*p*	95% CI	
							LL	*UL*				*LL*	*UL*
Past EB (scale)	.58, *p* < .001	.00, *p* = .587	.00, *p* = .314	0.03	0.06	.583	-0.10	0.16	0.16	0.16	.303	-0.18	0.44
Past EB (1 item)	.68, *p* < .001	.00, *p* = .304	.00, *p* = .702	0.14	0.14	.337	-0.15	0.40	-0.13	0.37	.720	-0.85	0.59
PBC	.66, *p* < .001	.03, *p* < .001	.00, *p* = .325	0.28	0.08	.002	0.12	0.43	-0.19	0.18	.293	-0.54	0.17
FVF intake	.09, *p* = .162	.01, *p* = .272	.00, *p* = .581	0.96	0.98	.319	-0.98	2.86	-1.21	2.22	.583	-5.88	2.95
Fat intake	.16, *p* = .005	.00, *p* = .422	.00, *p* = .421	0.96	1.25	.446	-1.33	3.54	-2.44	3.03	.403	-8.01	4.15
	χ^2	χ^2	χ^2	*b*	*SE*	*p*	95% CI		*b*	*SE*	*p*	95% CI	
							LL	*UL*				*LL*	*UL*
Menu Choice	22.00, *p* = .009	1.10, *p* = .295	1.24, *p* = .265	0.35	0.39	.316	-0.40	1.13	1.29	2.44	.545	-3.57	6.18

Note: EB = eating behaviour, PBC = perceived behavioural control, FVF = fruit/vegetable/fibre, *LL* = lower limit, *UL* = upper limit. Model 3: Sex, BMI, attitudes, subjective norms, habit strength, and implicit identity. Model 4: Self-control added. Model 5: Interaction between self-control and implicit identity added. χ^2 tests compare each model to the previous model, with Model 3 compared to an intercept-only model.

[a] Regression estimates for self-control from Model 4. [b] Regression estimates for the interaction from Model 5.

Summary

Study 1 was conducted as an initial assessment of implicit identity as a predictor of eating behaviour, using a cross-sectional online survey. Study 1 bivariate correlations and regression analyses found that unhealthy implicit identity was a significant predictor of perceived behavioural control for healthy eating and of past eating behaviour (scale). A significant mediation model was found, in which PBC mediated the relationship between unhealthy implicit identity and past eating behaviour (scale); participants with unhealthy implicit identities felt less in control over healthy eating, which then predicted less healthy eating behaviours.

Despite these significant findings, no other hypothesised relationships between implicit identity and the eating-related outcomes were significant. Unhealthy implicit identity was not a significant predictor of the single item measure of past eating behaviour, menu choice, fat consumption, or fruit, vegetable, and fibre consumption. Healthy implicit identity was not a significant predictor of any outcome variable. In addition, self-control was not a significant moderator for any of the outcome variables.

Study 1 provided strong evidence for habit strength as a predictor of eating-related outcomes. Healthy and unhealthy habit strength were both significant predictors of both measures of past eating behaviour and PBC; healthy habit was a significant predictor of menu choice; and unhealthy habit was a significant predictor of fat consumption. Regression models provided little evidence that the other predictor variables were predictive of eating-related outcomes. Attitudes was a significant predictor of the scale measure of past eating behaviour, with more positive attitudes predicting greater healthy eating. However, attitudes and subjective norms were not significantly associated with any other outcome variables in the final model.

While Study 1 provided some initial evidence for unhealthy implicit identity as a predictor, most hypothesised relationships were not significant. Given these mixed findings, it was decided that further research was needed to clarify the role of eating-related implicit identity as a predictor of eating behaviour. Studies 2 and 3 were therefore designed to replicate and extend Study 1 by looking at the two SC-IATs as predictors of eating-related behaviour in different populations (university students and an adult community sample) and using different measures of healthy and unhealthy eating.

Study 2

Method

Participants

Participants were adults living in New Zealand who were recruited as part of a wider community study on health and wellbeing. Recruitment occurred through social media, flyer drops in letter boxes, and letters posted to postal addresses retrieved from the white pages. Participants were recruited to participate in a longitudinal study and completed questionnaires at baseline (Time 1), 3 months (Time 2), and 12 months later (Time 3). Data collected at Time 1 and Time 2 were used for the current study. At study entry, participants were given the choice to complete the study online or on paper. Participants who completed the study on paper did not complete the implicit measure (IAT) and were therefore excluded from all data analyses. One hundred and sixty participants completed online measures at Time 1 and 158 at Time 2 (95% return response rate). Of these, 98 completed the implicit measure and were eligible for inclusion in this study. Due to the online nature of the study it is unknown why many participants did not complete the IAT. It is possible that some participants may have experienced technical problems or other difficulties and were unable to complete the measure, or participants may have chosen not to complete the measure for reasons such as boredom. Two participants were excluded for not completing the Time 2 outcome measures, and two participants were excluded for having a high error rate or a high percentage of fast response times on the IAT (an error rate above 20% or more than 10% of responses faster than 300 ms) (Karpinski & Steinman, 2006). As in Study 1, participants with a BMI above 40 or below 18.5 were excluded (*n*= 10)[2]. This left 84 participants for analysis. Descriptive statistics for this sample are displayed in Table 11. The majority of participants were female and New Zealand European. Ages ranged from 24 to 82 years, and BMIs ranged from 18.93 to 39.92. There was one missing value for age and two missing values for BMI. Eighteen participants (21.4%) reported having at least one food allergy and 23 (27.4%) reported having another dietary requirement (e.g. vegetarian, vegan).

Table 11
Study 2 Description of Sample

		N	%
Gender	Male	23	27.4
	Female	61	72.6
Ethnicity[a]	NZ European	73	86.9
	NZ Maori	4	4.8
	Other	10	11.9
Education	Left without school certificate	9	10.7
	NCEA level 1 or equivalent	3	3.6
	NCEA level 2 or equivalent	2	2.4
	NCEA level 3 or equivalent	7	8.3
	Other secondary school qualification (e.g. overseas)	5	6.0
	Trade certificate or diploma	5	6.0
	Other polytechnic certificate or diploma	17	20.2
	University degree	23	27.4
	University postgraduate qualification	13	15.5
		M	*SD*
Age		50.44	13.57
BMI		28.49	5.32

Note: N = 84. BMI = body mass index.
[a] more than 1 answer possible.

[2] When analyses were repeated with these participants included, the interaction between healthy implicit identity and self-control was no longer significant when predicting past eating behaviour (single item). Other results involving implicit variables were unchanged (see Data Analysis and Results sections).

Measures

Participants reported their date of birth, which was used to calculate their age in years. They also reported their gender (response options: male, female, or gender diverse), ethnicity, and highest educational qualification.

BMI (Time 1). Participants reported their height and weight, which were used to calculate BMI (see Study 1 Measures).

Single-Category Implicit Association Tests (Time 1). Two SC-IATs were used to measure implicit identification with healthy eating and implicit identification with unhealthy eating (see Study 1 Measures).

Habit (Time 2). Habit strength was measured using a 4-item version of the Self-Report Habit Index (Gardner et al., 2012) (see Study 1 measures). The short form contains 4 items measuring the subscale of automaticity (e.g. "X is something I do without thinking") and participants rate their agreement with these statements using a 7-point Likert scale (Gardner et al., 2012). Participants completed the measure twice, once for the behaviour of healthy eating and once for the behaviour of eating high-calorie snacks. Cronbach's alpha was .95 for healthy habit and .89 for unhealthy habit.

Attitudes to Healthy Eating (Time 1). Attitudes towards healthy eating were measured using the health subscale of the Food Choice Questionnaire (Steptoe et al., 1995). This subscale contains five items measuring motives for selecting foods for health reasons (e.g. "It is important to me that the food I eat on a typical day is nutritious"). Participants rated their agreement with these statements on a 4-point Likert scale, with higher scores indicating stronger attitudes in favour of healthy eating. Cronbach's alpha was .84.

Self-Control (Time 1). Self-control was measured using the Brief Self-Control Scale (Tangney et al., 2004) (see Study 1 measures). Cronbach's alpha was .81.

Past Eating Behaviour (Time 2). A 5-item scale and a single item were used to measure past eating behaviour at Time 2 (Kuijer & Boyce, 2012, 2014; Wood Baker et al., 2003) (see Study 1 measures). Cronbach's alpha for the scale measure was .73.

Servings Eaten Yesterday (Time 2). Participants were asked to report how many servings of seven different food groups they ate on the day preceding their participation (Conner et al., 2015; Russell et al., 1999; White et al., 2013). The foods measured were: fruits; vegetables; wholegrain cereals or bread; crisps, corn snacks, or corn chips; hot chips, French fries, or wedges; lollies, sweets, chocolate, or confectionary; and biscuits, cake, muffins, or buns. Participants were also asked to specify whether they were answering for a weekend or a weekday. Responses were made on a 6-point scale ranging from '0 servings' to '4 or more servings'. Higher scores indicated a greater number of servings eaten yesterday. In the literature on prediction of eating behaviours, fruit and vegetables are commonly combined into one outcome (Carfora et al., 2016a; Evans et al., 2017; Kothe & Mullan, 2015; Kothe et al., 2012) and unhealthy foods are also commonly combined into one outcome (Ayre et al., 2019; Evans et al., 2017; Gardner et al., 2015). The items were therefore used to create three scales: fruit and vegetable consumption (the average of the fruit and vegetable items), wholegrain consumption, and unhealthy food consumption (the average of the items measuring crisps, chips, lollies, and biscuits).

Perceived Behavioural Control (Time 2). A 4-item scale was used to measure perceived behavioural control over eating at Time 2 (Kuijer & Boyce, 2014) (see Study 1 Measures). Cronbach's alpha was .71.

Procedure

This study was approved by the University of Canterbury Human Ethics Committee (HEC 2018/24). People who were interested in participating in the study were asked to email the primary researcher and were either emailed a link to complete the study online or were posted a paper version of the survey. As the implicit measure could only be completed online, participants who requested a paper copy of the survey did not complete the implicit measure and were not included in this sample. The online survey (Time 1) was hosted on Qualtrics, and the implicit measure was hosted on millisecond.com. Participants who clicked on a link to the online survey were given a description of the study to read and were asked to consent to participate. Those who consented first completed demographic measures and then completed the rest of the survey. At the end of the survey, participants were given a link to the implicit measure. They were asked to keep the Qualtrics survey open in another tab while they did this. At the end of the implicit measure they were given a numerical code to enter back into the Qualtrics survey, to allow their responses to be matched while maintaining confidentiality. Finally, participants were thanked for their time and were asked if they wanted to make any comments about the study or survey. Time 1 took on average 30 minutes to complete. Approximately 3 months after the completion of the first survey and the implicit measure, participants were emailed a link to the second survey (Time 2). This survey took on average 5 minutes to complete and was also hosted on Qualtrics. Responses at Time 1 and Time 2 were matched using numerical codes, which were generated by Qualtrics and were linked to each participant’s email address. Participants received a $10 supermarket voucher for completing Time 1 and went into a draw to win one of four vouchers (two $50 vouchers, two $100 vouchers) for completing Time 2.

Data Analysis

Prior to analysis, relevant assumptions (absence of outliers, normal distributions, and linear relationships between variables) were checked (see Study 1 Data Analysis). No multivariate outliers were present for any of the analyses. Servings of fruits and vegetables had a negatively skewed distribution, and servings of unhealthy foods had a positively skewed distribution with one univariate outlier. Data transformations were used on these variables to create approximately normal distributions and to lessen the impact of outliers (Tabachnick & Fidell, 2014). Analyses predicting fruit and vegetable servings and servings of unhealthy foods were tested using both the transformed and non-transformed variables (Newton & Rudestam, 2013). As this did not affect the significance of either implicit identity variable, results are reported for the non-transformed variables.

Bivariate correlations and hierarchical multiple regression analyses were conducted using IBM SPSS version 25. Separate hierarchical multiple regressions were conducted predicting each outcome variable (past eating behaviour scale, past eating behaviour single item, PBC, servings of fruit and vegetables, servings of wholegrains, and servings of unhealthy foods). Alpha was set at .05, and bootstrapped 95% confidence intervals with 2000 samples were calculated for each analysis. Bootstrapped coefficients, standard errors, significance levels, and confidence intervals are reported for each predictor. In each regression, age, gender, and BMI were entered first (Model 1), explicit predictors (attitudes and habit) were entered in Model 2, and healthy and unhealthy implicit identity were entered in Model 3. Post-hoc power analyses (see Study 1 Data Analysis) found that these regression models had adequate power (93.9%) to detect a medium effect of implicit identity, but were underpowered (24.9%) to detect a small effect.

Moderation analyses were conducted using IBM SPSS version 25. A separate analysis was conducted for each outcome variable with self-control as a moderator for the relationship between implicit identity and the eating-related measures. In Model 4, self-control was added to the final regression model (Model 3) and in Model 5, the interaction term was added. Bootstrapped 95% confidence intervals with 2000 samples were calculated for the coefficients for self-control and the interaction term. Significant interaction effects were followed up with simple slope analyses at low (one standard deviation below the mean), average (at the mean) and high (one standard deviation over the mean) levels of the moderator). As in the regression analyses, each moderation was tested using both the transformed and non-transformed variables for norms, attitudes, and servings of unhealthy foods (Newton & Rudestam, 2013). As this did not affect the significance of the implicit variables, results are reported for the non-transformed variables.

Regression and moderation analyses were repeated with participants with all BMIs included. As allergies or other dietary requirements could affect eating behaviours, the analyses were also repeated excluding participants who reported having dietary requirements. The results remained largely unchanged. There were two instances where the significance of implicit identity as a predictor was affected (see Results).

Results

Correlations

Scale means and standard deviations and bivariate correlations between the measures are presented in Table 12. As in Study 1, healthy and unhealthy implicit identity were positively correlated with each other. Unhealthy implicit identity was negatively correlated with the single-item measure of past eating behaviour. No other significant correlations were found between healthy and unhealthy implicit identity and any of the other variables in the study. Attitudes towards healthy eating, healthy habit, and unhealthy habit were significantly correlated with all of the Time 2 outcome measures except for wholegrain consumption. The moderator variable of self-control was also correlated with all outcome variables except for wholegrain intake. Both measures of past eating behaviour and unhealthy food intake were correlated with all other outcome variables. PBC and fruit and vegetable intake were correlated with all outcome variables except wholegrain intake.

Table 12
Study 2 Correlations, Means, and Standard Deviations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. H implicit identity	1.00														
2. U implicit identity	.30**	1.00													
3. Age	.17	-.04	1.00												
4. Gender	.08	.04	-.24*	1.00											
5. BMI	-.05	.00	.09	-.09	1.00										
6. Attitudes	.02	-.17	-.05	.23*	-.19	1.00									
7. H habit	-.00	-.01	.08	.16	-.40**	.45**	1.00								
8. U habit	-.09	.15	-.24*	.07	.23*	-.29**	-.42**	1.00							
9. Self-control	-.07	-.11	.25*	.03	-.30**	.45**	.45**	-.49**	1.00						
10. Past EB (scale)	.13	-.07	.35**	.10	-.23*	.32**	.52**	-.52**	.53**	1.00					
11. Past EB (1 item)	-.15	-.27*	.16*	.02	-.22*	.41**	.46**	-.33**	.41**	.67**	1.00				
12. PBC	.13	-.16	.36**	.00	-.34**	.29**	.59**	-.53**	.50**	.82**	.61**	1.00			
13. FV intake	.08	.15	-.02	.29**	-.11	.41**	.56**	-.23*	.38**	.44**	.29**	.39**	1.00		
14. Wholegrain intake	.05	-.04	.12	-.31**	.03	-.19	-.08	.16	-.10	-.37**	-.38**	-.19	-.14	1.00	
15. Unhealthy food intake	-.03	.18	-.11	-.25*	.12	-.28**	-.45**	.40*	-.25*	-.53**	-.39*	-.52**	-.38**	.31**	1.00
M	-0.14	-0.28	50.44		28.49	2.92	3.47	2.62	3.50	3.89	4.65	4.10	4.11	3.32	1.59
SD	0.35	0.33	13.57		5.32	0.69	1.05	0.93	0.60	0.71	1.49	1.04	1.19	1.37	0.56

Note: H = healthy, U = healthy, BMI = body mass index, EB = eating behaviour, PBC = perceived behavioural control, FV = fruit/vegetable. Gender coded as 1 = male, 2 = female.
* p <.05. ** p <.01.

Regression Analyses

Regressions predicting the Time 2 outcome variables are presented in Tables 13-15. Implicit identity was not a significant predictor of any of the outcome measures after controlling for demographic and explicit predictors. Participants reported more healthy past eating behaviour on the scale measure when they were older and had a stronger healthy eating habit and a weaker unhealthy eating habit. They reported more healthy past eating behaviour on the single-item measure when they had a stronger healthy eating habit. Stronger PBC for healthy eating was predicted by older age, stronger healthy eating habit, and weaker unhealthy eating habit. Participants reported consuming more servings of unhealthy foods when they had a weaker healthy eating habit and a stronger unhealthy eating habit, and males tended to report consuming more servings of unhealthy foods than females. Participants reported consuming more servings of fruits and vegetables when they had a stronger healthy eating habit. Gender was the only significant predictor of wholegrain consumption in the final regression model, with males reporting greater consumption of wholegrains.

Table 13

Study 2 Regression Analyses Predicting Past Eating Behaviour

		Past eating behaviour (scale)						Past eating behaviour (single item)					
		R^2change	*b*	*SE*	*p*	95% CI		R^2change	*b*	*SE*	*p*	95% CI	
						LL	*UL*					*LL*	*UL*
Model 1	Constant	.23, *p* < .001	3.28	0.63	< .001	2.08	4.52	.08, *p* = .103	5.26	1.22	< .001	2.69	7.48
	Age		0.02	0.01	.001	0.01	0.03		0.02	0.01	.154	-0.01	0.04
	Gender		0.27	0.18	.139	-0.08	0.64		0.15	0.40	.713	-0.63	0.92
	BMI		-0.03	0.02	.025	-0.06	-0.01		-0.07	0.03	.048	-0.13	-0.00
Model 2	Constant	.24, *p* < .001	2.59	0.68	.001	1.25	3.96	.21, *p* < .001	2.15	1.60	.174	-1.03	5.26
	Age		0.02	0.01	.006	0.00	0.03		0.01	0.01	.436	-0.02	0.04
	Gender		0.19	0.14	.175	-0.08	0.48		-0.16	0.36	.682	-0.82	0.55
	BMI		-0.01	0.01	.647	-.003	0.02		-0.01	0.03	.698	-0.08	0.05
	Attitudes		0.07	0.10	.517	-0.13	0.27		0.50	0.24	.046	0.03	0.99
	H habit		0.21	0.08	.008	0.05	0.35		0.43	0.17	.010	0.09	0.75
	U habit		-0.22	0.08	.004	-0.36	-0.06		-0.15	0.19	.442	-0.53	0.21
Model 3	Constant	.00, *p* = .855	2.61	0.70	.001	1.24	4.01	.06, *p* = .041	1.65	1.51	.266	-1.33	4.65
	Age		0.02	0.01	.008	0.00	0.03		0.01	0.01	.264	-0.01	0.04
	Gender		0.18	0.15	.222	-0.11	0.48		-0.03	0.35	.933	-0.71	0.67
	BMI		-0.01	0.01	.663	-0.03	0.02		-0.02	0.03	.578	-0.07	0.04
	Attitudes		0.06	0.11	.573	-0.14	0.27		0.45	0.24	.067	0.00	0.93
	H habit		0.22	0.08	.011	0.05	0.36		0.44	0.17	.012	0.08	0.76
	U habit		-0.22	0.08	.008	-0.37	-0.05		-0.13	0.19	.522	-0.51	0.22
	H implicit identity		0.11	0.19	.576	-0.27	0.47		-0.62	0.39	.114	-1.37	0.14
	U implicit identity		-0.06	0.22	.775	-0.50	0.36		-0.81	0.45	.071	-1.71	0.04
	R^2total	.47. *p* < .001						.35, *p* < .001					

Note: Number of bootstrap samples = 2000. H = healthy, U = unhealthy, BMI = body mass index, *LL* = lower limit, *UL* = upper limit.

Table 14

Study 2 Regression Analyses Predicting PBC and Unhealthy Servings

		PBC						Serves of unhealthy foods					
		R^2change	*b*	*SE*	*p*	95% CI		R^2change	*b*	*SE*	*p*	95% CI	
						LL	*UL*					*LL*	*UL*
Model 1	Constant	.27, *p* < .001	4.34	0.86	<.001	2.73	6.04	.11, *p* = .027	2.30	0.47	<.001	1.44	3.21
	Age		0.03	0.01	.001	0.02	0.05		-0.01	0.01	.082	-0.02	0.00
	Gender		0.15	0.24	.524	-0.31	0.61		-0.37	0.14	.010	-0.65	-0.10
	BMI		-0.07	0.02	.001	-0.12	-0.03		0.01	0.01	.345	-0.01	0.04
Model 2	Constant	.27, *p* < .001	3.12	1.01	.003	1.22	5.11	.22, *p* < .001	2.75	0.71	<.001	1.47	4.21
	Age		0.02	0.01	.005	0.01	0.03		-0.00	0.00	.565	-0.01	0.01
	Gender		0.04	0.18	.840	-0.31	0.37		-0.32	0.13	.016	-0.57	-0.07
	BMI		-0.03	0.02	.166	-0.06	0.01		-0.01	0.01	.341	-0.03	0.01
	Attitudes		-0.00	0.17	.980	-0.33	0.34		-0.00	0.09	.973	-0.18	0.20
	H habit		0.41	0.11	.001	0.20	0.61		-0.18	0.07	.018	-0.35	-0.06
	U habit		-0.30	0.10	.001	-0.46	-0.10		0.17	0.06	.009	0.04	0.28
Model 3	Constant	.02, *p* = .233	3.07	0.95	.002	1.24	5.00	.03, *p* = .247	2.85	0.70	<.001	1.59	4.31
	Age		0.02	0.01	.011	0.00	0.03		-0.00	0.00	.550	-0.01	0.01
	Gender		0.02	0.18	.910	-0.34	0.36		-0.34	0.13	.011	-0.60	-0.09
	BMI		-0.03	0.02	.180	-0.06	0.01		-0.01	0.01	.346	-0.03	0.01
	Attitudes		-0.04	0.18	.796	-0.40	0.31		0.02	0.10	.827	-0.16	0.23
	H habit		0.44	0.11	.000	0.23	0.63		-0.19	0.08	.014	-0.36	-0.07
	U habit		-0.27	0.09	.004	-0.43	-0.07		0.16	0.07	.016	0.02	0.27
	H implicit identity		0.31	0.24	.189	-0.16	0.79		-0.02	0.16	.902	-0.34	0.30
	U implicit identity		-0.43	0.27	.131	-0.95	0.15		0.30	0.17	.086	-0.02	0.66
	R^2total	.55, *p* < .001						.36, *p* < .001					

Note: Number of bootstrap samples = 2000. H = healthy, U = unhealthy, BMI = body mass index, PBC = perceived behavioural control, *LL* = lower limit, *UL* = upper limit.

Table 15

Study 2 Regression Analyses Predicting Fruit/Vegetable and Wholegrain Servings

		Serves of fruits and vegetables (T2)						Serves of wholegrains					
		R^2change	*b*	*SE*	*p*	95% CI		R^2change	*b*	*SE*	*p*	95% CI	
						LL	*UL*					*LL*	*UL*
Model 1	Constant	.10, *p* = .040	2.95	1.14	.010	0.95	5.34	.09, *p* = .061	4.54	1.36	.001	2.01	7.38
	Age		0.01	0.01	.536	-0.01	0.03		0.01	0.01	.628	-0.02	0.03
	Gender		0.82	0.34	.023	0.13	1.46		-0.87	0.36	.016	-1.58	-0.18
	BMI		-0.02	0.02	.397	-0.07	0.03		0.00	0.03	.989	-0.06	0.05
Model 2	Constant	.31, *p* < .001	-0.46	1.40	.739	-2.93	2.64	.06, *p* = .203	3.97	1.87	.035	0.51	7.74
	Age		-0.00	0.01	.882	-0.02	0.02		0.01	0.01	.374	-0.02	0.04
	Gender		0.53	0.26	.053	-0.02	1.02		-0.86	0.35	.012	-1.56	-0.21
	BMI		0.03	0.02	.147	-0.01	0.08		-0.01	0.03	.690	-0.07	0.05
	Attitudes		0.27	0.20	.166	-0.18	0.61		-0.21	0.22	.338	-0.65	0.23
	H habit		0.59	0.17	.002	0.26	0.92		0.11	0.19	.574	-0.24	0.51
	U habit		-0.01	0.14	.927	-0.28	0.26		0.33	0.18	.066	-0.02	0.68
Model 3	Constant	.03, *p* = .169	-0.22	1.35	.867	-2.69	2.69	.02, *p* = .462	3.93	1.88	.041	0.46	7.84
	Age		-0.00	0.01	.861	-0.02	0.01		0.01	0.01	.505	-0.02	0.03
	Gender		0.49	0.27	.085	-0.08	1.00		-0.89	0.36	.014	-1.58	-0.19
	BMI		0.03	0.02	.130	-0.01	0.08		-0.01	0.03	.735	-0.07	0.05
	Attitudes		0.33	0.20	.118	-0.11	0.69		-0.26	0.23	.250	-0.70	0.19
	H habit		0.56	0.17	.003	0.23	0.90		0.14	0.20	.479	-0.24	0.55
	U habit		-0.04	0.14	.778	-0.30	0.25		0.37	0.19	.057	-0.00	0.73
	H implicit identity		0.02	0.34	.947	-0.62	0.72		0.44	0.49	.370	-0.57	1.40
	U implicit identity		0.64	0.39	.107	-0.11	1.38		-0.53	0.51	.284	-1.55	0.51
	R^2total	.44, *p* < .001						.16, *p* = .100					

Note: Number of bootstrap samples = 2000. H = healthy, U = unhealthy, BMI = body mass index, *LL* = lower limit, *UL* = upper limit.

Moderation Analyses

Results for the interaction of self-control with healthy and unhealthy implicit identity are presented in Table 16. Self-control was a significant predictor of the scale measure of past eating behaviour after controlling for demographic, explicit, and implicit predictors. There was a significant interaction between healthy implicit identity and self-control when predicting wholegrain consumption[3]. The interaction between healthy implicit identity and self-control was significant at the $p < .05$ level when predicting the single item of past eating behaviour; however, the confidence intervals included 0.

Following the recommendations of Aiken et al. (1991), the significant interaction between healthy implicit identity and self-control predicting wholegrain consumption was followed up with a simple slope analysis at low (one standard deviation below the mean), average (at the mean), and high (one standard deviation above the mean) levels of the moderator, using standardized variables to reduce problems with multicollinearity. Bootstrapped 95% confidence intervals with 2000 resamples were calculated. When self-control was low, there was a significant positive relationship between healthy implicit identity and wholegrain consumption (b = 1.59, SE = .54, p = .003, 95% CI [0.39, 2.58]). When self-control was average there was no significant relationship between healthy implicit identity and wholegrain consumption (b = 0.13, SE = .39, p = .726, 95% CI [-0.69, 0.85]). When self-control was high, there was a significant negative relationship between healthy implicit identity and wholegrain consumption (b = -1.34, SE = .46, p = .004, 95% CI [-2.18, -0.33]). In summary, people with strong healthy implicit identity ate more wholegrains when

[3] The significant interaction was no longer significant when analyses were repeated with participants of all BMIs included (b = 1.11, SE = 0.74, p = .102, 95% CI [-0.65, 2.229]) and when participants with dietary requirements were excluded (b = 0.84, SE = 1.14, p = .402, 95% CI [-1.65, 2.98]).

they also had low self-control, but ate fewer wholegrains when they also had high self-control.

Table 16
Study 2 Moderation Analyses

Unhealthy implicit identity * self-control													
	Model 3	Model 4	Model 5	Self-control[a]					Interaction[b]				
	R^2change	R^2change	R^2change	*b*	*SE*	*p*	95% CI		*b*	*SE*	*p*	95% CI	
							LL	*UL*				*LL*	*UL*
Past EB (scale)	.47, *p* < .001	.04, *p* = .022	.01, *p* = .311	0.31	0.13	.018	0.02	0.53	0.35	0.38	.347	-0.34	1.19
Past EB (1 item)	.35, *p* < .001	.01, *p* = .428	.02, *p* = .197	0.25	0.36	.492	-0.45	1.00	1.06	0.85	.201	-0.69	2.65
PBC	.55, *p* < .001	.01, *p* = .191	.00, *p* = .906	0.24	0.18	.182	-0.15	0.55	-0.06	0.50	.902	-1.00	1.04
Serves FV	.44, *p* < .001	.03, *p* = .061	.00, *p* = .536	0.43	0.24	.075	-0.03	0.91	0.37	0.63	.521	-0.75	1.77
Serves of wholegrains	.16, *p* = .100	.00, *p* = .924	.03, *p* = .115	0.03	0.40	.937	-0.74	0.79	-1.37	0.87	.105	-2.96	0.48
Serves of unhealthy food	.36, *p* < .001	.00, *p* = .600	.00, *p* = .499	0.06	0.13	.628	-0.20	0.30	-0.21	0.34	.530	-0.85	0.49
Healthy implicit identity * self-control													
	Model 3	Model 4	Model 5	Self-control[a]					Interaction[b]				
	R^2change	R^2change	R^2change	*b*	*SE*	*p*	95% CI		*b*	*SE*	*p*	95% CI	
							LL	*UL*				*LL*	*UL*
Past EB (scale)	.47, *p* < .001	.04, *p* = .022	.01, *p* = .236	0.31	0.13	.019	0.04	0.53	0.35	0.39	.309	-0.23	1.31
Past EB (1 item)	.35, *p* < .001	.01, *p* = .428	.03, *p* = .057	0.25	0.35	.464	-0.45	0.95	1.33	0.68	.034	-0.32	2.45
PBC	.55, *p* < .001	.01, *p* = .191	.00, *p* = .877	0.24	0.18	.174	-0.16	0.55	0.06	0.45	.883	-0.77	1.04
Serves FV	.44, *p* < .001	.03, *p* = .061	.00, *p* = .453	0.43	0.24	.072	-0.05	0.89	-0.39	0.51	.416	-1.32	0.69
Serves of wholegrains	.16, *p* = .100	.00, *p* = .924	.14, *p* < .001	0.03	0.40	.937	-0.78	0.79	-2.51	0.62	<.001	-3.54	-1.07
Serves of unhealthy food	.36, *p* < .001	.00, *p* = .600	.01, *p* = .381	0.06	0.13	.636	-0.21	0.32	-0.24	0.29	.359	-0.64	0.51

Note: EB = eating behaviour, PBC = perceived behavioural control, FV = fruit/vegetables, *LL* = lower limit, *UL* = upper limit. Model 3: Gender, age, BMI, attitudes, habit strength, and implicit identity. Model 4: Self-control added. Model 5: Interaction between self-control and implicit identity added.
[a] Regression estimates for self-control from Model 4. [b] Regression estimates for the interaction from Model 5.

Summary

Study 2 tested implicit identity as a predictor of eating behaviour using a community sample of New Zealand adults. Regression analyses showed that implicit identity was not a significant predictor of eating behaviour over and above the influence of demographic and explicit predictors. Self-control and implicit identity did not interact when predicting eating behaviour, except for the interaction between healthy implicit identity and self-control predicting wholegrain consumption. As in Study 1, habit strength was found to be a key predictor. In Study 2, habit strength was a significant predictor of every outcome variable except for wholegrain consumption.

Although Study 1 found that unhealthy implicit identity was a significant predictor of PBC and past eating behaviour, these findings were not replicated in Study 2. Further research is therefore needed to clarify the relationship between implicit identity and eating-related outcomes. Study 3 was conducted to provide an additional assessment of whether implicit identity, as measured by the two SC-IATs, can predict eating-related outcomes including baseline measures and a 7-day food diary. In addition, Study 3 included stress as an additional moderator variable.

Study 3

Method

Participants

Participants were students at the University of Canterbury who were recruited for a study on “personality and eating behaviours” and were given either course credit for a 100-level psychology course or a $10 voucher for participating. Participation involved completing a baseline survey and 7-day food diary. Participants were required to be over 18 years of age and fluent in English. The baseline survey was completed by 199 participants. Of these, 24 were excluded for large amounts of missing data (completing no more than demographic measures). Two were excluded for not completing the IAT. Three participants completed the survey twice; their first response was retained and their second response was excluded. Fourteen participants were removed based on SC-IAT criteria (having an error rate over 20% or more than 10% of responses with a latency under 300ms; see Karpinski & Steinman, 2006). In keeping with Studies 1 and 2, 21 participants were removed for having BMIs below 18.5 or over 30[4], leaving 135 participants remaining for analysis; due to the smaller number of obese participants in this study than in Studies 1 and 2, participants with BMIs between 30 and 40 were able to be excluded. Descriptive statistics for these participants are reported in Table 17 below. Ages ranged from 18.49 to 34.06 and BMI ranged from 18.52 to 29.90. There were two missing values for BMI. All participants reported an English fluency of 6 or above on a 10-point scale, with 120 (88.9%) rating their English language fluency as 10. Twenty-five (18.5%) participants reported having at least one food allergy (e.g. Coeliac disease, nut allergy). Forty-seven participants reported having another dietary requirement (e.g. vegetarian, vegan, gluten-free). Participant responses on the daily diary measures were included for analysis if the participant had completed at least five of the seven daily diaries. Analyses involving the daily diary variables were conducted with a smaller sample (N = 109) due to some participants completing fewer than five diary entries.

[4] When analyses were repeated with these participants included, the interaction between unhealthy implicit identity and stress predicting PBC was not significant. In the multi-level models, healthy implicit identity became a significant predictor of serves of unhealthy food in models 3 and 5. Other results for implicit variables were unchanged (see Results).

Table 17
Study 3 Description of Sample

		N (%)
Gender	Males	32 (23.7%)
	Females	102 (75.6%)
	Other	1 (0.7%)
Birthplace	New Zealand	110 (81.5%)
	Other	25 (18.5%)
Living Situation	Hall of residence	29 (21.5%)
	Flatting	40 (29.6%)
	Living at home	57 (42.2%)
	Other	9 (6.7%)
Study Level	100 level	109 (80.7%)
	200 level	16 (11.9%)
	300 level	9 (6.7%)
	400 level	1 (0.7%)
Ethnicity[a]	NZ European	114 (84.4%)
	NZ Maori	15 (11.1%)
	Samoan	2 (1.5%)
	Cook Island Maori	1 (0.7%)
	Tongan	2 (1.5%)
	Chinese	5 (3.7%)
	Other	15 (11.1%)
		M (SD)
	Age	21.32 (3.23)
	BMI	23.12 (2.71)

Note: N = 135. BMI = body mass index.
[a] More than 1 answer possible

Measures

Dietary Requirements. Participants were asked to report any food allergies or intolerances. They were also asked to report any other dietary requirements (e.g. vegetarianism, veganism).

Demographics. Participants reported their date of birth (used to calculate age), height and weight, gender (response options: male, female, gender diverse), ethnicity, place of birth, living situation, and current level of study. Participants were also asked to rate their level of fluency in English on a 10-point scale (1 = not very fluent, 10 = very fluent).

Body Mass Index. Height and weight were used to calculate BMI. Participants reported these values in inches and pounds or in centimetres and kilograms. All values were converted to centimetres and kilograms, and BMI was calculated using the formula: {BMI = [(weight)/(height*height)] * 10,000} (U.S. Department of Health & Human Services, 2014b).

Single-Category Implicit Association Tests. Two single-category implicit association tests were used to measure implicit identification with healthy eating and implicit identification with unhealthy eating (see Study 1 Measures).

Explicit Identity. Explicit self-identity was measured using the healthy eater subscale of the Eating Identity Type Inventory (Blake et al., 2013) (see Study 1 Measures). Cronbach's alpha was .84.

Habit. Habit strength was measured using a 4-item version of the Self-Report Habit Index (Gardner et al., 2012) (see Study 2 Measures). Participants completed the measure twice, once for the behaviour of healthy eating and once for the behaviour of eating high-calorie snacks. Cronbach's alpha was .94 for healthy habit and .90 for unhealthy habit.

Attitudes. Attitudes were measured using a 5-item scale (Conner et al., 2002) (see Study 1 Measures). Cronbach's alpha was .74.

Subjective Norms. Subjective norms were measured using one item (Conner et al., 2002) (see Study 1 Measures).

Self-Control. Self-control was measured using the Brief Self-Control Scale (Tangney et al., 2004) (see Study 1 Measures). Cronbach's alpha was .84.

Stress. The Perceived Stress Scale-short form (Kamarck et al., 1983), a four-item measure of stress, was used to measure stress and was supplemented with one item from the College Student Stress Scale (Feldt, 2008) to measure academic stress. Responses were made on a 5-point Likert scale from 'never' to 'very often'. Since the five items were measured on the same scale they were combined into one measure of general and academic stress. Cronbach's alpha for the scale measure of stress was .82.

Past eating behaviour. A five-item scale and a single item were used to measure past eating behaviour (Kuijer & Boyce, 2012, 2014; Wood Baker et al., 2003) (see Study 1 Measures). Cronbach's alpha for the scale measure was .65.

Perceived Behavioural Control. Perceived behavioural control (PBC) was measured using a four-item scale (Kuijer & Boyce, 2012, 2014) (see Study 1 Measures). Cronbach's alpha was .75.

Daily Food Intake. Participants were sent seven daily food diaries. At the end of each day, participants were asked to report the number of servings they had eaten that day for seven different types of foods: fruits; vegetables; wholegrains; crisps and corn chips; hot chips, fries, and wedges; biscuits, cake, and muffins; and chocolate or lollies (Conner et al., 2015; Russell et al., 1999; White et al., 2013) (see also Study 2). Responses were made on a 6-point scale ranging from no servings to four or more servings, with higher scores indicating more servings consumed that day. As in Study 2 the items on servings of food were used to create three scales: fruit and vegetable consumption, wholegrain consumption, and unhealthy food consumption.

Daily Stress. Each day participants were asked to what extent they had felt stressed that day (1 = not at all, 5 = extremely). They were also asked to what extent they had felt happy and depressed. These were filler items and not analysed as part of this thesis.

Procedure

This study was approved by the UC Human Ethics Committee (HEC 2018/65). The measure of implicit eating identity was hosted on millisecond.com and the survey and food diaries were hosted on Qualtrics. Anyone who was interested in participating filled out a Qualtrics form with their email address and were emailed an information sheet and a link to the study. The study began with a consent form; those who did not consent were automatically taken to the end of the survey. Those who did consent first answered demographic questions. They were then given a link to take the IAT. At the end of the IAT they were given a random 8-digit code to enter back into the Qualtrics survey; this allowed their data from the two sites to be matched anonymously. After entering the code into Qualtrics, participants completed the remainder of the baseline survey. Starting on the Monday after they submitted the baseline survey, each participant was emailed a food diary to complete once a day for 1 week. The food diaries were sent at 8pm each day and reminder emails were sent to non-completers at 11pm and then at 8am the next day. Participants had until 11am the next day to complete each food diary; after this time, the link expired. After participants received the final food diary they were sent a debriefing sheet. At this time, those participants who were completing the study for course credit were given a link to answer three brief questions about the study on a separate Qualtrics survey; this was a requirement of the course for any students receiving research participation credit and was not a part of the study.

Data Analysis

Cross-Sectional Data. Prior to conducting the regressions, relevant assumptions (absence of outliers, normal distributions, and linear relationships between variables) were checked (see Study 1 Data Analysis). Subjective norms had a significantly skewed distribution (Tabachnick & Fidell, 2014). A data transformation was used on subjective norms to create an approximately normal distribution (Tabachnick & Fidell, 2014). No multivariate outliers were present. Each analysis that included the transformed variable was tested using both the transformed and non-transformed variables (Newton & Rudestam, 2013). As this did not affect the significance of the results, results are reported for the non-transformed variable. In addition, each analysis was repeated including participants with all BMIs. Results were largely unchanged, except for five moderation analyses (see Results).

Bivariate correlations and hierarchical multiple regression analyses were conducted using IBM SPSS version 25. Separate regressions with alpha set at .05 were run to predict each baseline outcome variable (past eating behaviour scale and single item, and PBC). Age, gender, and BMI were entered in Model 1. One participant identified as gender diverse; this was treated as a missing value for the purposes of the analysis, as there were not enough gender diverse participants to analyse as a group. Known predictors of eating behaviour (attitudes, subjective norms, and habit strength) were entered in Model 2. As in Study 1, explicit identity was not included in order to avoid multicollinearity with habit strength (Tabachnick & Fidell, 2014). Finally, healthy and unhealthy implicit identity were added in Model 3. Bootstrapped 95% confidence intervals with 2000 samples, coefficients, standard errors, and significance levels were calculated for each predictor variable in the regressions. Post-hoc power analyses (see Study 1 Data Analysis) determined that these models had sufficient power to detect a medium effect of implicit identity (99.4%) but were underpowered (37.1%) to detect a small effect.

Moderation analyses were conducted using IBM SPSS version 25. Separate analyses were conducted looking at the interaction between stress and implicit healthy identity, stress and implicit unhealthy identity, self-control and implicit healthy identity, and self-control and implicit unhealthy identity when predicting each baseline eating-related outcome. First, the moderator (self-control or stress) was added to the regression model described above (Model 4). Secondly, the interaction term was added (Model 5). Bootstrapped 95% confidence intervals with 2000 samples were calculated for stress, self-control, and the interaction term.

Daily Diary Data. Two-level hierarchical models assessed the effects of healthy and unhealthy implicit identity (measured at baseline) and self-reported stress (measured daily for 7 days) on fruit and vegetable consumption, wholegrain consumption, and unhealthy food consumption (also measured daily for 7 days). Level 1 variables were self-reported stress, unhealthy food intake, fruit and vegetable intake, and wholegrain intake. Level 2 variables were age, gender, BMI, attitudes, subjective norms, healthy and unhealthy habit, and healthy and unhealthy implicit identity. There was a total of 697 days of diary data from 108 participants.

Relevant assumption checks were performed prior to the multilevel analysis (Tabachnick & Fidell, 2014). Unhealthy eating, age, and BMI had significant positive skew; attitudes, subjective norms, stress, fruit and vegetable intake, and wholegrain consumption had significant negative skew; and healthy habit had significant negative kurtosis. Unhealthy eating also had six univariate outliers and subjective norms had three outliers. Logarithmic transformations were performed on attitudes and unhealthy eating and a square root transformation was performed on fruit and vegetable intake, producing acceptable skew and kurtosis statistics with no univariate outliers. Transformations failed to produce acceptable skew and kurtosis statistics for age, BMI, stress, attitudes, subjective norms, healthy habit, and wholegrain consumption, so these variables were left untransformed (Tabachnick & Fidell, 2014). Results largely did not differ and so results are therefore reported for non-transformed variables; where there was a different result, this is reported in a footnote in the Results section. No multivariate outliers were present (Newton & Rudestam, 2013; Tabachnick & Fidell, 2014). To create an interpretable intercept, continuous variables were grand-mean centred around 0 prior to analysis (Heck et al., 2010). Gender was coded as 0 (male) or 1 (female), and time was coded from 1 (Monday) to 7 (Sunday).

A series of multi-level regression models were tested, using the same structure as the regression models. First, an unconditional model with no predictors specified was used to calculate the intraclass correlation coefficient (ICC) for each outcome variable, with variance components specified as the covariance structure. Model 1 specified time as the only predictor, to provide a baseline to compare more complex models to. Different covariance structures were compared for Model 1 and the Akaike Information Criterion (AIC) was used to determine which Level 1 and 2 covariance structures were the best fit, with lower AIC values indicating better model fit (Field, 2013; Heck et al., 2010). For all three outcome variables the covariance structures that provided the best fit were autoregressive errors, homogenous, at Level 1 and identity at Level 2. Analysis of the quadratic and cubic trends for time showed that they were not significant predictors of any eating-related outcome (*p*s > .05) so these trends were not included in the models. Next, Model 2 was calculated with time, demographic variables (age, gender, BMI) and known predictors of eating (attitudes, subjective norms, and healthy and unhealthy habit strength) added as predictors. Model 3 added healthy and unhealthy implicit identity to these predictors. Model 4 added stress, and Model 5 added the interactions between stress and healthy and unhealthy implicit identity. Each model's goodness of fit was compared to the previous and more basic model, so that Model 2 was compared to Model 1, Model 3 was compared to Model 2, Model 4 was compared to Model 3, and Model 5 was compared to Model 4. These comparisons were made using the difference between the log-likelihood ratio (-2LL) for each model compared to a critical chi-square value at *p* <. 05, with degrees of freedom equal to the difference in the number of parameters between the two models (Tabachnick & Fidell, 2014). As the -2LL for the more complex model was subtracted from the -2LL for the simpler model, a positive chi-square value indicated reduced -2LL and therefore better model fit for the more complex model. A negative chi-square value indicated the more complex model had a greater -2LL and therefore worse model fit than the simpler model. AIC was calculated as an additional measure of goodness-of-fit, with lower scores indicating better model fit (Field, 2013).

As with the regression models, the multi-level models were repeated with only participants with no dietary requirements included (*n* = 70 participants), and with participants with all BMIs included (n = 125). Results were largely unchanged; where a differing result was found, this is reported in a footnote in the Results section.

Subsequent to these analyses, exploratory analyses were conducted testing a) the interaction between time and implicit identity, and b) random slopes for implicit identity and for interaction terms including implicit identity. Results for these exploratory analyses are reported in Appendix O.

Results

Correlations

Bivariate correlations and scale means and standard deviations are displayed in Table 18. For the bivariate correlation analyses, daily diary data was averaged across the 7-day diary period for each participant. D scores for unhealthy implicit identity ranged from -1.21 to 0.72, and D scores for healthy implicit identity ranged from -0.99 to 0.52. Unhealthy implicit identity was not significantly correlated with any other variable, while healthy implicit identity was negatively correlated with stress (baseline survey and diaries), and positively correlated with healthy explicit identity, healthy habit, past eating behaviour (scale and single item), PBC for healthy eating, and self-control.

Attitudes was positively correlated with the scale measure of past eating behaviour, PBC, servings of fruits and vegetables, and servings of wholegrains. Subjective norms was positively correlated with the scale measure of past eating behaviour and servings of fruits and vegetables. Healthy explicit identity was positively correlated with all outcome variables except servings of unhealthy foods, while healthy and unhealthy habit were positively correlated with all outcome variables except servings of wholegrains and servings of unhealthy foods. Self-control was also correlated with all outcome variables except for servings of wholegrains and unhealthy foods, while baseline stress was correlated with past eating behaviour (single item) and PBC.

The scale measure of past eating behaviour was correlated with all outcomes except wholegrain intake, while the single item measure of past eating behaviour, PBC, and fruit and vegetable intake were correlated with all outcomes except unhealthy food intake. Wholegrain intake was significantly correlated with all outcomes except for unhealthy food intake and the scale measure of past eating behaviour. Unhealthy food intake was only correlated with the scale measure of past eating behaviour.

Table 18

Study 3 Correlations, Means, and Standard Deviations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. H implicit	1.00																		
2. U implicit	.16	1.00																	
3. Age	-.08	-.12	1.00																
4. Gender	-.03	-.10	.04	1.00															
5. BMI	-.04	-.06	-.00	-.03	1.00														
6. Att	.07	-.01	.01	.24	.04	1.00													
7. Norms	-.09	-.04	.10	.01	-.12	.32**	1.00												
8. Explicit identity	.30**	.02	.06	.03	-.12	.42**	.19*	1.00											
9. H habit	.25**	.04	.12	.01	-.21*	.35**	.18*	.70**	1.00										
10. U habit	.03	-.08	-.22**	.00	.09	-.19*	-.05	-.38**	-.28**	1.00									
11. SC	.20*	.10	.20*	-.09	-.08	.15	.08	.53*	.37**	-.34**	1.00								
12. Stress (B)	-.33**	-.06	-.06	.12	-.00	.01	-.04	-.26**	-.17*	.19*	-.42**	1.00							
13. Stress (D)[a]	-.30**	-.11	.09	.12	-.04	-.01	-.04	-.13	-.10	.12	-.14	.36**	1.00						
14. Past EB (scale)	.20*	.02	.09	-.08	-.17	.26**	.18*	.68**	.57**	-.40**	.41**	-.16	-.09	1.00					
15. Past EB (1 item)	.26**	.05	.02	-.18*	-.11	.14	.16	.69**	.48**	-.33**	.44**	-.19*	-.06	.72**	1.00				
16. PBC	.26**	.05	.12	-.24**	-.18*	.23**	.13	.68**	.60**	-.33**	.54**	-.25**	-.12	.71**	.67**	1.00			
17. Serves FV[a]	.17	.03	-.10	.05	-.08	.43**	.23*	.58**	.45**	-.23*	.30**	-.12	-.18	.47**	.42**	.38**	1.00		
18. Serves WG[a]	.03	.04	-.07	-.13	.10	.23*	.07	.28*	.17	-.12	.28**	-.14	-.16	.07	.22*	.19*	.36**	1.00	
19. Serves U[a]	.15	-.07	-.07	-.05	.05	-.11	-.18	-.10	-.08	.03	-.01	-.03	-.05	-.32**	-.17	-.18	-.02	.04	1.00
M	-0.12	-0.18	21.32		23.12	5.88	5.96	3.34	3.01	2.89	3.14	3.00	2.74	3.60	4.22	3.14	3.31	3.12	1.63
SD	0.31	0.36	3.23		271	0.82	1.27	0.86	0.98	0.91	0.85	0.68	0.90	0.64	1.32	0.81	0.96	1.11	0.40

Note: H = healthy, U = unhealthy, BMI = body mass index, Att = attitudes, SC = self-control, B = baseline, D = diaries, EB = eating behaviour, PBC = perceived behavioural control, FV = fruit/vegetables, WG = wholegrain. Gender coded as 1 = male, 2 = female.

[a] = average over past 7 days.

* *p* <.05. ** *p* <.01.

Regression Models

Results for the regressions predicting past eating behaviour (scale and single item) and PBC for healthy eating are presented in Tables 19-20. Although healthy implicit identity was significantly correlated with past eating behaviour and PBC, adding healthy and unhealthy implicit identity to the regression model did not improve the prediction of any of the eating-related outcomes. Healthy and unhealthy habit strength were significant predictors of all three outcomes in the regression models. Participants were more likely to report healthy eating and to have more perceived control over their eating when they had high healthy habit strength and low unhealthy habit strength. In addition, males tended to report higher PBC for healthy eating than females did.

Table 19

Study 3 Regression Analyses Predicting Past Eating Behaviour

		Past eating behaviour (scale)						Past eating behaviour (single item)					
		R^2change	*b*	*SE*	*p*	95% CI		R^2change	*b*	*SE*	*p*	95% CI	
						LL	*UL*					*LL*	*UL*
Model 1	Constant	.04, *p* = .121	4.40	0.65	< .001	3.13	5.74	.04, *p* = .179	6.12	1.21	< .001	3.83	8.61
	Age		0.02	0.02	.293	-0.02	0.05		0.01	0.03	.803	-0.07	0.06
	Gender		-0.14	0.14	.313	-0.42	0.13		-0.50	0.27	.065	-1.02	0.01
	BMI		-0.04	0.02	.033	-0.08	-0.00		-0.05	0.04	.167	-0.12	0.03
Model 2	Constant	.36, *p* = .000	3.34	0.68	< .001	2.04	4.68	.30, *p* = .000	4.52	1.27	< .001	2.00	7.08
	Age		-0.00	0.01	.722	-0.03	0.02		-0.04	0.03	.198	-0.09	0.01
	Gender		-0.13	0.12	.256	-0.36	0.10		-0.43	0.22	.050	-0.84	0.01
	BMI		-0.01	0.02	.511	-0.04	0.02		0.01	0.03	.796	-0.05	0.08
	Attitudes		0.04	0.07	.576	-0.09	0.17		-0.04	0.12	.763	-0.29	0.21
	Norms		0.03	0.05	.496	-0.05	0.13		0.06	0.09	.500	-0.11	0.25
	H Habit		0.31	0.06	< .001	0.19	0.41		0.60	0.11	< .001	0.36	0.80
	U Habit		-0.18	0.05	< .001	-0.29	-0.09		-0.33	0.11	.001	-0.53	-0.12
Model 3	Constant	.01, *p* = .320	3.44	0.68	< .001	2.12	4.81	.02, *p* = .192	4.69	1.24	< .001	2.26	7.21
	Age		-0.00	0.01	.656	-0.03	0.02		-0.03	0.03	.271	-0.09	0.02
	Gender		-0.13	0.12	.250	-0.35	0.10		-0.42	0.22	.057	-0.85	0.03
	BMI		-0.01	0.02	.478	-0.04	0.02		0.01	0.03	.805	-0.05	0.07
	Attitudes		0.03	0.07	.646	-0.10	0.17		-0.05	0.12	.685	-0.30	0.20
	Norms		0.04	0.05	.385	-0.04	0.14		0.08	0.09	.344	-0.10	0.26
	H Habit		0.29	0.06	< .001	0.16	0.40		0.54	0.12	< .001	0.29	0.75
	U Habit		-0.19	0.05	< .001	-0.30	-0.10		-0.36	0.11	.003	-0.58	-0.13
	H implicit identity		0.23	0.15	.137	-0.06	0.53		0.60	0.38	.112	-0.20	1.30
	U implicit identity		-0.09	0.12	.458	-0.33	0.16		-0.07	0.26	.793	-0.57	0.43
	R^2total	.41, *p* < .001						.35, *p* < .001					

Note: Number of bootstrap samples = 2000. H = healthy, U = unhealthy, BMI = body mass index, *LL* = lower limit, *UL* = upper limit.

Table 20

Study 3 Regression Analyses Predicting PBC

PBC							
		R^2change	*b*	*SE*	*p*	95% CI	
						LL	*UL*
Model 1	Constant	.11, *p* = .002	4.57	0.72	< .001	3.19	5.94
	Age		0.03	0.02	.110	-0.02	0.07
	Gender		-0.47	0.17	.009	-0.81	-0.15
	BMI		-0.06	0.02	.020	-0.10	-0.01
Model 2	Constant	.36, *p* = .000	2.80	0.77	.001	1.20	4.29
	Age		0.01	0.02	.465	-0.02	0.04
	Gender		-0.49	0.14	< .001	-0.76	-0.22
	BMI		-0.02	0.02	.274	-0.06	0.02
	Attitudes		0.12	0.07	.082	-0.03	0.25
	Norms		-0.01	0.05	.800	-0.11	0.08
	H Habit		0.42	0.06	< .001	0.30	0.54
	U Habit		-0.14	0.06	.036	-0.26	-0.02
Model 3	Constant	.01, *p* = .298	2.90	0.76	.001	1.35	4.35
	Age		0.01	0.02	.448	-0.02	0.04
	Gender		-0.49	0.14	.000	-0.76	-0.20
	BMI		-0.02	0.02	.238	-0.06	0.02
	Attitudes		0.11	0.07	.109	-0.03	0.25
	Norms		-0.00	0.05	.963	-0.10	0.09
	H Habit		0.39	0.06	< .001	0.28	0.52
	U Habit		-0.15	0.07	.022	-0.28	-0.02
	H implicit identity		0.28	0.16	.075	-0.05	0.58
	U implicit identity		-0.08	0.14	.592	-0.35	0.21
	R^2total	.48, *p* < .001					

Note: Number of bootstrap samples = 2000. H = healthy, U = unhealthy, BMI = body mass index, PBC = perceived behavioural control, *LL* = lower limit, *UL* = upper limit.

Moderation Analyses

Results from the moderation analyses are presented in Tables 21-22. R^2 change for Models 3-5 as well as coefficients for the moderator variable and the interaction term from the final model (Model 5) are presented. Adding self-control in Model 4 significantly improved the prediction of past eating behaviour (scale and single item)[5] and PBC. However, self-control did not interact significantly with healthy or unhealthy implicit identity when predicting any of the outcomes[6]. Stress was not a significant predictor of any of the outcome measures after controlling for the Model 3 predictors. Stress and unhealthy implicit identity interacted when predicting PBC[7]. No other interactions between stress and healthy or unhealthy implicit identity were significant.

A simple slopes analysis was used to explore the interaction between stress and unhealthy implicit identity predicting PBC. Although the interaction was significant, none of the slopes for low (*b* = -0.26, *SE* = 0.29, *p* = .352, 95% CI [-0.81, 0.38]), medium (*b* = 0.08, *SE* = 0.19, *p* = .687, 95% CI [-0.29, 0.48]), or high (*b* = 0.41, *SE* = 0.31, p = .183, 95% CI [-0.15, 1.05]) levels of stress were significantly different from zero.

[5] When analyses were repeated excluding participants with dietary requirements, Model 4 was no longer a significant predictor of past eating behaviour scale (R^2change = .03, *p* = .061) or single item (R^2change = .03, *p* = .055).

[6] Model 5 became a significant predictor of PBC when participants with dietary requirements were excluded (R^2change = .03, *p* = .024), and the interaction between unhealthy implicit identity and self-control became significant (*b* = -0.77, *SE* = 0.34, *p* = .021, 95% CI [-1.36, -0.03]).

[7] Model 5 was no longer a significant predictor of PBC when including participants with all BMIs (R^2change = .00, *p* = .521) and when excluding participants with dietary requirements (R^2change = .00, *p* = .795). The interaction between unhealthy implicit identity and stress was no longer significant when including participants with all BMIs (*b* = 0.15, *SE* = 0.09, *p* = .567, 95% CI [-0.34, 0.66]) and when excluding participants with dietary requirements (*b* = 0.16, *SE* = 0.57, *p* = .753, 95% CI [-1.11, 1.14]).

Table 21

Study 3 Moderation Analyses for Implicit Identity and Self-Control

	Model 3	Model 4	Model 5	Self-control[a]					Interaction[b]				
	R^2	R^2change	R^2change	*b*	*SE*	*p*	95% CI		*b*	*SE*	*p*	95% CI	
							LL	*UL*				*LL*	*UL*
H implicit identity * SC													
Past EB (scale)	.41, *p* < .001	.02, *p* = .036	.00, *p* = .588	0.17	0.08	.042	0.01	0.34	0.14	0.25	.574	-0.36	0.62
Past EB (1 item)	.35, *p* < .001	.03, *p* = .018	.00, *p* = .604	0.40	0.19	.035	0.04	0.74	0.28	0.68	.673	-1.04	1.68
PBC	.48, *p* < .001	.06, *p* < .001	.00, *p* = .964	0.36	0.09	.001	0.19	0.55	0.01	.29	.962	-0.51	0.66
U implicit identity * SC													
Past EB (scale)	.41, *p* < .001	.02, *p* = .036	.00, *p* = .683	0.17	0.08	.035	0.02	0.32	0.09	0.23	.698	-0.34	0.58
Past EB (1 item)	.35, *p* < .001	.03, *p* = .018	.00, *p* = .935	0.40	0.19	.035	0.03	0.76	-0.04	0.45	.928	-0.92	0.83
PBC	.48, *p* < .001	.06, *p* < .001	.01, *p* = .257	0.36	0.09	<.001	0.18	0.55	-0.28	0.28	.313	-0.81	0.26

Note: H = healthy, U = unhealthy, EB = eating behaviour, PBC = perceived behavioural control, SC = self-control, *LL* = lower limit, *UL* = upper limit. Model 3: Gender, BMI, attitudes, subjective norms, habit strength, and implicit identity. Model 4: Self-control added. Model 5: Interaction between self-control and implicit identity added.
[a] Regression estimates for self-control from Model 4. [b] Regression estimates for the interaction from Model 5.

Table 22

Study 3 Moderation Analyses for Implicit Identity and Stress

	Model 3	Model 4	Model 5	Stress[a]					Interaction[b]				
	R^2	R^2change	R^2change	*b*	*SE*	*p*	95% CI		*b*	*SE*	*p*	95% CI	
							LL	*UL*				*LL*	*UL*
H implicit identity * Stress													
Past EB (scale)	.41, *p* < .001	.00, *p* = .831	.00, *p* = .534	0.02	0.08	.846	-0.13	0.17	0.13	0.20	.478	-0.26	0.54
Past EB (1 item)	.35, *p* < .001	.00, *p* = .573	.00, *p* = .390	0.09	0.15	.545	-0.19	0.40	0.39	0.52	.446	-0.60	1.45
PBC	.48, *p* <.001	.00, *p* = .639	.00, *p* = .433	-0.04	0.09	.662	-0.23	0.14	0.20	0.25	.415	-0.27	0.72
U implicit identity * Stress													
Past EB (scale)	.41, *p* < .001	.00, *p* = .831	.01, *p* = .212	0.02	0.07	.830	-0.13	0.16	0.27	0.20	.155	-0.12	0.67
Past EB (1 item)	.35, *p* < .001	.00, *p* = .573	.00, *p* = .736	0.09	0.15	.547	-0.19	0.39	0.15	0.40	.698	-0.67	0.90
PBC	.48, *p* < .001	.00, *p* = .639	.02, *p* = .028	-0.04	0.09	.645	-0.23	0.15	0.55	0.26	.027	0.03	1.03

Note: H = healthy, U = unhealthy, EB = eating behaviour, PBC = perceived behavioural control, *LL* = lower limit, *UL* = upper limit. Model 3: Gender, BMI, attitudes, subjective norms, habit strength, and implicit identity. Model 4: Stress added. Model 5: Interaction between stress and implicit identity added.
[a] Regression estimates for stress from Model 4. [b] Regression estimates for the interaction from Model 5.

Multi-Level Models

Fruit and Vegetable Consumption. ICC for the unconditional model was 0.58. Model 2 was a significantly better fit than Model 1, χ^2 (7) = 148.26, p < .05. Adding implicit identity in Model 3 did not improve model fit compared to Model 2, χ^2 (2) = 0.81, *ns*. Model 4, in which stress was added, showed worse fit than Model 3, χ^2 (1) = -39.48, p <.05. Adding the interaction terms in Model 5 did not significantly change the model fit relative to Model 4, χ^2 (2) = 3.61, *ns*. Adding implicit identity and the interactions between implicit identity and stress therefore did not improve the prediction of fruit and vegetable consumption.

Parameter estimates for the models are included in Table 23. In Model 1, time was not a significant predictor. However, in Models 2-5, time, age, attitudes, and healthy and unhealthy habit were all significant predictors, and stress was a significant predictor in Models 4 and 5[8]. Time was negatively associated with fruit and vegetable consumption, indicating that fruit and vegetable consumption declined throughout the week. People reported consuming more fruits and vegetables when they were younger, had positive attitudes towards healthy eating, had stronger healthy eating habits, and had weaker unhealthy eating habits. Stress was negatively associated with fruit and vegetable intake, indicating that participants were likely to report lower fruit and vegetable intake on days where they reported higher levels of stress. Implicit identity was not a significant predictor of fruit and vegetable consumption.

[8] When excluding participants with dietary requirements, unhealthy implicit identity became a significant predictor in Model 4 (b = 0.45, SE = 0.20, p = .025, 95% CI [0.06, 0.85]).

Table 23

Study 3 Parameter Estimates from Multi-Level Models Predicting Fruit and Vegetable Intake

Model	-2LL	AIC	Predictors	*b*	*SE*	*p*	95% CI	
							LL	*UL*
1	1902.27	1912.27	Intercept	3.50	0.11	< .001	3.29	3.72
			Time	-0.05	0.03	.074	-0.10	0.00
2	1754.01	1778.01	Intercept	3.52	0.14	< .001	3.25	3.79
			Time	-0.05	0.02	.034	-0.09	-0.00
			Age	-0.06	0.02	.006	-0.09	-0.02
			Gender	-0.03	0.14	.835	-0.31	0.25
			BMI	0.00	0.02	.909	-0.04	0.05
			Attitudes	0.36	0.09	< .001	0.19	0.53
			Norms	0.03	0.05	.593	-0.08	0.14
			Healthy habit	0.41	0.07	<.001	0.27	0.54
			Unhealthy habit	-0.17	0.07	.001	-0.31	-0.04
3	1753.21	1781.85	Intercept	3.51	0.14	< .001	3.24	3.79
			Time	-0.05	0.02	.033	-0.09	-0.00
			Age	-0.05	0.02	.010	-0.09	-0.01
			Gender	-0.02	0.14	.883	-0.31	0.26
			BMI	0.00	0.02	.940	-0.04	0.05
			Attitudes	0.34	0.09	< .001	0.17	0.52
			Norms	0.04	0.06	.462	-0.07	0.15
			Healthy habit	0.39	0.07	< .001	0.25	0.53
			Unhealthy habit	-0.18	0.07	.011	-0.32	-0.04
			Healthy implicit identity	0.19	0.22	.398	-0.25	0.62
			Unhealthy implicit identity	0.02	0.18	.916	-0.33	0.37
4	1792.69	1822.69	Intercept	3.56	0.12	< .001	3.34	3.79
			Time	-0.06	0.02	.006	-0.10	-0.02
			Age	-0.05	0.02	.004	-0.09	-0.02
			Gender	-0.03	0.13	.794	-0.28	0.21
			BMI	-0.00	0.02	.887	-0.04	0.04
			Attitudes	0.36	0.08	< .001	0.21	0.51
			Norms	0.02	0.05	.621	-0.07	0.12
			Healthy habit	0.41	0.06	< .001	0.29	0.53
			Unhealthy habit	-0.14	0.06	.020	-0.26	-0.02
			Healthy implicit identity	0.11	0.19	.583	-0.27	0.48
			Unhealthy implicit identity	0.03	0.16	.823	-0.27	0.34
			Stress	-0.08	0.03	.022	-0.14	-0.01
5	1789.08	1823.08	Intercept	3.58	0.12	< .001	3.35	3.80
			Time	-0.06	0.02	.009	-0.10	-0.02
			Age	-0.05	0.02	.003	-0.09	-0.02
			Gender	-0.05	0.13	.681	-0.30	0.20
			BMI	-0.01	0.02	.796	-0.04	0.03
			Attitudes	0.35	0.08	< .001	0.20	0.50
			Norms	0.02	0.05	.644	-0.07	0.12
			Healthy habit	0.41	0.06	< .001	0.29	0.53
			Unhealthy habit	-0.13	0.06	.034	-0.25	-0.01
			Healthy implicit identity	0.07	0.19	.699	-0.03	0.45
			Unhealthy implicit identity	0.08	0.16	.631	-0.23	0.38
			Stress	-0.07	0.03	.037	-0.14	-0.00
			Stress*H implicit identity	0.17	0.10	.094	-0.03	0.38
			Stress*U implicit identity	-0.11	0.10	.271	-0.30	0.86

Note: H = healthy, U = unhealthy, BMI = body mass index, *LL* = lower limit, *UL* = upper limit.

Wholegrain Consumption. ICC for the unconditional model was 0.47. Model 2 was a significantly better fit than Model 1, χ^2 (7) = 89.25, *p* < .05. Adding implicit identity in Model 3 did not improve model fit compared to Model 2, χ^2 (2) = 2.1, *ns*. Adding stress in Model 4 decreased model fit compared to Model 3, χ^2 (1) = -39.62, *p* < .05. Compared to Model 4, adding the interaction terms in Model 5 did not alter model fit, χ^2 (2) = 0.04, *ns*. Adding implicit identity and the interactions between implicit identity and stress therefore did not improve the prediction of wholegrain consumption.

Parameter estimates for the models are included in Table 24. Gender and attitudes were significant predictors in Models 2-5, and healthy habit was a significant predictor in Models 4 and 5. Males, people with positive attitudes towards healthy eating, and people with stronger healthy eating habits reported consuming more servings of wholegrains. Implicit identity was not a significant predictor of wholegrain consumption.

Table 24

Study 3 Parameter Estimates from Multi-Level Models Predicting Wholegrain Intake

Model	-2LL	AIC	Predictors	*b*	*SE*	*p*	95% CI	
							LL	*UL*
1	2327.97	2337.97	Intercept	3.18	0.14	< .001	2.91	3.45
			Time	-0.01	0.32	.690	-0.08	0.05
2	2238.72	2262.72	Intercept	3.62	0.20	< .001	3.23	4.01
			Time	-0.01	0.03	.640	-0.08	0.05
			Age	-0.03	0.03	.286	-0.09	0.03
			Gender	-0.56	0.20	.006	-1.00	-0.16
			BMI	0.05	0.03	.121	-0.01	0.11
			Attitudes	0.35	0.12	.005	0.10	0.59
			Norms	-0.04	0.08	.635	-0.19	0.11
			Healthy habit	0.14	0.10	.146	-0.05	0.33
			Unhealthy habit	-0.06	0.10	.531	-0.25	0.13
3	2236.62	2264.62	Intercept	3.63	0.20	< .001	3.24	4.02
			Time	-0.01	0.03	.641	-0.08	0.05
			Age	-0.03	0.03	.239	-0.09	0.02
			Gender	-0.58	0.20	.005	-0.98	-0.18
			BMI	0.05	0.03	.111	-0.01	0.11
			Attitudes	0.38	0.12	.003	0.13	0.62
			Norms	-0.06	0.08	.428	-0.22	0.09
			Healthy habit	0.18	0.10	.072	-0.02	0.38
			Unhealthy habit	-0.03	0.10	.731	-0.23	0.16
			Healthy implicit identity	-0.44	0.31	.156	-1.05	0.17
			Unhealthy implicit identity	0.14	0.25	.571	-0.35	0.64
4	2276.24	2306.24	Intercept	3.67	0.16	< .001	3.35	3.99
			Time	-0.02	0.03	.498	-0.08	0.04
			Age	-0.04	0.02	.135	-0.09	0.01
			Gender	-0.60	0.18	< .001	-0.95	-0.26
			BMI	0.04	0.03	.119	-0.01	0.10
			Attitudes	0.41	0.11	< .001	0.20	0.62
			Norms	-0.08	0.07	.241	-0.22	0.05
			Healthy habit	0.21	0.09	.017	0.04	0.38
			Unhealthy habit	0.04	0.09	.680	-0.12	0.20
			Healthy implicit identity	-0.52	0.27	.054	-1.05	0.01
			Unhealthy implicit identity	0.11	0.22	.623	-0.32	0.54
			Stress	-0.07	0.05	.150	-0.16	0.02
5	2276.20	2310.20	Intercept	3.67	0.17	< .001	3.35	3.99
			Time	-0.02	0.03	.510	-0.08	0.04
			Age	-0.04	0.02	.134	-0.09	0.11
			Gender	-0.60	0.18	< .001	-0.95	-0.26
			BMI	0.04	0.03	.124	-0.01	0.10
			Attitudes	0.41	0.11	< .001	0.20	0.62
			Norms	-0.08	0.07	.239	-0.22	0.05
			Healthy habit	0.21	0.09	.017	0.04	0.38
			Unhealthy habit	0.04	0.09	.674	-0.13	0.21
			Healthy implicit identity	-0.53	0.27	.053	-1.06	0.01
			Unhealthy implicit identity	0.11	0.22	.611	-0.32	0.54
			Stress	-0.07	0.05	.153	-0.16	0.03
			Stress*H implicit identity	0.00	0.15	.997	-0.29	0.29
			Stress*U implicit identity	-0.03	0.14	.835	-0.31	0.25

Note: H = healthy, U = unhealthy, BMI = body mass index, *LL* = lower limit, *UL* = upper limit.

Unhealthy Food Consumption. ICC for the unconditional model was 0.43. Model 2, in which demographic variables and known predictors of eating behaviour were added, was not a better fit than Model 1 (time-only model), χ^2 (7) = 28.14, *ns*. Adding implicit identity in Model 3 did not improve model fit relative to Model 2, χ^2 (2) = 4.57, *ns*. Adding stress in Model 4 did not improve model fit compared to Model 3, χ^2 (1) = -8.20, *ns*. Model 5, χ^2 (2) = -23.89, $p < .05$. Adding implicit identity and the interactions between implicit identity and stress therefore did not improve the prediction of consumption of unhealthy foods.

Parameter estimates for the models are included in Table 25. Time was a significant predictor in all models and subjective norms were a significant predictor in Models 2-5. Healthy implicit identity was a significant predictor in Model 4 but not in any other model, suggesting this significant result may be a Type 1 error and that implicit identity is not a useful predictor of daily unhealthy food consumption[9]. Consumption of unhealthy foods increased throughout the week and was also higher in participants who reported low subjective norms for healthy eating.

[9] When transformed variables for attitudes and unhealthy food intake were used, healthy implicit identity became a significant predictor in Model 3 (*b* = 0.06, *SE* = 0.03, *p* = .030, 95% CI [0.01, 0.12]) and in Model 5 (*b* = 0.06, *SE* = 0.03, *p* = .031, 95% CI [0.01, 0.11]). When participants with all BMIs were included, healthy implicit identity also became a significant predictor in Model 3 (*b* = 0.26, *SE* = 0.11, *p* = .017, 95% CI [0.05, 0.48]) and Model 5 (*b* = 0.27, *SE* = 0.10, *p* = .006, 95% CI [0.08, 0.46]). However, when participants with dietary requirements were excluded, healthy implicit identity was no longer a significant predictor of Model 4 (*b* = 0.15, *SE* = 0.14, *p* = .274, 95% CI [-0.12, 0.42]).

Table 25

Study 3 Parameter Estimates from Multi-Level Models Predicting Unhealthy Food Intake

Model	-2LL	AIC	Predictors	*b*	*SE*	*p*	95% CI	
							LL	*UL*
1	957.34	967.34	Intercept	1.52	0.05	< .001	1.43	1.62
			Time	0.03	0.01	.028	0.00	0.05
2	929.20	953.20	Intercept	1.56	0.07	< .001	1.41	1.70
			Time	0.03	0.01	.021	0.00	0.05
			Age	-0.01	0.01	.539	-0.03	0.01
			Gender	-0.04	0.08	.576	-0.19	0.11
			BMI	0.00	0.01	.955	-0.02	0.02
			Attitudes	0.00	0.05	.941	-0.09	0.09
			Norms	-0.07	0.03	.014	-0.13	-0.01
			Healthy habit	-0.02	0.04	.595	-0.09	0.05
			Unhealthy habit	0.01	0.04	.769	-0.06	0.08
3	924.63	952.63	Intercept	1.55	0.07	< .001	1.41	1.69
			Time	0.03	0.01	.019	0.00	0.05
			Age	-0.01	0.01	.605	-0.03	0.02
			Gender	-0.0	0.07	.619	-0.18	0.11
			BMI	0.00	0.01	.982	-0.02	0.02
			Attitudes	-0.01	0.05	.786	-0.10	0.08
			Norms	-0.06	0.03	.049	-0.11	-0.00
			Healthy habit	-0.04	0.04	.296	-0.11	0.03
			Unhealthy habit	-0.01	0.04	.878	-0.10	0.07
			Healthy implicit identity	0.22	0.11	.050	-0.00	0.45
			Unhealthy implicit identity	-0.12	0.09	.212	-0.30	0.07
4	932.83	962.83	Intercept	1.56	0.07	< .001	1.42	1.70
			Time	0.03	0.01	.018	0.00	0.05
			Age	-0.01	0.01	.549	-0.03	0.01
			Gender	-0.05	0.07	.508	-0.19	0.10
			BMI	0.00	0.01	.961	-0.02	0.02
			Attitudes	-0.01	0.04	.829	-0.10	0.08
			Norms	-0.06	0.03	.046	-0.11	-0.00
			Healthy habit	-0.04	0.04	.265	-0.11	0.03
			Unhealthy habit	-0.01	0.04	.739	-0.08	0.06
			Healthy implicit identity	0.22	0.11	.048	0.00	0.45
			Unhealthy implicit identity	-0.13	0.09	.171	-0.31	0.05
			Stress	0.01	0.02	.709	-0.03	0.04
5	956.72	990.72	Intercept	1.58	0.06	< .001	1.45	1.70
			Time	0.03	0.01	.007	0.01	0.05
			Age	-0.01	0.01	.428	-0.03	0.01
			Gender	-0.07	0.07	.273	-0.20	0.06
			BMI	-0.01	0.01	.494	-0.03	0.01
			Attitudes	0.00	0.04	.981	-0.08	0.08
			Norms	-0.07	0.03	.009	-0.12	-0.02
			Healthy habit	-0.04	0.03	.219	-0.11	0.02
			Unhealthy habit	0.00	0.03	.897	-0.06	0.07
			Healthy implicit identity	0.20	0.10	.057	-0.01	0.40
			Unhealthy implicit identity	-0.11	0.08	.196	-0.27	0.06
			Stress	-0.01	0.02	.765	-0.41	0.03
			Stress*H implicit identity	0.08	0.06	.173	-0.03	0.19
			Stress*U implicit identity	-0.04	0.05	.416	-0.15	0.06

Note: H = healthy, U = unhealthy, BMI = body mass index, *LL* = lower limit, *UL* = upper limit.

Summary

Study 3 was conducted to further clarify the relationship between implicit identity and eating behaviour, using a sample of New Zealand university students and adding perceived stress as a moderator. Healthy implicit identity was significantly and positively correlated with both measures of eating over the past two weeks and PBC. However contrary to hypotheses, Study 3 regression analyses found that implicit identity was not a significant predictor of any of these outcome measures when controlling for demographic variables and other predictors of eating behaviour. Rather, habit strength appeared to be the key predictor of these eating-related outcomes. This was different to Study 1 where unhealthy implicit identity was a significant predictor of both past eating behaviour (scale) and PBC in the regression models. Multi-level models looking at healthy and unhealthy implicit identity and daily stress as predictors of consumption of fruits and vegetables, wholegrains, and unhealthy foods also found no significant relationship between implicit identity and eating behaviour, and no significant interactions between implicit identity and stress.

Adding self-control to the regression model improved the prediction of past eating behaviour (scale and single item) and PBC. However as in Study 1, self-control did not interact with healthy or unhealthy implicit identity when predicting any of the eating-related outcomes. Study 3 also tested stress as a possible moderator. Adding stress to the regression model did not improve the prediction of any of the outcome variables. There was one significant interaction effect; stress and implicit unhealthy identity interacted when predicting PBC. However, the slopes at different levels of stress did not differ significantly from zero. Moreover, the interaction ceased to be significant when analyses were repeated with participants with all BMIs included or when analyses were repeated with participants with dietary requirements excluded. No other moderation analyses involving stress were significant. Further research is therefore needed to confirm whether stress is a significant moderator of the relationship between implicit identity and eating-related outcomes.

General Discussion Studies 1-3

Studies 1-3 investigated whether healthy and unhealthy implicit identity, measured using two SC-IATs, were able to predict eating behaviour. It was hypothesised that greater implicit identification with healthy eating would predict healthier eating-related behaviours, while greater implicit identification with unhealthy eating would predict unhealthy eating-related behaviours. It was also hypothesised that self-control would moderate the relationship between implicit identity and eating behaviour, with implicit identity being a stronger predictor when self-control was low. Study 3 also tested the hypothesis that stress would be a significant moderator. It was expected that implicit identity would be a stronger predictor when stress was high.

However, the results of Studies 1-3 largely did not support these hypotheses. Study 1 found that unhealthy implicit identity significantly predicted PBC for healthy eating and the scale measure of past eating behaviour in the regression models, and also showed a significant indirect effect of implicit unhealthy identity on eating behaviour through PBC. However, these findings were not replicated in Study 2 or Study 3. In both Study 2 and Study 3, implicit healthy and unhealthy identity were nonsignificant as predictors in all regression models tested. Study 3 also used multi-level modelling to test implicit identity as a predictor of daily food diaries. However contrary to hypotheses, implicit identity did not predict healthy or unhealthy eating as reported in the food diaries. Although Study 2 found a significant interaction effect between healthy implicit identity and self-control when predicting wholegrain consumption, no other significant interaction effects were found across the three studies. It may be that this significant interaction effect is the result of some particular characteristics of the Study 2 sample and is not generalizable to other samples, or it may be a Type 1 error.

All three studies provide strong support for habit strength as a key predictor of eating-related behaviour. In Study 1, habit strength predicted all outcome variables measured except for fruit, vegetable, and fibre consumption. Habit strength was also a significant predictor in all but one of the Study 2 regression analyses and in all Study 3 regression analyses. These findings indicate that habits are key influences on people's eating-related behaviours and may be an important intervention target.

Although Studies 1-3 did not show consistent support for the healthy and unhealthy implicit identity as predictors of eating-related behaviour, implicit identity has been shown to predict other types of behaviour (Banaji & Nock, 2007; Caudwell & Hagger, 2014; Hawkins & Nosek, 2012). In addition, dual-process theories show the importance of both implicit and explicit processes in predicting behaviour (Evans, 2003, 2008; Hofmann et al., 2008; Sheeran et al., 2013; Strack & Deutsch, 2004). One possible explanation for the lack of consistent significant results in Studies 1-3 is the type of implicit measure used. Studies 1-3 used two Single-Category Implicit Association Tests (SC-IATs) to measure strength of identification with healthy eating and strength of identification with unhealthy eating separately from each other. However, the assumption that identification with healthy eating and identification with unhealthy eating are best measured independently may be incorrect. Rather, it may be the relative strength of identification with healthy eating compared to unhealthy eating (or vice versa) which is key. Relative strength of implicit identification with two target categories (such as healthy and unhealthy eating) can be measured using the original Implicit Association Test (IAT). In the IAT, participants used two response keys to categorise items from two opposing categories (self/other) along with words related to two evaluative dimensions (healthy foods/unhealthy foods). This measures the strength of implicit identification with healthy eating relative to the strength of implicit identification with unhealthy eating. The final two studies of my thesis (Studies 4-5) will therefore assess an IAT measuring strength of implicit identification with healthy versus unhealthy eating as a predictor of eating-related behaviours.

Chapter 3: Studies 4 and 5

This chapter will describe the method and results of the final two studies of my PhD. Studies 4 and 5 built on Studies 1-3 (described in Chapter 2) by using a different measure of implicit identity to predict eating-related behaviour. In the three previous studies, two single-category implicit association tests (SC-IATs) were used to measure implicit identification as a healthy eater and implicit identification as an unhealthy eater. Studies 4 and 5 used a single Implicit Association Test (IAT) rather than the two SC-IATs. In the IAT, participants used two response keys to categorise items from two opposing categories (self/other) along with words related to two evaluative dimensions (healthy foods/unhealthy foods). The IAT provides a single D score for each participant to measure the strength of their implicit identification with healthy eating relative to the strength of their implicit identification with unhealthy eating, instead of measuring the two aspects of identity separately (see Study 4 Method section).

The main reason for using an IAT instead of SC-IATs in Studies 4-5 was to test whether this could better predict the eating-related measures. The two SC-IATs were used in Studies 1-3 because it was assumed that identification as a healthy eater and identification as an unhealthy eater were best measured separately; for instance, a person could identify with eating fruits and vegetables (healthy eating) and also with eating chocolate (unhealthy eating). However, the SC-IATs failed to reliably predict eating-related behaviour across Studies 1-3. Although Study 1 provided some initial evidence for implicit identity as a predictor of the eating-related measures, the relationship was weak and this was not replicated in Study 2 or Study 3. One possible explanation for the lack of reliably significant results using the SC-IATs is that it may be the relative strength of identification with healthy versus unhealthy eating, rather than absolute identification with healthy eating and unhealthy eating, which is important for predicting behaviour. That is, it could be how much more strongly a person identifies with healthy eating compared to unhealthy eating (or vice versa), regardless of the actual strength of identification with healthy or unhealthy eating, which is important for predicting eating behaviour. Consistent with this hypothesis, a study comparing an IAT measuring implicit attitudes towards fruits and desserts with a SC-IAT measuring implicit attitudes towards desserts found that the IAT - but not the SC-IAT - was able to predict self-reported dessert consumption (Richetin & Perugini, 2008). Therefore, Studies 4-5 used an IAT measuring the relative strength of implicit identification with healthy and unhealthy foods to test whether this was a better predictor than measuring each aspect of implicit identity separately.

In addition, research has suggested that there are other benefits to using the IAT over the SC-IAT. One advantage is that IAT measures typically have better internal consistency than SC-IATs (Schnabel et al., 2008; Stieger et al., 2011). In addition, the IAT may be more resistant to participants deliberately trying to fake their results by responding more slowly on certain trial blocks. Although implicit measures are generally seen as resistant to self-presentation bias and demand compliance, it is possible that some people may work out the purpose of the measure and be able to alter their responses (de Houwer, 2006; Greenwald et al., 2009; Steffens, 2004; Vecchione et al., 2014). When participants are instructed to fake their performance, SC-IAT scores are typically more affected than IAT scores (Stieger et al., 2011), indicating that the IAT is more resistant to faking than the SC-IAT. These findings offer additional support for the use of an IAT in Studies 4-5.

Another difference in the implicit measure for Studies 4 and 5 is that the IAT used different healthy food stimuli than those used in the SC-IATs. In Studies 1-3, the healthy food stimuli were designed to cover a range of different food groups (fruits, vegetables, grains, and proteins). However, a possible limitation of this is that people's perceptions of healthy eating may differ, particularly for certain food groups. For instance, some people believe low-carbohydrate diets are healthy while others do not (Clarke & Best, 2017; Finney Rutten et al., 2008). A small pilot study with 40 participants suggested that fruits and vegetables may be perceived as being more healthy than other healthy food groups; images of fruits and vegetables were rated more highly on perceived healthiness (M = 4.50; range = 1-5, higher scores indicate greater perceived healthiness) than images of high-protein foods (M = 3.92) or high-fibre foods (M = 3.50). Consequently, only fruits and vegetables were used as healthy eating stimuli in the IAT. These stimuli are listed in the measures section.

Studies 4 and 5 also used a new eating-related measure. In this measure, participants were asked to choose three courses (a drink, a main course, and a dessert) from a hypothetical restaurant menu (Feldman et al., 2015; Tonkin et al., 2019). This menu choice measure was used instead of the hypothetical sandwich menu used in Study 1 for two reasons. Firstly, the menu choice used in Studies 4 and 5 asked participants to choose three items, unlike the Study 1 measure which only asked participants to choose one item; this allowed for greater variability in responding. Secondly, the stimuli on the restaurant menu were designed to more closely match the IAT stimuli. For instance, two of the courses (mains and desserts) contained items featuring fruits and vegetables to match the healthy eating stimuli used in the IAT. It was hoped that these changes would improve the correspondence between the IAT and the menu choice measure, and thus improve the ability of the IAT to predict responses on the menu choice measure (Irving & Smith, 2020).

Study 4 was conducted to provide an initial assessment of the IAT as a predictor of eating-related behaviour. Study 5 built on Study 4 by using a behavioural outcome measure in which participants were asked to choose one of four different snacks (two healthy options and two unhealthy options) (Ayres et al., 2012; Ellis et al., 2014; Weijzen et al., 2008). Previously, eating-related behaviour had been measured in this thesis by using items asking about past behaviour (e.g. past eating behaviour) or hypothetical menu choices. The snack choice therefore provided an important measure of actual behaviour.

Study 5 also built on the results of Study 4 by including stress as a possible moderator of the relationship between implicit identity and each outcome variable. Study 4 looked at self-control as a moderator; Study 5 expanded on this by measuring both self-control and stress as possible moderators. Stress was hypothesised to be a moderator of the relationship between implicit identity and eating behaviour as stress depletes self-control resources (Muraven & Baumeister, 2000). Low self-control can reduce the influence of the controlled processing system on behaviour and increase the influence of the automatic system, making implicit factors more predictive of behavioural outcomes (Haynes et al., 2015). It was therefore expected that stress would moderate the relationship between implicit identity and the eating-related measures, with implicit identity being a stronger predictor among participants who reported more stress.

The hypotheses for Studies 4 and 5 were the same as Studies 1-3 but looked at relative implicit identity, rather than absolute implicit identity, as a predictor of the eating-related outcome measures. It was hypothesised that greater relative identification with healthy eating compared to unhealthy eating (as shown by a positive D score) would predict more self-reported healthier past eating behaviour; more self-reported servings of fruits, vegetables, and wholegrains eaten yesterday; a greater number of healthy selections made from the menu; and greater likelihood of a healthy snack choice (Study 5 only). It was also hypothesised that greater relative identification with healthy eating would predict stronger perceived behavioural control for healthy eating. As in previous studies, self-control was expected to moderate the relationship between implicit identity and the eating-related measures. Stress was also expected to be a moderator (Study 5 only).

H_1: Greater implicit identification with healthy eating, relative to implicit identification with unhealthy eating, will predict more healthy eating-related behaviours, fewer unhealthy eating-related behaviours, and stronger perceived behavioural control for healthy eating.

H_2: Implicit identity will be a stronger predictor of eating-related behaviour in participants with lower trait self-control.

H_3: Implicit identity will be a stronger predictor of eating-related behaviour in participants with higher self-reported stress (Study 5).

Study 4

Method

Participants

Participants in Study 4 were American adults. The study was advertised as a survey on "personality and health behaviours" on Amazon's MTurk and was open to American workers who were over 18 years of age, fluent in English, and had achieved Masters status on MTurk (see Study 1 Participants). Participants were paid US$2 on completion of the study. Average completion time was 28.91 minutes (*SD* = 90.72). A total of 200 participants were recruited. One response was removed because the participant only completed demographic measures and then exited the survey. Two participants completed the survey twice; their first response was retained and their second response was deleted. One participant was removed for failing an attention check. Twenty participants were removed based on IAT criteria (see Measures). As in Study 1, participants with a BMI under 18.5 or over 40 were excluded from further analysis (N = 17)[10]. Finally, three participants were removed for having D score outliers (more than 3.29 standard deviations from the mean).

This left 156 participants for analysis. Descriptive statistics for the 156 participants included for analysis are included in Table 26. Ages ranged from 23 to 67 and BMI ranged from 19.37 to 39.78. Of the participants who chose ‘other’ as their ethnicity, two identified as Hispanic and one as both Asian and Caucasian. Participants were also asked to report any food allergies/intolerances or other dietary requirements. 14 participants (9.0%) reported food allergies such as a peanut allergy or gluten allergy. 7 (4.5%) were vegetarian; 4 (2.6%) were pescatarian; 7 (4.5%) were gluten free; and 8 (5.1%) reported other dietary requirements such as ketogenic diets or low sugar diets.

Table 26
Study 4 Description of Sample

		N (%)
Gender	Males	70 (44.9)
	Females	85 (54.5)
	Other	1 (0.6)
Education	High school or other	34 (21.8)
	Associate’s degree	37 (23.7)
	Bachelor’s degree	72 (46.2)
	Master’s degree	13 (8.3)
Ethnicity	White/Caucasian	132 (84.6)
	Other	24 (15.4)
		M (SD)
	Age[a]	41.81 (10.64)
	BMI	27.09 (4.90)

Note: *N* = 156. BMI = body mass index.
[a] There were 68 missing values (43.6%).

Measures

Participants reported their date of birth, gender (response options: male, female, other), highest educational qualification, ethnicity, allergies or dietary requirements, height

[10] When analyses were repeated with these participants included, the results for the implicit variables were unchanged (see Data Analysis section).

(in inches), weight (in pounds), and accuracy of their self-reported weight and height. Date of birth was used to calculate age (in years) and weight and height were used to calculate BMI.

Attention Check. Participants were asked to explain their reasons for the menu choices they made and were instructed not to leave the answer box blank. Participants could fail the attention check by not answering the question (*n* = 0) or by entering a random string of letters instead of answering the question (*n* = 1), in which case they were excluded from analyses.

Body Mass Index (BMI). BMI was calculated using the height and weight information provided by participants (see Study 1 measures).

Implicit Association Test. Participants completed an implicit association test (IAT) to measure the relative strength of their implicit identification with healthy and unhealthy foods (Greenwald et al., 1998; Stout et al., 2011). In an IAT, participants use two response keys to categorise items from two opposing categories (e.g. self/other) along with words related to two evaluative dimensions (e.g. healthy eating/unhealthy eating). Stimuli used in the IAT are shown in Table 27 below. One category and one dimension are paired on the left response key and the other category and dimension are paired on the right key; halfway through the IAT the categories are swapped over. The order of the pairings is counterbalanced between participants (see Table 28). If a person is faster and more accurate when the pairings are “healthy + self” and “unhealthy + other” than when the pairings are “healthy + other” and “unhealthy + self”, this shows stronger implicit identification with healthy eating relative to unhealthy eating. Similarly, if a person is faster and more accurate when the pairings are “unhealthy + self” and “healthy + other” than when the pairings are “healthy + self” and “unhealthy + other”, this shows stronger implicit identification with unhealthy eating.

Table 27
Implicit Association Test Stimuli

Self	Others	Healthy Food	Unhealthy Food
I	Others	Fruit	Cake
Me	Him	Vegetables	Chocolate
Myself	Her	Salad	Pizza
My	They	Carrot	Fries
Self	Them	Apple	Candy

Table 28
Implicit Association Test Blocks

Block	Trial type	Pairing (even participants)	Pairing (odd participants)
1	20 practice trials	L: Healthy R: Unhealthy	L: Unhealthy R: Healthy
2	20 practice trials	L: Self R: Other	L: Other R: Self
3	20 test trials	L: Self + Healthy R: Other + Unhealthy	L: Self + Unhealthy R: Other + Healthy
4	40 test trials	L: Self + Healthy R: Other + Unhealthy	L: Self + Unhealthy R: Other + Healthy
5	20 practice trials	L: Unhealthy R: Healthy	L: Healthy R: Unhealthy
6	20 test trials	L: Self + Unhealthy R: Other + Healthy	L: Self + Healthy R: Other + Unhealthy
7	40 test trials	L: Self + Unhealthy R: Other + Healthy	L: Self + Healthy R: Other + Unhealthy

Note: L = left response key, R = right response key.

A D score was calculated for each participant using the algorithm proposed by Greenwald et al. (2003), which divides the difference between the hypothesis-compatible test block mean and the hypothesis-incompatible test block mean by the pooled standard deviation of all test block trials. Trials with latencies greater than 10,000ms were deleted. Participants were also excluded if they had more than 10% of responses with a response time under 300 ms, more than 10% of responses with a response time over 10,000ms, or an error rate greater than 20% (Greenwald et al., 2003; Karpinski & Steinman, 2006). This helps to ensure that participants are responding quickly enough to be using the automatic processing system but are paying attention and not responding randomly.

A positive D score indicates greater implicit identification with healthy foods relative to unhealthy foods, and a negative D score indicates greater implicit identification with unhealthy foods relative to healthy foods. Three participants had extreme D scores (3.29 standard deviations above or below the mean) and were excluded from analysis (Tabachnick & Fidell, 2014).

Explicit Identity. Explicit self-identity was measured using the healthy eater subscale of the Eating Identity Type Inventory (Blake et al., 2013) (see Study 1 measures). Cronbach's alpha was .95.

Habit. Habit strength was measured using the Self-Report Habit Index (Verplanken & Orbell, 2003) (see Study 1 measures). Due to researcher error, one item from the healthy eating scale was accidentally omitted from the survey ("healthy eating is something I start doing before I realise I'm doing it"). Therefore, the snack habit scale was calculated using 12 items as normal but the healthy eating habit scale was calculated using 11 items. Cronbach's alpha was .97 for healthy habit and also .97 for unhealthy habit.

Attitudes. A five-item scale was used to measure attitudes towards healthy eating (Conner et al., 2002) (see Study 1 measures). Cronbach's alpha for this measure was .80.

Subjective Norms. Subjective norms was measured using one item (Conner et al., 2002) (see Study 1 measures).

Self-Control. Self-control was measured using the Brief Self-Control Scale (Tangney et al., 2004) (see Study 1 measures). Cronbach's alpha for this scale was .91.

Past eating behaviour. The five-item scale and single item measuring past eating behaviour that were used in Studies 1-3 were also used in Study 4 (Kuijer & Boyce, 2012, 2014; Wood Baker et al., 2003) (see Study 1 measures). Cronbach's alpha for the scale was .77.

Menu Choice. Participants were asked to imagine that they were having dinner at a restaurant and were asked to choose a drink, main course, and dessert from a hypothetical menu. There were two options for drinks, four options for a main course, and four options for desserts (see Table 29; full measure is shown in Appendix L). Each option was shown as a picture with a brief description. The menu choice was coded as number of healthy options selected, ranging from 0 (no healthy options selected) to 3 (healthy options selected for all 3 courses). Thirty participants (19.2%) made no healthy choices; 47 (30.1%) made one healthy choice; 48 (30.8%) made two healthy choices; and 31 (19.9%) made three healthy choices.

Table 29
Study 4 Menu Choice Responses

Course	Option	Category	*N* (%)
Drink	A soft drink or soda	Unhealthy	56 (35.9%)
	Water (still or sparkling)	Healthy	100 (64.1%)
Main	Burger and wedges	Unhealthy	39 (25%)
	Pizza	Unhealthy	41 (26.3%)
	Salmon and salad	Healthy	50 (32.1%)
	Roast vegetable salad	Healthy	26 (16.7%)
Dessert	Chocolate cake	Unhealthy	46 (29.5%)
	Key lime pie	Unhealthy	50 (32.1%)
	Greek yoghurt and berries	Healthy	31 (19.9%)
	Sorbet	Healthy	29 (18.6%)

Servings Eaten Yesterday. Participants were asked to report how many servings of seven different food groups they ate on the day preceding their participation (Conner et al., 2017; Conner et al., 2015; Russell et al., 1999; White et al., 2013) (see Study 2 measures). The foods measured were: fruits; vegetables; wholegrain cereals or bread; crisps, corn snacks, or corn chips; hot chips, French fries, or wedges; lollies, sweets, chocolate, or confectionary; and biscuits, cake, muffins, or buns. Participants were also asked to specify whether they were answering for a weekend or a weekday. Responses were made on a 6-point scale ranging from ‘0 servings’ to ‘4 or more servings’. Higher scores indicated a greater number of servings eaten yesterday. As in previous studies, the items were used to create three scales: fruit and vegetable consumption (the average of the fruit and vegetable items), wholegrain consumption, and unhealthy food consumption (the average of the items measuring crisps, chips, lollies, and biscuits).

Perceived Behavioural Control. Perceived behavioural control was measured using four items (Kuijer & Boyce, 2012, 2014) (see Study 1 measures). Cronbach's alpha for this scale was.70.

Procedure

This study received approval from the University of Canterbury Human Ethics Committee (HEC 2018/01). The IAT was hosted on millisecond.com and the other questions were hosted on Qualtrics. First, participants read an information sheet about the study and were asked whether they consented to participate. Participants who did not consent were taken to the end of the survey. Those who did consent first answered demographic questions. They were then given a link to take the IAT. At the end of the IAT each participant was given a unique eight-digit code which they were asked to enter back into the Qualtrics survey, in order to anonymously match responses on the IAT with responses on the survey. After finishing the IAT, participants returned to the Qualtrics survey and completed the rest of the survey questions in the following order: menu choice, attention check, past eating behaviour, servings eaten yesterday, allergies and dietary requirements, subjective norms, attitudes, PBC, explicit identity, habit, and self-control. Finally, there were eight questions on personality, which were used as filler questions and were not analysed. The study concluded with a debriefing sheet which explained the study hypotheses and the purpose of the IAT. Participants were provided with contact details for the researcher if they had any concerns or questions after completing the study.

Data Analysis

Prior to analysis, relevant assumptions (absence of outliers, normal distributions, and linear relationships between variables) were checked (see Study 1 Data Analysis). No multivariate outliers were present for any of the analyses. Norms, attitudes, and unhealthy servings all had skewed distributions, and norms and unhealthy servings also had two univariate outliers. Data transformations were used on these three variables to create approximately normal distributions, defined by skew and kurtosis statistics with a z-score of less than 3.29 (Tabachnick & Fidell, 2014). Each regression that included these items was tested using both the transformed and non-transformed variables (Newton & Rudestam, 2013). This did not alter the pattern of results, and so results are reported for non-transformed variables.

There was one missing value for attitudes, two missing values for unhealthy habit, and two missing values for self-control. Due to the small number of missing values and the fact they were missing at random, participants with missing values were excluded from analyses using these variables (Newton & Rudestam, 2013; Tabachnick & Fidell, 2014). A total of 68 participants (43.6%) did not report their date of birth, meaning that age could not be calculated for these participants. Little’s MCAR test was not significant, $\chi^2(127) = 110.93$, $p = .844$, suggesting the data was missing completely at random (Tabachnick & Fidell, 2014). Age was not a critical variable for this study and was therefore not used in any further analysis (Tabachnick & Fidell, 2014). Due to the small number of participants who identified as a gender other than male or female, gender was treated as a binary variable (male/female) for the purposes of statistical analysis. The response of ‘other’ was treated as a missing variable, as there were not enough participants to analyse as a separate group.

Bivariate correlations and hierarchical multiple regression analyses were conducted using IBM SPSS version 25. Separate hierarchical multiple regressions were conducted predicting each outcome variable (past eating behaviour scale, past eating behaviour single item, menu choice, servings of fruit and vegetables, servings of wholegrains, servings of unhealthy foods, and PBC). Alpha was set at .05, and bootstrapped 95% confidence intervals with 2000 samples were calculated for each analysis. Bootstrapped coefficients, standard errors, significance levels, and confidence intervals are reported for each predictor. In each regression, gender and BMI were entered first (Model 1), explicit predictors (attitudes, subjective norms, and habit) were entered in Model 2, and implicit identity (IAT D score) was entered in Model 3. Due to the high correlation between explicit identity and healthy habit ($r = .85$, $p < .05$), explicit identity was not included in the regression analyses in order to avoid multicollinearity (Tabachnick & Fidell, 2014). Post-hoc power analyses determined that these regression models had adequate power (99.8%) to detect a medium effect but were underpowered (41.9%) to detect a small effect.

Moderation analyses were conducted using IBM SPSS version 25. A separate analysis was conducted for each outcome variable with self-control as a moderator for the relationship between implicit identity and the eating-related measures. In Model 4, self-control was added to the final regression model (Model 3) and in Model 5, the interaction term was added. Bootstrapped 95% confidence intervals with 2000 samples were calculated for the coefficients for self-control and the interaction term. Significant interaction effects were followed up with simple slope analyses at low (one standard deviation below the mean), average (at the mean) and high (one standard deviation over the mean) levels of the moderator). As in the regression analyses, each moderation was tested using both the transformed and non-transformed variables for norms, attitudes, and servings of unhealthy foods (Newton & Rudestam, 2013). This did not alter the pattern of results, and so results are reported for non-transformed variables.

Regression and moderation analyses were repeated with participants with all BMIs included, which did not change the pattern of results for any analysis. As allergies or other dietary requirements could affect eating behaviours, the analyses were also repeated excluding participants who reported having dietary requirements. This did not change the significance of implicit identity as a predictor or self-control as a moderator for any outcome variable.

Results

Correlations

Scale means and standard deviations and bivariate correlations between the predictor and outcome variables are shown in Table 30. Implicit identity was positively correlated with attitudes and with healthy eating habit; participants who implicitly identified with healthy eating were more likely to report positive attitudes towards healthy eating and a stronger healthy eating habit. Implicit identity was not significantly correlated with any of the eating-related measures. Instead, these outcome measures were significantly correlated with the explicit predictors. In particular, attitudes and healthy habit were significantly correlated with all 6 eating-related measures. Explicit identity was correlated with all eating-related measures except for servings of wholegrains. Subjective norms was correlated with menu choice and servings of fruits and vegetables. Unhealthy habit was correlated with menu choice, past eating behaviour (both the single item and the scale), PBC, and unhealthy servings. Self-control was significantly correlated with all eating-related measures, attitudes, explicit identity, and habit strength.

Table 30

Study 4 Correlations, Means, and Standard Deviations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Implicit Identity	1.00															
2. Gender	.04	1.00														
3. BMI	-.02	.10	1.00													
4. Attitudes	.19*	.18*	-.13	1.00												
5. Norms	.05	.03	.11	.27**	1.00											
6. Explicit identity	.10	-.07	-.12	.64**	.21**	1.00										
7. H habit	.17*	-.03	-.24**	.70**	.16	.85**	1.00									
8. U habit	-.02	.05	.20**	-.41**	-.01	-.51**	-.52**	1.00								
9. Self-control	.01	.10	-.10	.52**	.13	.63**	.63**	-.53**	1.00							
10. Past EB (scale)	.13	.01	-.11	.50**	.13	.75**	.65**	-.58**	.56**	1.00						
11. Past EB (1 item)	.05	-.10	-.13	.48**	.05	.80**	.70**	-.43**	.56**	.77**	1.00					
12. PBC	.05	-.01	-.25**	.53**	.04	.63**	.66**	-.63**	.60**	.66**	.61**	1.00				
13. Menu choice	.10	.11	-.08	.56**	.16*	.48**	.48**	-.27**	.36**	.48**	.34**	.33**	1.00			
14. Serves FV	.04	.05	.03	.39**	.27**	.50**	.43**	-.15	.34**	.46**	.45**	.33**	.31**	1.00		
15. Serves WG	.05	.05	-.10	.23**	.01	.16	.19*	-.01	.19*	.07	.13	.11	.19*	.17*	1.00	
16. Serves U	-.05	-.12	.04	-.26**	-.07	-.39**	-.31**	.45**	-.26**	-.62**	-.40**	-.41**	-.32**	-.15	.06	1.00
M	0.51		28.09	5.61	6.02	3.33	3.89	3.52	3.53	3.74	4.40	3.35	1.50	3.34	2.64	1.70
SD	0.68		6.76	0.94	1.23	1.10	1.65	1.65	0.80	.074	1.52	0.87	1.03	1.21	1.33	0.74

Note: H = healthy, U = unhealthy, BMI = body mass index, EB = eating behaviour, PBC = perceived behavioural control FV = fruit/vegetables, WG = wholegrain.

* p <.05. ** p <.01.

Regression Models

Regression models were conducted to see if implicit identity could predict each outcome variable over and above the influence of BMI, gender, healthy and unhealthy habit, attitudes, and norms. Results for the regression analyses are presented in Tables 31-34.

Both healthy and unhealthy habit were significant predictors of the scale measure of past eating behaviour; people reported more healthy eating when they had stronger healthy eating habits and weaker unhealthy eating habits. Healthy habit was the only significant predictor of the single-item measure, with people reporting more healthy eating when they had a stronger healthy eating habit. Attitudes and healthy habit were significant predictors of menu choice; participants with more favourable attitudes towards healthy eating and stronger healthy eating habits chose more healthy options from the menu. Healthy and unhealthy habit were both significant predictors of PBC. Participants reported greater PBC for healthy eating when they had a strong healthy eating habit and a weak unhealthy eating habit. Healthy habit and subjective norms were significant predictors of servings of fruits and vegetables; people consumed more fruits and vegetables the previous day when they had stronger subjective norms for healthy eating and a stronger healthy eating habit. There were no significant predictors of wholegrain consumption. Unhealthy habit was a significant predictor of servings of unhealthy food. People reported consuming more servings of unhealthy foods when they had a stronger unhealthy habit. Implicit identity was not a significant predictor of any of the outcome variables.

Table 31

Study 4 Regression Analyses Predicting Past Eating Behaviour

		Past Eating Behaviour (scale)						Past Eating Behaviour (single item)					
		R^2change	*b*	*SE*	*p*	95% CI		R^2change	*b*	*SE*	*p*	95% CI	
						LL	*UL*					*LL*	*UL*
Model 1	Constant	.02, *p* = .320	4.26	0.36	< .001	3.59	4.98	.02, *p* = .159	5.89	0.75	< .001	4.44	7.36
	Gender		0.00	0.12	.983	-0.24	0.23		-0.25	0.24	.309	-0.73	0.23
	BMI		-0.02	0.01	.133	-0.04	0.01		-0.04	0.02	.102	-0.08	0.01
Model 2	Constant	.49, *p* < .001	2.97	0.37	< .001	2.25	3.72	.47, *p* < .001	2.45	1.13	.034	0.21	4.62
	Gender		0.02	0.09	.799	-0.15	0.21		-0.24	0.18	.186	-0.58	0.12
	BMI		0.01	0.01	.306	-0.01	0.03		0.02	0.02	.296	-0.02	0.05
	Attitudes		0.02	0.06	.729	-0.11	0.14		0.05	0.16	.746	-0.26	0.35
	Norms		0.02	0.04	.678	-0.05	0.10		-0.08	0.09	.356	-0.24	0.11
	H Habit		0.21	0.03	< .001	0.14	0.27		0.59	0.08	< .001	0.44	0.74
	U Habit		-0.14	0.03	< .001	-0.20	-0.09		-0.08	0.07	.322	-0.22	0.06
Model 3	Constant	.00, *p* = .399	2.97	0.38	< .001	2.27	3.72	.01, *p* = .238	2.43	1.12	.033	0.22	4.60
	Gender		0.02	0.09	.807	-0.16	0.20		-0.24	0.18	.187	-0.57	0.11
	BMI		0.01	0.01	.304	-0.01	0.03		0.02	0.02	.291	-0.02	0.05
	Attitudes		0.01	0.06	.818	-0.12	0.14		0.07	0.16	.658	-0.25	0.37
	Norms		0.02	0.04	.666	-0.05	0.10		-0.08	0.09	.349	-0.24	0.10
	H Habit		0.21	0.03	< .001	0.14	0.27		0.59	0.08	< .001	0.45	0.74
	U Habit		-0.14	0.03	< .001	-0.20	-0.09		-0.07	0.07	.359	-0.22	0.07
	Implicit identity		0.08	0.09	.367	-0.10	0.26		-0.25	0.19	.190	-0.62	0.13
	R^2total	.51, *p* < .001						.50, *p* < .001					

Note: Number of bootstrap samples = 2000. H = healthy, U = unhealthy, BMI = body mass index, *LL* = lower limit, *UL* = upper limit.

Table 32

Study 4 Regression Analyses Predicting Menu Choice and PBC

		Menu Choice						PBC					
		R^2change	*b*	*SE*	*p*	95% CI		R^2change	*b*	*SE*	*p*	95% CI	
						LL	*UL*					*LL*	*UL*
Model 1	Constant	.02, *p* = .319	1.54	0.52	.005	0.52	2.55	.07, *p* = .004	4.67	0.46	< .001	3.77	5.57
	Gender		0.22	0.16	.184	-0.11	0.53		0.00	0.14	.992	-0.27	0.27
	BMI		-0.01	0.02	.399	-0.05	0.02		-0.05	0.02	.003	-0.08	-0.02
Model 2	Constant	.33, *p* < .001	-1.77	0.64	.006	-3.05	-0.59	.49, *p* < .001	3.26	0.48	< .001	2.25	4.16
	Gender		0.07	0.14	.640	-0.21	0.35		-0.01	0.10	.953	-0.20	0.19
	BMI		0.01	0.02	.525	-0.02	0.04		-0.01	0.01	.241	-0.04	0.01
	Attitudes		0.42	0.10	< .001	0.22	0.61		0.11	0.07	.148	-0.05	0.25
	Norms		0.01	0.05	.891	-0.10	0.11		-0.04	0.04	.338	-0.11	0.05
	H Habit		0.13	0.06	.033	0.02	0.26		0.20	0.04	< .001	0.11	0.29
	U Habit		-0.01	0.05	.885	-0.11	0.10		-0.19	0.04	< .001	-0.27	-0.12
Model 3	Constant	.00, *p* = .989	-1.77	0.65	.006	-3.05	-0.55	.00, *p* = .550	3.25	0.48	< .001	2.26	4.17
	Gender		0.07	0.14	.639	-0.21	0.34		-0.01	0.10	.962	-0.20	0.18
	BMI		0.01	0.02	.528	-0.02	0.04		-0.01	0.01	.248	-0.04	0.01
	Attitudes		0.42	0.10	< .001	0.22	0.61		0.11	0.08	.142	-0.05	0.26
	Norms		0.01	0.05	.889	-0.10	0.11		-0.04	0.04	.332	-0.11	0.05
	H Habit		0.13	0.06	.033	0.02	0.26		0.20	0.04	< .001	0.12	0.29
	U Habit		-0.01	0.05	.889	-0.11	0.10		-0.19	0.04	< .001	-0.27	-0.11
	Implicit identity		0.00	0.16	.988	-0.32	0.31		-0.07	0.11	.508	-0.29	0.13
	R^2total	.35, *p* < .001						.56, *p* < .001					

Note: Number of bootstrap samples = 2000. H = healthy, U = unhealthy, BMI = body mass index, PBC = perceived behavioural control, *LL* = lower limit, *UL* = upper limit.

Table 33

Study 4 Regression Analyses Predicting Fruit/Vegetable and Wholegrain Servings

		Serves of fruits and vegetables						Serves of wholegrains					
		R^2change	*b*	*SE*	*p*	95% CI		R^2change	*b*	*SE*	*p*	95% CI	
						LL	*UL*					*LL*	*UL*
Model 1	Constant	.00, *p* = .864	3.04	0.61	< .001	1.81	4.24	.01, *p* = .418	3.12	0.69	< .001	1.69	4.43
	Gender		0.08	0.20	.691	-0.34	0.47		0.18	0.22	.413	-0.25	0.61
	BMI		0.01	0.02	.707	-0.03	0.05		-0.03	0.02	.268	-0.07	0.02
Model 2	Constant	.24, *p* < .001	-0.46	0.81	.558	-2.04	1.15	.06, *p* = .053	1.08	0.96	.255	-0.83	2.96
	Gender		0.02	0.19	.933	-0.36	0.40		0.07	0.23	.786	-0.38	0.52
	BMI		0.03	0.02	.199	-0.01	0.06		-0.02	0.02	.491	-0.06	0.03
	Attitudes		0.15	0.13	.233	-0.13	0.41		0.29	0.16	.074	-0.04	0.61
	Norms		0.15	0.08	.042	0.01	0.31		-0.06	0.09	.481	-0.23	0.11
	H Habit		0.28	0.07	< .001	0.13	0.42		0.09	0.10	.335	-0.10	0.29
	U Habit		0.07	0.07	.340	-0.06	0.21		0.11	0.08	.201	-0.06	0.27
Model 3	Constant	.00, *p* = .486	-0.47	0.82	.549	-2.05	1.17	.00, *p* = .961	1.08	0.97	.255	-0.80	3.03
	Gender		0.02	0.19	.924	-0.36	0.40		0.07	0.23	.783	-0.38	0.52
	BMI		0.03	0.02	.193	-0.01	0.06		-0.02	0.02	.497	-0.06	0.03
	Attitudes		0.17	0.14	.206	-0.12	0.43		0.29	0.17	.085	-0.06	0.61
	Norms		0.15	0.08	.046	0.01	0.32		-0.06	0.09	.486	-0.23	0.11
	H Habit		0.28	0.08	< .001	0.14	0.42		0.09	0.10	.342	-0.11	0.29
	U Habit		0.07	0.07	.310	-0.06	0.21		0.11	0.08	.210	-0.06	0.27
	Implicit identity		-0.15	0.20	.443	-0.54	0.23		0.01	0.26	.953	-0.48	0.55
	R^2total	.24, *p* < .001						.07. *p* = .134					

Note: Number of bootstrap samples = 2000. H = healthy, U = unhealthy, BMI = body mass index, *LL* = lower limit, *UL* = upper limit.

Table 34

Study 4 Regression Analyses Predicting Unhealthy Servings

		Serves of unhealthy food					
		R^2change	*B*	*SE*	*p*	95% CI	
						LL	*UL*
Model 1	Constant	.02, *p* = .316	1.74	0.35	< .001	1.06	2.47
	Gender		-0.17	0.12	.174	-0.41	0.07
	BMI		0.01	0.01	.532	-0.01	0.03
Model 2	Constant	.21, *p* < .001	1.85	0.47	< .001	0.98	2.82
	Gender		-0.21	0.12	.089	-0.43	0.02
	BMI		-0.01	0.01	.424	-0.03	0.01
	Attitudes		0.03	0.08	.755	-0.14	0.18
	Norms		-0.02	0.05	.652	-0.12	0.07
	H Habit		-0.06	0.06	.300	-0.17	0.05
	U Habit		0.18	0.04	< .001	0.10	0.27
Model 3	Constant	.00, *p* = .685	1.84	0.47	< .001	0.96	2.83
	Gender		-0.21	0.12	.088	-0.43	0.02
	BMI		-0.01	0.01	.435	-0.03	0.01
	Attitudes		0.03	0.08	.720	-0.13	0.19
	Norms		-0.02	0.05	.654	-0.12	0.07
	H Habit		-0.06	0.06	.318	-0.17	0.05
	U Habit		0.18	0.04	< .001	0.10	0.27
	Implicit identity		-0.05	0.13	.702	-0.30	0.19
	R^2total	.23, *p* < .001					

Note: Number of bootstrap samples = 2000. H = healthy, U = unhealthy, BMI = body mass index, *LL* = lower limit, *UL* = upper limit.

Moderation Analyses

Self-control was analysed as a moderator for the relationship between implicit identity and each eating outcome. Self-control was a significant predictor of past eating behaviour (single item) and PBC even after controlling for demographic, explicit, and implicit variables (see Table 35). However, self-control was not a significant moderator for the relationship between implicit identity and any of the outcome variables (see Table 35).

Summary

Contrary to hypotheses, Study 4 did not find implicit eating-related identity to be a significant predictor of healthy or unhealthy eating. In both the bivariate correlations and the regression analyses, implicit identity was not a significant predictor for any of the eating-related outcomes measured. In addition, the hypothesis that self-control would moderate the relationship between implicit identity and the eating-related measures was not supported. Self-control was not a significant moderator for any of the eating-related outcomes measured in Study 4, although it was a significant predictor of PBC and the single-item measure of past eating behaviour over and above demographic, explicit, and implicit predictors.

Although it was expected that the eating-related measures would be predicted by both implicit and explicit variables, this study found that the eating-related measures were predicted only by explicit variables. In particular, habit strength was a key predictor variable. Past eating behaviour, menu choice, PBC, servings of fruits and vegetables, and servings of unhealthy foods were all significantly predicted by habit strength. Although the other explicit variables were correlated with eating-related measures, these relationships did not remain significant in the regression models (with the exception of attitudes when predicting menu choice and subjective norms when predicting fruit and vegetable intake).

Study 5 was conducted as an additional assessment of whether implicit eating-related identity, as measured by the IAT, can predict eating behaviour and eating-related outcomes. Stress was included as an additional moderator variable.

Table 35

Study 4 Moderation Analyses for Implicit Identity and Self-Control

	Model 3	Model 4	Model 5	Self-control[a]					Interaction[b]				
	R^2change	R^2change	R^2change	*b*	*SE*	*p*	95% CI		*b*	*SE*	*p*	95% CI	
							LL	*UL*				*LL*	*UL*
Past EB (scale)	.51, *p* < .001	.01, *p* = .094	.00, *p* = .460	0.12	0.08	.114	-0.03	0.26	-0.10	0.13	.453	-0.34	0.18
Past EB (1 item)	.50, *p* < .001	.02, *p* = .013	.00, *p* = .258	0.37	0.15	.016	0.06	0.68	0.31	0.32	.326	-0.33	0.92
PBC	.56, *p* < .001	.02, *p* = .011	.00, *p* = .703	0.21	0.08	.006	0.07	0.35	-0.06	0.15	.701	-0.33	0.26
Menu Choice	.34, *p* < .001	.00, *p* = .881	.00, *p* = .881	0.02	0.10	.862	-0.16	0.21	0.03	0.19	.864	-0.34	0.43
Serves FV	.24, *p* < .001	.01, *p* = .209	.00, *p* = .796	0.19	0.16	.237	-0.12	0.52	0.07	0.26	.768	-0.38	0.63
Serves WG	.08, *p* = .127	.01, *p* = .139	.00, *p* = .903	0.27	0.20	.159	-0.13	0.67	-0.04	0.30	.889	-0.64	0.56
Serves U	.23, *p* < .001	.00, *p* = .430	.01, *p* = .259	0.07	0.10	.483	-0.12	0.27	0.19	0.19	.302	-0.17	0.56

Note: H = healthy, U = unhealthy, EB = eating behaviour, PBC = perceived behavioural control, FV = fruit/vegetable, WG = wholegrains, *LL* = lower limit, *UL* = upper limit. Model 3: Gender, BMI, attitudes, subjective norms, habit strength, and implicit identity. Model 4: Self-control added. Model 5: Interaction between self-control and implicit identity added.

[a] Regression estimates for self-control from Model 4. [b] Regression estimates for the interaction from Model 5.

Study 5

Method

Participants

Participants were students recruited from the University of Canterbury. Students from a large first-year Psychology class were recruited via a research participation website and received course credit for participating. Other students were recruited via emails sent to all Psychology students and posts on student Facebook groups. These participants received a $10 voucher for participating. The study was advertised to all participants as research on “personality and health behaviours”. Participants were required to be over 18 years of age and fluent in English. Due to the use of a snack choice measure participants were also required to have no dietary requirements. Despite the advertised requirements, some participants with low English fluency and/or dietary requirements signed up and participated in the study. Participants with a self-reported English fluency of under 5 (out of 10) were excluded from analysis (n = 2). Participants with dietary requirements were included for analysis to increase statistical power, but this did not affect the results (see Data Analysis).

One hundred and twenty participants took part in the study. One participant exited the survey after completing the demographic measures and was excluded. One participant did not do the IAT and was also excluded. Two participants were excluded for having high error rates on the IAT and two were excluded for having a low English fluency rating. As in Study 3, participants with BMIs under 18 or over 30 were also excluded (n = 15)[11]. This left 99 participants for analysis; descriptive statistics for these participants are reported in Table 36.

[11] When analyses were repeated with participants with all BMIs included, the results for the implicit variables were unchanged (see Data Analysis section).

Ages ranged from 18 to 42, with one missing value, and BMI ranged from 18.40 to 29.14. The majority of participants (81.2%) reported that English was their first language.

Table 36
Study 5 Description of Sample (*N* = 99)

		N (%)
Gender	Males	27 (27.3%)
	Females	71 (71.7%)
	Gender diverse	1 (1.0%)
Year at University	1st year	60 (60.6%)
	2nd year	9 (9.1%)
	3rd year	12 (12.1%)
	4th year	5 (5.1%)
	5th or higher year	13 (13.1%)
Ethnicity[a]	NZ European	74 (74.7%)
	NZ Maori	7 (7.1%)
	Asian	23 (23.2%)
	Other	8 (8.1%)
Birthplace	New Zealand	61 (61.6%)
	Other	38 (38.4%)
Living Situation	Hall of Residence	22 (22.2%)
	Flatting	33 (33.3%)
	Living at home	36 (36.4%)
	Other	8 (8.1%)
		M (SD)
	Age	22.47 (5.08)
	BMI	23.33 (2.56)

Note: N = 99. BMI = body mass index.
[a] More than 1 answer possible.

Measures

Participants reported their date of birth, gender (response options: male, female, gender diverse), current level of study, ethnicity, English fluency, allergies or dietary requirements, height (in centimetres or inches), and weight (in kilograms or pounds). Date of birth was used to calculate age (in years) and weight and height were used to calculate BMI.

Attention Check. As in Study 4, participants were asked to explain their reasons for the menu choices they made and were instructed not to leave the answer box blank. All participants provided an answer to the attention check.

Body Mass Index (BMI). BMI was calculated using the height and weight information provided by participants (see Study 3 measures).

Implicit Association Test. An Implicit Association Test was used to measure relative strength of implicit identity as a healthy or unhealthy eater (see Study 4 measures).

Explicit Identity. Explicit self-identity was measured using the healthy eater subscale of the Eating Identity Type Inventory (Blake et al., 2013) (see Study 1 measures). Cronbach's alpha was .81.

Habit. Habit strength was measured using the Self-Report Habit Index (Verplanken & Orbell, 2003) (see Study 1 measures). Cronbach's alpha was .95 for healthy habit and .92 for snack habit.

Attitudes. Attitudes were measured using 5 items (Conner et al., 2002) (see Study 1 measures). Cronbach's alpha was .68.

Subjective Norms. Norms was measured using one item (Conner et al., 2002) (see Study 1 measures). Participants rated their agreement with this statement on a 7-point scale where higher scores indicated stronger norms for healthy eating.

Self-Control. Self-control was measured using the Brief Self-Control Scale (Tangney et al., 2004) (see Study 1 measures). Cronbach's alpha was .79.

Stress. Stress was measured using five items from the Perceived Stress Scale – Short Form (Kamarck et al., 1983) and the College Student Stress Scale (Feldt, 2008) (see Study 3 Measures). Cronbach's alpha was .70.

Past eating behaviour. The 5-item scale and single-item measures of past eating behaviour were also used in Study 5 (Kuijer & Boyce, 2012, 2014; Wood Baker et al., 2003) (see Study 1 measures). Cronbach's alpha was .61 for the scale measure.

Menu Choice. Participants completed a three-item hypothetical menu choice as a measure of healthy eating (see Study 4 measures for details). Sixteen participants (16.2%) made no healthy choices; 38 participants (38.4%) made one healthy choice; 36 participants

(36.4%) made two healthy choices; and nine participants (9.1%) made three healthy choices. A summary of responses to the menu choice in Study 5 is shown in Table 37.

Table 37
Study 5 Menu Choice Responses

Course	Option	Category	*N* (%)
Drink	Soda	Unhealthy	37 (37.4%)
	Water	Healthy	62 (62.6%)
Main	Salmon and salad	Healthy	37 (37.4%)
	Burger and wedges	Unhealthy	15 (15.2%)
	Pizza	Unhealthy	39 (39.4%)
	Roast vegetable salad	Healthy	8 (8.1%)
Dessert	Chocolate cake	Unhealthy	38 (38.4%)
	Key lime pie	Unhealthy	29 (29.3%)
	Greek yoghurt and berries	Healthy	14 (14.1%)
	Sorbet	Healthy	18 (18.2%)

Snack Choice. Participants were presented with a box containing four snack options (Ayres et al., 2012; Ellis et al., 2014; Weijzen et al., 2008). The snack options were a small Jazz apple; a 50g packet of Mother Earth roasted unsalted almonds; a 50g bar of Cadbury Dairy Milk chocolate; or a 40g packet of Bluebird Original Cut Ready Salted potato chips. These snacks were decided on following a pilot study in which 50 participants rated 18 different snack foods on perceived healthiness, tastiness, and appeal. The chosen snacks all scored highly on combined tastiness and appeal (M_{apple} = 2.30, $M_{almonds}$ = 2.82, $M_{chocolate}$ = 2.86, M_{chips} = 3.07; range = 1-7, lower scores indicate greater tastiness/appeal). Apples and almonds were perceived as healthy, while chips and chocolate were not (M_{apple} = 1.43, $M_{Almonds}$ = 2.02, $M_{chocolate}$ = 6.25, M_{chips} = 6.11; range = 1-7, lower scores indicate greater perceived healthiness). The snacks were also selected to be a similar size and price. Participants were instructed to choose the snack that they would most like to eat and to place it in a paper bag to take home with them at the end of the study; to conceal the true purpose of the snack choice and prevent demand characteristics, participants were told this was a reward for their participation. Each box contained a numerical code and participants were asked to type the number on their box into the survey, which allowed their snack choice to be anonymously matched with their survey data. One participant did not choose a snack and seven participants could not be matched with their snack choice because they did not enter their participant code into the survey. Unhealthy choices were coded as 1 and healthy choices were coded as 2. Of the participants who chose a snack and entered their participant code, 45 participants (49.5%) made a healthy snack choice and 46 participants (50.5%) made an unhealthy snack choice. A summary of responses is reported in Table 38.

Table 38
Study 5 Snack Choice Responses

Item	Category	*N* (%)
Chocolate	Unhealthy	34 (34.3%)
Potato chips	Unhealthy	12 (12.1%)
Almonds	Healthy	39 (39.4%)
Apple	Healthy	6 (6.1%)

Servings Eaten Yesterday. The servings eaten yesterday measure was also used in Study 5 (Conner et al., 2017; Conner et al., 2015; Russell et al., 1999; White et al., 2013) (see Study 4 measures for details). Participants reported how many servings of fruits and vegetables, wholegrains, and unhealthy foods they ate the day prior to completing the study.

Perceived Behavioural Control. Perceived behavioural control (PBC) was measured using four items (Kuijer & Boyce, 2012, 2014) (see Study 1 measures). Higher scores indicated greater PBC. Cronbach's alpha was .65.

Procedure

This study received approval from the University of Canterbury Human Ethics Committee (HEC 2018/65). Sessions were run with up to 10 participants at a time in a computer room on the university campus. The room had dividers between the computers so each participant's responses were not visible to the other participants. The IAT and survey were completed on a computer; the survey was hosted on Qualtrics and the IAT was hosted on millisecond.com. First, participants read an information sheet about the study and were asked whether they consented to participate. Participants who did not consent were taken to the end of the survey. Those who did consent first answered demographic questions. They were then given a link to take the IAT and were asked to enter their IAT code back into the survey. They then completed the rest of the survey questions in the following order: menu choice, attention check, snack choice, servings eaten yesterday, allergies and dietary requirements, past eating behaviour, subjective norms, attitudes, PBC, explicit identity, habit, self-control, and stress. Finally, there were filler questions on smoking, alcohol consumption, sleep, and exercise, which were designed to disguise the focus of the study and were not analysed. The study concluded with a debriefing sheet which explained the study hypotheses and the purpose of the IAT. Participants were provided with contact details for the researcher and her supervisors if they had any concerns or questions after completing the study. After the participants had finished the study and left the room, the researcher recorded which snack had been taken from which box. The researcher then matched each snack choice with the survey data using the 3-digit code on each snack box.

Data Analysis

Prior to analysis, relevant assumptions (absence of outliers, normal distributions, and linear relationships between variables) were checked (see Study 1 Data Analysis). Unhealthy servings had moderate positive skew so a log transformation was used to approximate a normal distribution (Tabachnick & Fidell, 2014). Regression and moderation analyses including this variable were repeated using both the transformed and non-transformed variables (Newton & Rudestam, 2013); this did not change the significance of implicit identity, and so results are reported for the non-transformed variables. No multivariate outliers were present.

Regression analyses were conducted using IBM SPSS version 25. Separate hierarchical multiple regressions were conducted predicting menu choice, past eating behaviour, servings of fruits and vegetables, servings of unhealthy foods, servings of wholegrains, and PBC. A logistic regression was used to predict the dichotomous variable of snack choice. Due to the small number of participants who identified as gender diverse, gender was treated as a dichotomous variable (male/female), with gender diverse treated as a missing value for the purposes of the regression analyses. In each regression gender, age, and BMI were entered in Model 1, explicit predictors of behaviour (attitudes, norms, and habit strength) were entered in Model 2, and implicit identity was entered in Model 3. Alpha was set at .05, and bootstrapped 95% confidence intervals with 2000 samples were calculated. Bootstrap coefficients, standard errors, significance levels, and confidence intervals are reported for each analysis. Due to the high correlation between explicit identity and healthy habit ($r = .80$, $p < .05$), explicit identity was excluded from the regression models to prevent issues with multicollinearity. Post-hoc power analyses (see Study 1 Data Analysis) determined that these regression models had sufficient power to detect a medium effect (96.8%) but were underpowered (28.5%) to detect a small effect.

Moderation analyses were conducted using IBM SPSS version 25. A separate analysis was conducted for each outcome variable with self-control as a moderator for the relationship between implicit identity and eating behaviour. In addition, separate analyses were conducted looking at stress as a moderator between implicit identity and each eating behaviour outcome variable. In Model 4, the moderator variable was added to the final regression model (Model 3). In Model 5, the interaction term was added. 95% bootstrap confidence intervals with 2000 samples were calculated for each moderation analysis.

Each regression and moderation analysis was reported including participants with all BMIs. This did not change the significance of implicit identity as a predictor of any of the outcome variables. As having allergies or other dietary requirements could have affected participants' responses, each analysis was also repeated excluding any participants who reported dietary requirements. Again, this did not change the significance of implicit identity as a predictor for any outcome variable.

Results

Correlations

Bivariate correlations between the outcome and predictor variables, as well as scale means and standard deviations, are shown in Table 39. Implicit identity was not significantly correlated with any outcome or predictor variables, but was correlated with gender; males tended to report more healthy implicit identities. Of the explicit predictors, attitudes, explicit identity, and unhealthy habit were correlated with the most outcome variables. Participants who reported positive attitudes towards healthy eating also made healthier menu choices and snack choices and reported more healthy past eating behaviour (scale and single item); more servings of fruits and vegetables consumed; and greater PBC for healthy eating. Participants who reported an explicit identity for healthy eating made more healthy menu and snack choices and reported more healthy past eating behaviour (scale and single item), more servings of fruits and vegetables, fewer servings of unhealthy foods, and greater PBC. Participants who reported an unhealthy eating habit made less healthy menu and snack choices, reported consuming more servings of unhealthy foods, and scored lower on past eating behaviour (scale and single item), servings of fruits and vegetables, and PBC. In contrast, participants with healthy eating habits made more healthy menu and snack choices and reported healthier past eating behaviour (scale and single item), more servings of fruits and vegetables consumed yesterday, and greater PBC for healthy eating. Norms was positively correlated with menu choice and past eating behaviour (single item). Wholegrain consumption was not significantly correlated with any predictor variables.

Table 39

Study 5 Correlations, Means, and Standard Deviations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Implicit identity	1.00																		
2. Age	-.11	1.00																	
3. Gender	-.20*	-.10	1.00																
4. BMI	.06	.19	-.05	1.00															
5. Attitudes	-.03	.12	.14	.12	1.00														
6. Norms	.09	.06	.12	.01	.19	1.00													
7. Explicit identity	.12	.09	-.06	-.01	.62**	.11	1.00												
8. H habit	.00	.02	-.02	-.04	.55**	.06	.80**	1.00											
9. U habit	.03	-.11	.02	-.04	-.34**	.00	-.63**	-.61	1.00										
10. SC	.15	.12	.03	-.09	.28**	.10	.45**	.33**	-.44**	1.00									
11. Stress	-.06	-.17	.14	-.04	-.23*	-.14	-.27**	-.26**	.18	-.25*	1.00								
12. Past EB (scale)	.00	.17	-.04	.04	.38**	.11	.64**	.61**	-.69**	.41**	-.36**	1.00							
13. Past EB (1 item)	.06	.19	-.11	.08	.53**	.22*	.74**	.62**	-.60**	.48**	-.27**	.69**	1.00						
14. PBC	-.05	.05	-.10	-.04	.31**	.02	.58**	.48**	-.57**	.43**	-.29**	.60**	.53**	1.00					
15. Menu choice	-.01	.29**	-.07	.06	.32**	.21*	.55**	.50**	-.42**	.30**	-.27**	.47**	.50**	.34**	1.00				
16. Snack choice	-.07	.15	.11	.03	.21*	.02	.26*	.24*	-.38**	.24*	-.03	.29**	.20	.16	.34**	1.00			
17. Serves FV	.07	-.05	-.00	.01	.34**	.08	.54**	.49**	-.41**	.21*	-.11	.42**	.53**	.24*	.23*	.16	1.00		
18. Serves WG	.17	-.09	.01	-.08	.15	.02	.13	.04	.06	.06	-.11	.01	.20*	-.14	.00	.02	.17	1.00	
19. Serves U	-.05	-.13	-.09	-.05	-.14	-.08	-.24*	-.18	.25*	-.04	.10	-.32**	-.23*	-.30**	-.17	-.20	-.16	.09	1.00
M	0.60	22.47		23.33	5.79	5.36	3.35	3.14	2.67	3.19	3.08	3.66	4.31	3.23	1.38	1.49	3.69	2.99	1.67
SD	0.47	5.08		2.56	0.86	1.63	0.79	0.88	0.79	0.60	0.59	0.58	1.28	0.77	0.87	0.50	1.17	1.41	0.56

Note: H = healthy, U = unhealthy, SC = self-control, EB = eating behaviour, PBC = perceived behavioural control, FV = fruit/vegetable, WG = wholegrain.

* p <.05. ** p <.01.

Regression Models

Regression models were conducted to see if implicit identity was a significant predictor of each outcome measure, over and above the influence of age, gender, BMI, attitudes, norms, and healthy and unhealthy habit. Results are presented in Tables 40-43.

Healthy and unhealthy habit were significant predictors of the scale measure of past eating behaviour. People were more likely to report healthy past eating behaviour when they had a strong healthy eating habit and a weak unhealthy eating habit. Norms, attitudes, and unhealthy habit were significant predictors of the single item measure. Participants reported more healthy eating when they had stronger subjective norms for healthy eating, a positive attitude to healthy eating, and a weaker unhealthy eating habit. Age, subjective norms, and healthy habit were significant predictors of menu choice. Participants made more healthy menu choices when they were older, when they had stronger subjective norms, and when they had a stronger healthy eating habit. Unhealthy habit was the only significant predictor of snack choice. Participants with weaker unhealthy eating habits were more likely to choose a healthy snack. Unhealthy habit was a significant predictor of PBC for healthy eating, with participants who had weaker unhealthy eating habits reporting greater PBC. Healthy eating habit was the only significant predictor of servings of fruits and vegetables. Participants reported consuming more servings of fruits and vegetables when they had a stronger healthy eating habit. There were no significant predictors of wholegrain consumption. Unhealthy habit was the only significant predictor of servings of unhealthy food, with a stronger unhealthy eating habit predicting greater consumption of unhealthy foods. Implicit identity was not a significant predictor of any of the outcome variables.

Table 40

Study 5 Regression Analyses Predicting Past Eating Behaviour

		Past Eating Behaviour (scale)						Past Eating Behaviour (single item)					
		R^2change	*b*	*SE*	*p*	95% CI		R^2change	*b*	*SE*	*p*	95% CI	
						LL	*UL*					*LL*	*UL*
Model 1	Constant	.03, *p* = .435	3.31	0.69	<.001	1.94	4.71	.06, *p* = .150	3.00	1.45	.042	0.08	5.85
	Age		0.02	0.01	.073	-0.00	0.04		0.04	0.03	.108	-0.01	0.10
	Gender		-0.04	0.14	.799	-0.31	0.23		-0.32	0.32	.293	-0.96	0.33
	BMI		-0.00	0.03	.998	-0.05	0.05		0.04	0.05	.430	-0.06	0.14
Model 2	Constant	.53, *p* < .001	3.52	0.58	<.001	2.46	4.74	.53, *p* < .001	1.62	1.34	.222	-1.05	4.22
	Age		0.01	0.01	.208	-0.01	0.03		0.02	0.02	.254	-0.01	0.05
	Gender		-0.03	0.09	.764	-0.21	0.15		-0.42	0.22	.058	-0.84	0.01
	BMI		0.00	0.02	.903	-0.03	0.03		0.04	0.04	.343	-0.04	0.10
	Attitudes		0.03	0.07	.712	-0.10	0.15		0.38	0.18	.047	0.01	0.73
	Norms		0.03	0.03	.222	-0.02	0.08		0.15	0.06	.020	0.03	0.27
	H Habit		0.18	0.08	.013	0.03	0.32		0.30	0.15	.059	-0.01	0.60
	U Habit		-0.37	0.08	<.001	-0.53	-0.23		-0.64	0.16	<.001	-0.95	-0.33
Model 3	Constant	.00, *p* = .916	3.52	0.59	<.001	2.42	4.75	.00, *p* = .741	1.58	1.35	.242	-1.12	4.25
	Age		0.01	0.01	.229	-0.01	0.03		0.02	0.02	.248	-0.01	0.05
	Gender		-0.02	0.09	.785	-0.21	0.15		-0.40	0.23	.081	-0.85	0.04
	BMI		0.00	0.02	.918	-0.03	0.03		0.03	0.04	.380	-0.04	0.10
	Attitudes		0.03	0.07	.710	-0.10	0.15		0.38	0.19	.049	0.00	0.72
	Norms		0.03	0.03	.228	-0.02	0.08		0.15	0.06	.029	0.02	0.27
	H Habit		0.18	0.08	.014	0.04	0.32		0.30	0.15	.058	-0.01	0.61
	U Habit		-0.37	0.08	<.001	-0.53	-0.23		-0.64	0.16	<.001	-0.96	-0.33
	Implicit identity		0.01	0.11	.922	-0.22	0.21		0.06	0.19	.741	-0.33	0.44
	R^2total	.55, *p* < .001						.59, *p* < .001					

Note: Number of bootstrap samples = 2000. H = healthy, U = unhealthy, BMI = body mass index, *LL* = lower limit, *UL* = upper limit.

Table 41

Study 5 Regression Analyses Predicting Menu and Snack Choices

		Menu Choice						Snack Choice							
		R^2change	*B*	*SE*	*p*	95% CI		-2LL	χ^2	R^2	*B*	*SE*	*p*	95% CI	
						LL	*UL*							*LL*	*UL*
Model 1	Constant	.09, *p* = .034	0.34	0.92	.712	-1.51	2.09	120.80	3.92, *p* = .270	.06	-1.25	2.46	.573	-6.65	3.30
	Age		0.05	0.02	.008	0.02	0.08				0.08	0.06	.139	-0.02	0.22
	Gender		-0.13	0.22	.538	-0.55	0.30				-0.61	0.57	.234	-1.89	0.38
	BMI		0.01	0.04	.785	-0.06	0.08				-0.01	0.10	.873	-0.21	0.18
Model 2	Constant	.28, *p* < .001	-0.78	1.03	.446	-2.84	1.16	107.36	13.43, *p* = .009	.23	0.73	4.20	.835	-8.43	8.17
	Age		0.04	0.02	.008	0.01	0.07				0.07	0.08	.154	-0.03	0.27
	Gender		-0.13	0.20	.498	-0.52	0.26				-0.77	0.68	.166	-2.34	0.35
	BMI		0.02	0.03	.577	-0.04	0.07				-0.02	0.12	.882	-0.25	0.22
	Attitudes		-0.03	0.10	.801	-0.21	0.19				0.16	0.44	.681	-0.69	1.20
	Norms		0.10	0.05	.043	0.00	0.19				-0.02	0.18	.900	-0.40	0.33
	Healthy Habit		0.38	0.11	.001	0.16	0.59				0.04	0.46	.907	-0.81	0.95
	Unhealthy Habit		-0.18	0.11	.124	-0.40	0.05				-1.06	0.51	.014	-2.26	-0.22
Model 3	Constant	.00, *p* = .868	-0.76	1.03	.461	-2.80	1.25	107.35	0.03, *p* = .872	.23	0.74	4.29	.829	-8.51	8.59
	Age		0.04	0.02	.010	0.01	0.07				0.07	0.08	.167	-0.03	0.26
	Gender		-0.14	0.20	.493	-0.55	0.26				-0.75	0.72	.191	-2.45	0.41
	BMI		0.02	0.03	.569	-0.04	0.07				-0.01	0.13	.899	-0.25	0.23
	Attitudes		-0.03	0.10	.803	-0.22	0.19				0.16	0.46	.683	-0.62	1.23
	Norms		0.10	0.05	.048	0.00	0.20				-0.01	0.18	.928	-0.41	0.34
	Healthy Habit		0.38	0.11	.001	0.15	0.60				0.04	0.48	.927	-0.89	0.97
	Unhealthy Habit		-0.18	0.12	.128	-0.41	0.05				-1.06	0.52	.015	-2.32	-0.21
	Implicit identity		-0.03	0.15	.858	-0.34	0.27				-0.09	0.67	.870	-1.42	1.17
	R^2total	.37, *p* < .001													

Note: Number of bootstrap samples = 2000. H = healthy, U = unhealthy, BMI = body mass index, *LL* = lower limit, *UL* = upper limit. χ^2 tests each model against the previous model; Model 1 is tested against a null model containing no predictors. R^2 for snack choice is Nagelkerke's R^2.

Table 42

Study 5 Regression Analyses Predicting Fruit/Vegetable and Unhealthy Servings

		Serves of fruits and vegetables						Serves of wholegrains					
		R^2change	*b*	*SE*	*p*	95% CI		R^2change	*B*	*SE*	*p*	95% CI	
						LL	*UL*					*LL*	*UL*
Model 1	Constant	.01, *p* = .870	3.54	1.36	.011	0.92	6.19	.01, *p* = .823	3.96	1.74	.029	0.55	7.51
	Age		-0.02	0.02	.399	-0.06	0.02		-0.03	0.03	.426	-0.08	0.05
	Gender		-0.07	0.29	.831	-0.61	0.53		-0.02	0.33	.958	-0.63	0.64
	BMI		0.03	0.05	.556	-0.07	0.13		-0.02	0.07	.832	-0.16	0.11
Model 2	Constant	.28, *p* < .001	2.46	1.52	.102	-0.29	5.69	.04, *p* = .402	2.21	2.20	.318	-1.84	6.89
	Age		-0.03	0.02	.197	-0.08	0.01		-0.03	0.03	.338	-0.09	0.04
	Gender		-0.07	0.26	.784	-0.60	0.47		-0.12	0.34	.733	-0.77	0.58
	BMI		0.03	0.05	.569	-0.07	0.13		-0.03	0.07	.634	-0.17	0.10
	Attitudes		0.13	0.15	.380	-0.16	0.43		0.40	0.21	.052	-0.05	0.78
	Norms		0.04	0.07	.537	-0.09	0.18		0.00	0.10	.998	-0.21	0.20
	H Habit		0.38	0.15	.009	0.09	0.68		-0.09	0.24	.686	-0.59	0.34
	U Habit		-0.34	0.18	.062	-0.69	-0.01		0.14	0.23	.566	-0.35	0.55
Model 3	Constant	.00, *p* = .635	2.38	1.52	.118	-0.43	5.49	.02, *p* = .150	1.87	2.21	.401	-2.29	6.41
	Age		-0.03	0.02	.249	-0.08	0.01		-0.02	0.03	.500	-0.08	0.05
	Gender		-0.05	0.28	.866	-0.62	0.51		-0.01	0.35	.965	-0.66	0.72
	BMI		0.03	0.05	.618	-0.07	0.13		-0.04	0.07	.544	-0.18	0.08
	Attitudes		0.13	0.15	.378	-0.16	0.43		0.40	0.21	.052	-0.04	0.78
	Norms		0.04	0.07	.593	-0.10	0.18		-0.02	0.11	.854	-0.23	0.18
	H Habit		0.39	0.15	.010	0.09	0.68		-0.09	0.23	.700	-0.57	0.35
	U Habit		-0.34	0.18	.059	-0.69	0.01		0.14	0.23	.554	-0.36	0.57
	Implicit identity		0.11	0.23	.630	-0.35	0.56		0.47	0.36	.197	-0.20	1.18
	R^2total	.29, *p* < .001						.07, *p* = .525					

Note: Number of bootstrap samples = 2000. H = healthy, U = unhealthy, BMI = body mass index, *LL* = lower limit, *UL* = upper limit.

Table 43

Study 5 Regression Analyses Predicting Unhealthy Servings and PBC

		Serves of unhealthy food						PBC					
		R^2change	*b*	*SE*	*p*	95% CI		R^2change	*b*	*SE*	*p*	95% CI	
						LL	*UL*					*LL*	*UL*
Model 1	Constant	.03, p = .383	2.52	0.57	<.001	1.40	3.66	.02, p = .549	3.93	0.90	<.001	2.17	5.65
	Age		-0.01	0.01	.174	-0.04	0.01		0.01	0.02	.516	-0.02	0.05
	Gender		-0.15	0.13	.260	-0.41	0.12		-0.19	0.19	.341	-0.56	0.19
	BMI		-0.01	0.02	.557	-0.05	0.03		-0.03	0.03	.416	-0.09	0.04
Model 2	Constant	.08, p = .116	2.18	0.72	.004	0.74	3.56	.35, p < .001	4.23	1.01	<.001	2.29	6.28
	Age		-0.01	0.01	.329	-0.03	0.01		0.00	0.01	.927	0.03	0.03
	Gender		-0.14	0.13	.291	-0.41	0.13		-0.18	0.16	.266	-0.50	0.13
	BMI		-0.01	0.02	.568	-0.06	0.03		-0.03	0.03	.358	-0.09	0.03
	Attitudes		-0.02	0.08	.817	-0.18	0.12		0.09	0.11	.464	-0.14	0.31
	Norms		-0.03	0.04	.474	-0.11	0.04		-0.01	0.05	.899	-0.10	0.09
	H Habit		-0.00	0.10	.994	-0.19	0.19		0.16	0.10	.117	-0.05	0.36
	U Habit		0.19	0.09	.049	0.02	0.38		-0.41	0.11	.001	-0.64	-0.20
Model 3	Constant	.00, p = .563	2.23	0.72	.003	0.78	3.62	.02, p = .602	4.29	1.02	<.001	2.43	6.42
	Age		-0.01	0.01	.300	-0.03	0.01		0.00	0.01	1.00	-0.03	0.03
	Gender		-0.16	0.13	.237	-0.43	0.12		-0.20	0.16	.224	-0.52	0.12
	BMI		-0.01	0.02	.616	-0.06	0.03		-0.03	0.03	.385	-0.09	0.03
	Attitudes		-0.02	0.08	.828	-0.18	0.13		0.09	0.11	.455	-0.14	0.31
	Norms		-0.03	0.04	.524	-0.11	0.05		-0.00	0.05	.958	-0.09	0.09
	H Habit		-0.00	0.09	.990	-0.19	0.18		0.16	0.10	.119	-0.05	0.36
	U Habit		0.18	0.09	.044	0.02	0.37		-0.41	0.11	.001	-0.64	-0.19
	Implicit identity		-0.07	0.13	.561	-0.31	0.20		-0.08	0.15	.624	-0.40	0.19
	R^2total	.11, p = .213						.37, p < .001					

Note: Number of bootstrap samples = 2000. H = healthy, U = unhealthy, BMI = body mass index, PBC = perceived behavioural control, *LL* = lower limit, *UL* = upper limit.

Moderation Analyses

Self-control and stress were analysed as moderators for the relationship between implicit identity and each eating outcome. Demographic variables, known explicit predictors (attitudes, norms, and healthy and unhealthy habit) and implicit identity were added in steps 1-3. Results for self-control are displayed in Table 44 and results for stress are displayed in Table 45. Self-control was a significant predictor of past eating behaviour (single item) and PBC, while stress was a significant predictor of the scale measure of past eating behaviour and PBC. However, neither self-control nor stress was a significant moderator for the effect of implicit identity on any of the outcome variables.

Table 44

Study 5 Moderation Analyses for Implicit Identity and Self-Control

	Model 3	Model 4	Model 5	Self-control[a]					Interaction[b]				
	R^2change	R^2change	R^2change	*b*	*SE*	*p*	95% CI		*b*	*SE*	*p*	95% CI	
							LL	*UL*				*LL*	*UL*
Past EB (scale)	.55, *p* < .001	.01, *p* = .250	.00, *p* = .707	0.09	0.09	.279	-0.07	0.27	-0.05	0.20	.784	-0.47	0.34
Past EB (1 item)	.59, *p* < .001	.03, *p* = .010	.01, *p* = .224	0.43	0.19	.032	0.04	0.81	-0.34	0.33	.271	-1.06	0.20
Menu Choice	.37, *p* < .001	.00, *p* = .441	.00, *p* = .794	0.11	0.16	.495	-0.21	0.40	-0.06	0.25	.813	-0.66	0.35
PBC	.37, *p* < .001	.04, *p* = .024	.00, *p* = .898	0.28	0.13	.026	0.03	0.54	0.03	0.27	.917	-0.50	0.64
Serves FV	.29, *p* < .001	.00, *p* = .961	.00, *p* = .531	-0.01	0.25	.968	-0.46	0.52	-0.22	0.37	.515	-0.95	0.51
Serves WG	.08, *p* = .525	.00, *p* = .676	.00, *p* = .635	0.12	0.26	.640	-0.36	0.65	0.23	0.51	.635	-0.76	1.26
Serves U	.11, *p* = .213	.01, *p* = .255	.00, *p* = .759	0.13	0.12	.298	-0.13	0.35	0.06	0.22	.769	-0.39	0.46
	χ^2	χ^2	χ^2	*b*	*SE*	*p*	95% CI		*b*	*SE*	*p*	95% CI	
							LL	*UL*				*LL*	*UL*
Snack Choice	17.37, *p* = .026	0.47, *p* = .495	0.00, *p* = .947	0.32	0.64	.545	-1.02	1.59	-0.05	1.35	.953	-3.16	2.39

Note: EB = eating behaviour, PBC = perceived behavioural control, FV = fruit/vegetable, WG = wholegrain, U = unhealthy, *LL* = lower limit, *UL* = upper limit. Model 3: Gender, BMI, attitudes, subjective norms, habit strength, and implicit identity. Model 4: Self-control added. Model 5: Interaction between self-control and implicit identity added. χ^2 tests compare each model to the previous model, with Model 3 compared to an intercept-only model.

[a] Regression estimates for self-control from Model 4. [b] Regression estimates for the interaction from Model 5.

Table 45

Study 5 Moderation Analyses for Implicit Identity and Stress

	Model 3	Model 4	Model 5	Stress[a]					Interaction[b]				
	R^2change	R^2change	R^2change	*b*	*SE*	*p*	95% CI		*b*	*SE*	*p*	95% CI	
							LL	*UL*				*LL*	*UL*
Past EB (scale)	.55, *p* < .001	.03, *p* = .022	.01, *p* = .288	-0.17	0.07	.015	-0.30	-0.04	-0.16	0.17	.320	-0.45	0.21
Past EB (1 item)	.59, *p* < .001	.00, *p* = .883	.01, *p* = .329	-0.02	0.17	.894	-0.35	0.33	-0.31	0.31	.267	-0.97	0.31
Menu Choice	.37, *p* < .001	.01, *p* = .332	.00, *p* = .732	-0.13	0.12	.292	-0.36	0.11	-0.09	0.25	.681	-0.54	0.45
PBC	.37, *p* < .001	.03, *p* = .059	.01, *p* = .284	-0.22	0.11	.038	-0.42	-0.01	-0.25	0.24	.246	-0.73	0.24
Serves FV	.29, *p* < .001	.00, *p* = .626	.00, *p* = .848	0.09	0.17	.581	-0.25	0.43	-0.07	0.34	.824	-0.69	0.68
Serves WG	.08, *p* = .525	.01, *p* = .401	.02, *p* = .166	-0.22	0.25	.369	-0.68	0.30	-0.72	0.57	.179	-1.89	0.41
Serves U	.11, *p* = .213	.00, *p* = .913	.01, *p* = .407	0.01	0.10	.913	-0.17	0.22	-0.17	0.20	.340	-0.62	0.21
	χ^2	χ^2	χ^2	*b*	*SE*	*p*	95% CI		*b*	*SE*	*p*	95% CI	
							LL	*UL*				*LL*	*UL*
Snack Choice	17.37, *p* = .026	0.16, *p* = .685	1.04, *p* = .307	0.17	0.54	.708	-0.85	1.18	-0.89	1.58	.421	-4.95	1.36

Note: EB = eating behaviour, PBC = perceived behavioural control, FV = fruit/vegetable, WG = wholegrain, U = unhealthy, *LL* = lower limit, *UL* = upper limit. Model 3: Gender, BMI, attitudes, subjective norms, habit strength, and implicit identity. Model 4: Self-control added. Model 5: Interaction between self-control and implicit identity added. χ^2 tests compare each model to the previous model, with Model 3 compared to an intercept-only model.

[a] Regression estimates for stress from Model 4. [b] Regression estimates for the interaction from Model 5.

Summary

This study confirmed the finding of Study 4 that implicit eating-related identity, as measured by the IAT, is not a significant predictor of healthy and unhealthy eating behaviour. Implicit identity was not significantly correlated with any outcome measure. In addition, adding implicit identity to a regression model containing explicit predictors did not significantly improve the model's ability to predict any of the eating outcome measures. As in Study 4, the explicit predictors – particularly habit strength – were more important for predicting eating behaviour. Study 5 also replicated the finding that, contrary to hypotheses, self-control did not moderate the relationship between implicit identity and eating-related behaviour. However as in Study 4 self-control was a significant predictor of PBC and the single-item measure of past eating behaviour even after controlling for demographic, explicit, and implicit predictors in Models 1-3. Stress was also not a significant moderator of the relationship between implicit identity and eating-related behaviour, but was a significant predictor of the scale measure of past eating behaviour and PBC even after controlling for the demographic, explicit, and implicit predictors.

For the outcome measure of servings of wholegrains consumed yesterday, neither the explicit nor the implicit predictor variables were significant predictors of eating behaviour. This may be due to sample size, as attitudes approached significance when predicting servings of wholegrains. The lack of significant predictors for servings of wholegrains may also be due to the measurement design; the predictor variables ask about healthy eating in general, while wholegrain consumption is a specific eating behaviour that may not be considered healthy by all people (Clarke & Best, 2017; Finney Rutten et al., 2008). Other research has identified several predictors of wholegrain consumption, including knowledge and availability (Kamar et al., 2016) as well as perceived healthiness and pleasantness

(Vassallo et al., 2009). Future research is needed to identify further predictors of wholegrain consumption, including implicit predictors.

General Discussion Studies 4-5

Studies 4 and 5 investigated whether implicit identity measured using the IAT was able to predict eating behaviour. It was hypothesised that greater implicit identification with healthy eating relative to unhealthy eating, as measured by a positive D score, would predict healthier past eating behaviour; more healthy menu choices; a healthy snack choice (Study 5 only); greater PBC for healthy eating; more servings of fruits and vegetables; more servings of wholegrains; and fewer servings of unhealthy foods. It was also hypothesised that self-control and stress would moderate the relationship between implicit identity and eating behaviour, with implicit identity being a stronger predictor when self-control was low or when stress was high. However, the results of both studies did not support these hypotheses. In both Studies 4 and 5, implicit identity was not a significant predictor of any of the eating behaviour outcomes, and the relationship between implicit identity and eating behaviour was not moderated by self-control or by stress.

Although it was expected that eating behaviour would be predicted by both implicit and explicit variables, this study found that eating behaviour was predicted only by explicit variables. In particular, habit strength was a key predictor variable in both studies. In Study 4, past eating behaviour, menu choice, PBC, servings of fruits and vegetables, and servings of unhealthy foods were all significantly predicted by habit strength in the regression models. Although the other explicit variables were correlated with eating outcomes, these relationships did not remain significant in the regression model (with the exception of attitudes when predicting menu choice and norms when predicting servings of fruits and vegetables). Meanwhile in Study 5 habit strength significantly predicted past eating behaviour, menu choice, snack choice, servings of fruits and vegetables, servings of unhealthy food, and PBC. The only other significant predictors in Study 5 were attitudes (past eating behaviour single item measure) norms (past eating behaviour single item measure and menu choice) and age (menu choice). The finding that the IAT was not predictive of eating behaviour across two studies with different samples suggests that implicit identity is not a useful predictor of eating behaviour.

This lack of significant findings regarding implicit identity is surprising given that it has been shown to predict behaviour in other domains (Banaji & Nock, 2007; Caudwell & Hagger, 2014; Hawkins & Nosek, 2012). It may be that for healthy and unhealthy eating behaviours, explicit predictors are more important than implicit predictors. However, this contradicts dual-process theories which focus on the importance of both implicit and explicit processes (Evans, 2003, 2008; Hofmann et al., 2008; Sheeran et al., 2013; Strack & Deutsch, 2004). A second potential explanation for the null findings is that it is implicit identity in particular, rather than implicit processes in general, that is a poor predictor of eating behaviour. It is possible that other implicit variables are better predictors of eating behaviour than implicit identity; for instance, research has shown implicit attitudes to predict eating behaviour (de Bruijn et al., 2012; Goldstein et al., 2014; Houben et al., 2010, 2012; Mai et al., 2015; Prestwich et al., 2011).

Another interesting finding from Studies 4 and 5 was the lack of any significant predictors for wholegrain consumption in the regression models of both studies. Although the focus of the IAT on fruits and vegetables may have reduced its correspondence with this outcome measure, it was expected that the IAT and explicit measures would still have been significant predictors. It may be that more specific predictor variables are needed (e.g. an IAT measuring implicit identification with wholegrain consumption). Future research is needed to explore the predictors of specific eating behaviours such as wholegrain consumption.

These null results from Studies 4 and 5 raise some interesting issues for future research. Future research is needed to assess whether different measures of implicit identity are better predictors of eating behaviour and to examine whether other implicit variables are more predictive of eating outcomes. Future research could look to identify other implicit variables that may be important for explaining eating behaviours, as well as investigate why implicit identity predicts other behaviours but not eating behaviour. Future research could also address some of the limitations of Studies 4 and 5; for instance, research could use a community sample to improve generalisability of results.

Overall, Studies 4 and 5 confirmed the finding from Studies 1-3 that implicit identity is not a significant predictor of healthy and unhealthy eating behaviours and that neither self-control nor stress is a significant moderator. Contrary to hypotheses, Studies 4 and 5 found that only explicit predictors – most notably habit strength – were predictive of healthy and unhealthy eating. Future research is needed to explore issues relating to implicit predictors.

Chapter 4: General Discussion

This thesis was conducted to assess the ability of implicit eating-related identity to predict eating behaviour, over and above the influence of known predictors of eating behaviour (attitudes, subjective norms, and habit strength), demographic variables (age and sex/gender), and BMI. In addition, this thesis tested whether self-control and stress moderate the relationship between implicit identity and eating behaviour. A series of five studies were conducted. Studies 1-3 measured implicit healthy eating identity and implicit unhealthy eating identity using two Single-Category Implicit Association Tests (SC-IATs), while Studies 4-5 measured implicit healthy eating identity relative to implicit unhealthy eating identity using one Implicit Association Test (IAT). Hypotheses for Studies 1-3 were that implicit identity as a healthy eater would predict healthy eating-related behaviours and that implicit identity as an unhealthy eater would predict unhealthy eating-related behaviours. For Studies 4-5, it was hypothesised that implicit identity as a healthy eater, relative to implicit identity as an unhealthy eater, would predict more healthy eating behaviours and fewer unhealthy eating behaviours. For all five studies it was hypothesised that implicit identity would be a stronger predictor when self-control was low. For Studies 3 and 5, it was also hypothesised that implicit identity would be a stronger predictor when stress was high.

Relationship Between Implicit Identity and Eating Outcomes

Summary of Findings

Bivariate correlations were calculated in all five studies to provide initial evidence regarding the association between implicit identity and eating-related outcomes. In Study 1, unhealthy implicit identity was negatively associated with the scale measure of past eating behaviour and PBC. Study 2 found a negative correlation between unhealthy implicit identity and the single-item measure of past eating behaviour. In contrast, Study 3 found that unhealthy implicit identity was not correlated with any of the outcome measures, while healthy implicit identity was positively associated with both measures of past eating behaviour and with PBC. In Studies 4 and 5, implicit identity was not correlated with any of the eating-related outcome variables. Therefore, although the SC-IATs in Studies 1-3 found some evidence of an association between implicit identity and past eating behaviour and PBC, these were not found using the IAT in Studies 4-5. In addition, none of the studies found a significant association between implicit identity and the other eating outcomes measured (hypothetical menu choice, snack choice, Block fat screener, Block fruit and fibre screener, servings of fruits and vegetables, servings of wholegrains, and servings of unhealthy foods). Studies 1-3 were also inconsistent as to whether unhealthy or healthy implicit identity was a better predictor of behaviour; two studies found unhealthy, but not healthy, implicit identity to be associated with eating-related behaviour, while the third study found the opposite pattern. Across all five studies, then, bivariate correlations provided some evidence for an association between implicit identity and eating behaviour, but this was inconsistent. Notably, significant correlations were only observed when SC-IATs were used to measure implicit identity, were small in magnitude, and were only observed for three of the eating outcome measures. This indicates that there is no robust, reliable association between implicit eating identity and eating-related outcomes.

Hierarchical linear regression models were used to assess whether implicit identity could predict eating-related outcomes over and above the influence of known behavioural predictors (age, sex/gender, BMI, attitudes, subjective norms, and habit). Study 1 provided some initial support for implicit identity as a predictor of eating behaviour; implicit unhealthy identity was found to significantly predict both perceived behavioural control (PBC) for healthy eating and self-reported past eating behaviour. An explorative mediation model was tested and found that participants with stronger implicit unhealthy identities had lower PBC for healthy eating, which predicted less healthy past eating behaviour. However, regression models found implicit identity was not a significant predictor for the other Study 1 outcome measures. In addition, implicit identity was not a significant predictor in the regression models predicting any of the outcome variables in Studies 2-5. The significant results from Study 1 failed to be replicated in the other four studies. This indicates that, contrary to hypotheses, implicit eating-related identity is not able to predict eating behaviour or related outcomes.

Possible Explanations

The finding that implicit identity was not a reliable predictor of eating outcomes was unexpected given that another implicit construct, implicit attitudes, has been shown to be useful in predicting eating behaviour (de Bruijn et al., 2012; Goldstein et al., 2014; Houben et al., 2010, 2012; Mai et al., 2015; Prestwich et al., 2011). In addition, implicit identity has been found to predict a range of different behaviours, such as political party preference, alcohol consumption, criminal behaviour, self-harm, and effort on university tests (Banaji & Nock, 2007; Caudwell & Hagger, 2014; Gray et al., 2011; Hawkins & Nosek, 2012; Rivera & Veysey, 2018; Stout et al., 2011). It is unclear why this predictive ability would not apply to eating behaviours. However, it should be noted that the association between implicit predictors and outcomes is not always consistent (Blanton et al., 2009), and other studies have also failed to find significant implicit identity-outcome relationships when controlling for other predictors. For example, Brick and Lai (2018) found that while implicit environmentalist identity was associated with pro-environment behaviours and preferences, this association was not significant when controlling for explicit identity. Although we did not control for explicit identity in the regression models, we did control for other explicit predictors. As in the study by Brick and Lai (2018), other variables seemed to be stronger behavioural predictors than implicit identity in our study.

Eating Behaviour Measurement. One possibility is that differences between eating-related behaviour and other behaviours may explain the differing results. Unlike the concepts of ‘healthy eating’ and ‘unhealthy eating’, many behaviours which are predicted by implicit identity can be clearly and consistently defined. For example, in the field of health psychology most research has focused on implicit identity as a predictor of alcohol consumption. Beverages can be clearly defined as alcoholic or non-alcoholic, the number of standard drinks in any alcoholic beverage can be quantified, and there are consistent guidelines regarding the number of standard drinks contained in each alcoholic beverage (Ministry of Health, 2019a). Other outcomes studied in implicit identity research are also able to be clearly defined, for example workplace hiring decisions (Agerström & Rooth, 2011), political party preference (Hawkins & Nosek, 2012), or self-harm (Banaji & Nock, 2007). Because these behaviours can be clearly defined, there are likely to be generally high levels of agreement between individuals regarding what these behaviours look like. For example, because drinks can be clearly categorised as containing or not containing alcohol, all participants should be able to identify whether or not they engage in the behaviour of drinking alcoholic beverages and definitions of this behaviour should be consistent across participants. An implication of this for implicit measurement is that when participants are completing an IAT, the target categories (such as ‘alcohol’ and ‘not alcohol’) are likely to be viewed in a consistent way by all participants. That is, when one participant identifies with the consumption of alcoholic beverages, they are likely to be identifying with the same behaviour as when other participants identify with the consumption of alcoholic beverages. However, this is not necessarily the case when measuring healthy and unhealthy eating behaviours.

In contrast to clearly definable behaviours such as drinking alcohol, there are many differences in what may be classified as ‘healthy’ and ‘unhealthy’ eating (Bucher et al., 2015;

Falk et al., 2001; Tangney et al., 2017). For example, Falk et al. (2001) interviewed participants about their conceptualisations of healthy eating and found a range of viewpoints, including healthy eating as meaning consuming low fat foods, eating to obtain nutrients, or eating to control weight. In addition, individuals may have incorrect perceptions about what constitutes a healthy diet. For instance, one study found that participants tended to underestimate the number of calories contained in fast food items (Elbel, 2011). In another study, participants asked to serve themselves food representing a "healthy diet" served themselves on average twice as much sugar and salt as recommended by healthy eating guidelines, indicating a lack of knowledge about the nutrient contents of certain foods (Mötteli et al., 2016). This means that while two participants may both identify with the concept of healthy eating, the specific behaviours that they view as 'healthy' may be very different. This could lead to reduced correspondence between the categories being measured in the IAT and the eating behaviours being measured as outcomes. Across the five studies, the IAT stimuli and the eating outcome measures were designed to focus on common perceptions of healthy and unhealthy eating – fruit, vegetables, and fibre for healthy eating, and fat, sugar, and salt for unhealthy eating (Bucher et al., 2015; Paquette, 2005). In addition, specific foods were used as target stimuli rather than words relating to the overall concepts of healthy and unhealthy eating in an attempt at reducing the impact of differing conceptualisations of 'healthy' and 'unhealthy'. However, it is not necessarily the case that implicit identification with specific unhealthy or healthy foods used in the implicit measures correspond with overall patterns of healthy and unhealthy eating measured in the outcome variables. Different patterns of cognitive associations between specific foods and the concepts of 'healthy' and 'unhealthy' could have reduced the ability of implicit identity to predict eating behaviour.

Implicit Measurement. A review by Greenwald and Lai (2020) found that IATs are stronger predictors of outcomes when there is greater contrast between the two categories measured by the IAT, so that belonging to one category on the IAT implies that a person does not belong to the other category. This was not the case for the IAT studies here (Studies 4 and 5), as it is possible to identify with both healthy and unhealthy eating simultaneously. Indeed, Studies 1 and 2 found a significant small-moderate positive correlation between healthy and unhealthy implicit identities, and in Study 3 there was small positive correlation between the implicit identities which approached significance. The finding that healthy and unhealthy implicit identity were positively correlated in the SC-IAT research indicates that they are not mutually exclusive. This lack of contrast between the two categories may have limited the ability of the IAT to predict eating-related outcomes. However, this issue is inherent in eating behaviour research as healthy and unhealthy eating behaviours are not conceptually distinct; for example, a person could eat both fruits and vegetables (a healthy eating behaviour) and high-fat fast food meals (an unhealthy eating behaviour). To account for this possibility, SC-IATs measuring implicit identification with healthy and unhealthy eating separately were used in Studies 1-3; however, like in the IAT studies, the SC-IAT studies largely did not find implicit identity to be a significant predictor of eating behaviour. While the lack of contrast between healthy and unhealthy eating may explain the lack of significant findings in the IAT studies, it cannot explain the lack of consistently significant results in the SC-IAT studies.

Recently, Payne et al. (2017a, 2017b) proposed that implicit biases (negative implicit attitudes towards certain groups) are best considered at the context (or group) level, rather than the individual level. Specifically, they argue that aggregate level implicit biases within a given context are more predictive of real-world behavioural outcomes than individual differences in implicit biases are predictive of that individual's behaviour. As an example of this 'bias of the crowds' perspective, research has found that community-level implicit prejudice towards people with HIV predicts distress among HIV-positive residents of that community (Miller et al., 2016). High community-level prejudice may be reflected in greater discrimination within these communities, which likely has negative impacts on the wellbeing of people with HIV (Miller et al., 2016). In support of this perspective, Vuletich and Payne (2019) found that following interventions designed to change implicit bias, individual IAT scores changed at random whereas group-level IAT averages returned to baseline. This supports the view that group-level aggregate IAT scores reflect stable situational influences, whereas individual IAT scores are highly changeable from moment to moment. However, the usefulness of considering implicit measures from this 'bias of the crowds' perspective has been questioned by some researchers (Blanton & Jaccard, 2017) and so further research is required.

Nevertheless, this explanation could conceivably apply to implicit eating-related identities. Implicit biases refer to unconscious evaluations of target objects as being positive or negative, while implicit identity refers to unconscious associations between a target object and the self. Like implicit attitudes or biases, implicit eating-related identities could be seen as group-level phenomena as different groups and cultures have different norms and values around eating (Levine et al., 2016; Ogden et al., 2017; Voytyuk & Hruschka, 2017), which may influence automatic self-object associations. For example, people living in a community where there are strong implicit associations with healthy living and eating may show more positive health outcomes than people living in communities where there are stronger implicit associations with unhealthy living and eating. Future work is needed to more closely examine this. In addition, scores on measures of implicit identity such as the IAT could potentially be influenced by situational factors (such as recent exposure to eating-related stimuli in the media) as well as by individual differences (Elliston et al., 2017; Gonçalves et al., 2018), so the relative malleability of implicit associations could mean its association with behaviour is unreliable.

Another possible explanation for the null findings could be that the stimuli used in the implicit measure were too specific. According to the correspondence principle, implicit measures should best predict behaviour when the stimuli are most similar to the behaviours being measured (Ajzen & Fishbein, 1977). For example, a cantaloupe IAT should be better than a general fruit IAT at predicting cantaloupe consumption (Irving & Smith, 2020). This thesis used a broad definition of healthy and unhealthy eating, as these behaviours are complex and encompass a variety of different foods (Department of Health, 2015, 2017; Health Canada, 2019; Ministry of Health, 2020; Office of Disease Prevention and Health Promotion, 2017; Public Health England, 2016a, 2016b; World Health Organization, 2017a, 2017b, 2020a). However, as implicit measures contain a limited number of stimuli and cannot represent all healthy and unhealthy foods, this may have reduced correspondence between the implicit stimuli and the eating outcome measures. Interestingly, eating outcomes that were designed to have greater correspondence with the implicit measure were still not predicted by implicit identity. The IAT in Studies 4-5 contrasted fruits and vegetables with unhealthy foods, but this did not predict servings of fruits, vegetables, or unhealthy foods. However, correspondence could still be improved as not all fruits, vegetables, or unhealthy foods could be included as IAT stimuli. Research using an IAT to measure implicit attitudes (positive and negative evaluations) towards specific food items has found this can significantly predict the corresponding behaviour (Pavlović et al., 2016; Prestwich et al., 2011). For example, Pavlović et al. (2016) found that implicit attitudes towards sweets and fruits were able to predict consumption of these foods. The relationship between implicit identity and eating behaviour at this level of specificity has not yet been studied. Future research could test more specific implicit measures and eating outcome measures (e.g. testing whether implicit identification with fruits and chocolates predicts fruit and chocolate consumption) to see if implicit identity is a better predictor of behaviour when there is greater correspondence between measures. Alternatively, implicit measures could use words and phrases describing the concepts of healthy and unhealthy eating (e.g. ‘healthy eater’, ‘unhealthy diet’) rather than specific foods to measure implicit identification at a more general level to see if this better predicts general measures of eating behaviour.

While the use of more specific measures of implicit eating-related identity and eating behaviour may increase the predictive ability of implicit identity by increasing predictor-outcome correspondence, a drawback of this approach would be reduced generalisability. Although more specific measures could be more likely to show a significant relationship between implicit identification with a specific food item and consumption of that food, this result may not generalise to other foods or other eating behaviours. For example, a finding that implicit identification with chocolate consumption predicts the amount of chocolate eaten would not be informative about predicting the consumption of healthy foods like fruits and vegetables, or even about predicting the consumption of other types of unhealthy foods. The use of more specific measures would therefore limit the usefulness of findings, and consequently more general measures were preferred in this thesis. In future research it will be important to use both specific and general measures in order to balance the ability to find significant results with the ability to generalise findings.

Moderators of the Implicit Identity-Eating Relationship

Summary of Findings

Self-control was significantly and positively correlated with both measures of past eating behaviour, PBC, and fruit and vegetable consumption in all five studies, with menu choice in Studies 1, 4, and 5, and with snack choice in Study 5. Correlations with other outcome measures (wholegrain consumption, high-fat food consumption, and servings of unhealthy food) were inconsistent. When added to the regression models, self-control was also an inconsistent predictor. Baseline stress was correlated with past eating behaviour (single item) and PBC in Study 3 and with both measures of past eating behaviour, menu choice, and PBC in Study 5; correlations with other outcome measures in these studies were not significant. Stress did not predict any outcome measures over and above the other predictors in Study 3 regressions, but did predict fruit and vegetable intake in the multi-level models. In Study 5 stress was a significant predictor of past eating behaviour (scale) and PBC in the regression models, but was not a significant predictor of any other outcome measures when other predictors were included. Thus, associations between self-control and stress and the outcome measures were inconsistent across the five studies, particularly in the regression models where other predictor variables were included.

Moderation analyses were conducted to assess whether implicit identity interacted with self-control (Studies 1-5) and stress (Studies 3 and 5) to predict eating-related outcomes. These analyses also largely did not support the hypotheses of this thesis. All five studies tested the interaction between self-control and implicit identity predicting each outcome variable. Across all five studies, only one interaction term was significant – the interaction between healthy implicit identity and self-control predicting servings of wholegrains in Study 2. This finding was not replicated in Study 4 or Study 5, which also examined servings of wholegrains as an outcome variable, or in Study 1 which looked at the related outcome of fibre intake. This lack of replication suggests that the significant interaction found in Study 2 may be a Type 1 error rather than a reliable result. Study 3 and Study 5 also tested stress as a moderator. Again, only one significant interaction was found – the interaction between unhealthy implicit identity and stress predicting PBC in Study 3. However, although the interaction term was significant, a simple slopes analysis found no significant differences at three levels of the moderator. In addition, this result was not replicated in Study 5. Again, this suggests that the interaction between stress and implicit identity in Study 2 is not a reliable result.

Possible Explanations

The finding that trait self-control and self-reported stress did not consistently interact with implicit identity across the five studies was surprising. Based on dual-process theories it was expected that implicit identity would be most predictive of behaviour when the ability for controlled processing was low (Hofmann et al., 2008). High trait self-control enables people to overcome impulses and engage in more controlled, explicit decision making, which should reduce the influence of implicit predictors on behaviour (Muraven & Baumeister, 2000; Strack & Deutsch, 2004). Indeed, previous research has found implicit attitudes and self-control to interact when predicting behaviour (Friese, Hofmann, & Wänke, 2008; Haynes et al., 2015; Trendel & Werle, 2016). Stress can deplete self-control resources (Muraven & Baumeister, 2000), and consequently it was expected that higher stress would make implicit identity a stronger predictor. However, these hypotheses were not supported in this thesis. This may largely be due to the non-significant association between implicit identity and eating-related behaviour that was observed throughout the five studies; it may be that there is no consistent relationship between implicit identity and eating behaviour, including a lack of moderation effects.

Another possibility for the lack of significant interaction effects is that it is other factors, not self-control or stress, that moderate the relationship between implicit eating-related identity and eating outcomes. That is, there may be a significant relationship between implicit identity and eating which is masked by moderator variables which were not included in this research. In particular, implicit variables may be more predictive of behaviour in situations that prevent controlled processing, such as when a snap decision is required

(Payne, 2006). This thesis included menu and snack choice tasks – situations in which participants were asked to make unplanned decisions about food – which were aimed at eliciting less controlled and more automatic processing. However, no time limit was put on these tasks, and therefore it is possible that participants spent time considering their answer and thus engaged in controlled processing. This may explain why implicit identity was not a significant predictor of these outcome measures. Future research could compare implicit identity as a predictor of eating-related behaviour in situations that allow for more or less controlled processing, such as having participants complete a virtual shopping task or test food consumption in a laboratory situation with or without a time limit.

Relationship Between Habit Strength and Eating Outcomes

Summary of Findings

Across all five studies, habit strength was found to be the strongest and most reliable predictor of eating-related outcomes in the regression models. Habit strength predicted past eating behaviour and PBC for healthy eating in all five studies. Habit strength also predicted menu choice and fat intake in Study 1; servings of fruits and vegetables and servings of unhealthy food in Studies 2, 4, and 5; servings of fruits and vegetables and servings of wholegrains in Study 3; menu choice in Studies 4-5; and snack choice in Study 5. As expected, stronger healthy habit strength and weaker unhealthy habit strength were associated with more healthy eating behaviours, while weaker healthy eating habit and stronger unhealthy eating habit were associated with more unhealthy eating behaviours. Bivariate correlations between habit strength and the eating-related outcome measures were also largely significant.

Possible Explanations

Other studies have also found habit strength to predict a range of healthy and unhealthy eating-related behaviours (Brug et al., 2006; de Bruijn, 2010; de Bruijn et al., 2007; de Bruijn et al., 2008; de Vries et al., 2014; Judah et al., 2020; Rees et al., 2018; Verhoeven et al., 2012). In this thesis, habit strength was a significant predictor over and above the effect of age, sex/gender, BMI, attitude, and subjective norms. Studies by de Bruijn (2010) and de Bruijn et al. (2008) also support the ability of habit strength to predict eating behaviour after controlling for attitudes and subjective norms as well as intentions and PBC. Verhoeven et al. (2012) found that habit strength predicted unhealthy snacking after controlling for a range of demographic factors, perceived health consequences, and sensitivity to food cues. This thesis therefore adds to the literature supporting habit strength as an important predictor of eating behaviour.

According to Ouellette and Wood (1998) there are two pathways by which past behaviour and future behaviour are associated. For behaviours which are likely to become habitual, past behaviour reflects habits and these habits are likely to also influence future behaviour. If habits are unlikely to form, future behaviour is controlled by deliberate reasoning. Past behaviour can affect future behaviour by influencing the deliberate reasoning process, for example by informing intentions, attitudes, perceived behavioural control, and perceived norms. For a habit to form, a behaviour must be performed and evaluated positively, and there must be the opportunity to perform the behaviour again under similar circumstances (Aarts et al., 1997). As eating is a behaviour that is performed multiple times a day and often in similar contexts (e.g. at the same time of day or in the same location), at least some eating behaviours are likely to become habitual. Once a habit has formed, conscious cognitive processes such as intentions are less predictive of behaviour (Aarts et al., 1997). This is indeed what was found in this thesis, as habit strength was a more consistent predictor of eating-related behaviour than the explicit predictors of attitudes and subjective norms.

Habit strength may be a particularly important predictor of eating behaviour due to its automaticity. A habit develops when a behaviour has been repeatedly performed in the same context until it is automatically cued by that context (Orbell & Verplanken, 2010; Riet et al., 2011; Verplanken & Orbell, 2003). Habits can be more important than controlled reasoning or conscious motivation in regulating behaviour as this automaticity means they influence behaviour more quickly and easily and also place less demand on short-term memory (Gardner et al., 2019; Orbell & Verplanken, 2010; Ouellette & Wood, 1998). Self-control has been likened to a ‘muscle’ which becomes fatigued with heavy use, so behaviours which rely on effortful self-control may not be consistently enacted (Muraven & Baumeister, 2000). Thus, habits are likely to control behaviour in situations where people do not have the cognitive capacity to engage in controlled processing or when people lose conscious motivation for a behaviour (Gardner et al., 2019). Due to the speed and efficiency of cognitive associations between habitual behaviours and their cues, habits may also affect behaviour before controlled processing takes over (Orbell & Verplanken, 2010). Eating-related habits are therefore likely to be highly influential on behaviour as they may influence behaviour more quickly than controlled processing or they may determine behaviour in situations where controlled processing ability is decreased.

Given that habits are believed to affect behaviour more strongly when automatic rather than controlled processing is predominant, a significant relationship between habit strength and implicit identity would be expected. However, the five studies in this thesis provided little evidence for such an association. No significant correlations were found between implicit identity and habit strength in Studies 1, 2, and 5. Healthy implicit identity was significantly and positively correlated with healthy habit strength in Study 3, and implicit identity was significantly and positively correlated with healthy habit strength in Study 4; however, these correlations were small. No other significant correlations between habit strength and implicit identity were found in Studies 3 and 4. The finding that implicit identity is not reliably associated with habit strength is consistent with the finding that implicit identity is not a robust predictor of eating-related outcomes in this thesis.

Future Research

Some researchers distinguish between different types of habit and argue that this has implications for the prediction of behaviour. Habits can differ in terms of whether they relate to the performance of a behaviour or the preparation to perform the behaviour (Kaushal et al., 2017). For example, packing gym clothes would be classified as a preparatory behaviour, while the exercise itself would be a performance behaviour (Kaushal et al., 2017). Preparatory habits may be more important than performance habits in predicting certain behaviours, and research is needed to examine whether this is also true in the area of eating behaviour (Gardner et al., 2019; Kaushal et al., 2017). Some researchers also distinguish habits that relate to the instigation of behaviours from habits relating to the execution of behaviours, such as going to the gym versus the specific exercises done at the gym (Gardner et al., 2016; Gardner et al., 2019; Phillips & Gardner, 2016). The Self-Report Habit Index, which is widely used in habit research (including in this thesis), primarily measures habits for instigation (Gardner, 2015; Gardner et al., 2016; Phillips & Gardner, 2016). Further research is therefore needed on the different types of habit, including habits for behavioural execution, and their roles in predicting eating behaviours.

Practical Implications

If habit is an important predictor of behaviour, it will be important to develop interventions to help people develop healthy eating habits and weaken or change unhealthy eating habits. Emerging research on habit formation has identified consistently performing a behaviour in the presence of a cue, coping planning, and the formation of implementation intentions (‘if-then’ plans) to be beneficial in forming a habit (Gollwitzer, 1999; Lally & Gardner, 2013; Orbell & Verplanken, 2010). Implementation intentions may also be beneficial for changing habits, particularly when paired with the technique of mental contrasting, which involves mentally comparing a goal and a desired outcome with the negative current reality (Adriaanse et al., 2010). Since habits are triggered automatically by cues, changing the environment to remove or alter these cues may help reduce unwanted habitual behaviours (Cleo et al., 2019; Fletcher et al., 2011; Lally & Gardner, 2013; Walker et al., 2015; Wood et al., 2005). Importantly, habit-based interventions appear to be acceptable to participants (Cleo et al., 2018).

Summary and Interpretation of Other Findings

Demographic Predictors and BMI

Age, sex (Study 1) or gender (Studies 2-5), and BMI were included in Model 1 in the regression analyses. These variables were included because research has linked BMI, age, and sex to eating behaviours (Cornier et al., 2013; Olsen et al., 2015; Stice et al., 2016; Thompson et al., 2011; Wardle et al., 2004). However, this thesis did not support these variables as key predictors of eating-related outcomes; while age, sex/gender, and BMI were associated with eating-related outcomes in some regression models, they were not consistently significant across the five studies. Older age predicted healthier past eating behaviour (scale) and more PBC in Study 2 and healthier menu choices in Study 5. Males reported higher PBC in Study 1 and 3 and more wholegrain consumption in Study 2. Lower BMI was associated with higher PBC in Study 1. Aside from these results, age, sex/gender, and BMI were not significant predictors in the regression models. Bivariate correlations also largely did not support age, sex/gender, and BMI as predictors; while there were some additional significant associations between age, sex/gender, and BMI and the eating outcomes, these were not consistent across the five studies.

One potential explanation for the lack of significance of BMI as a predictor is that BMIs were restricted to between 18.5 and 30 (Studies 3 and 5) or 18.5 and 40 (Studies 1, 2, and 4) for the primary analyses in all five studies. By reducing the range of BMIs to exclude very low-weight and high-weight participants, this may have limited the ability of the regression models to test BMI as a predictor. However, each regression was repeated with all BMIs included and this did not change the significance of BMI as a predictor for any outcome variable in any of the five studies. Restricted range of values could also potentially explain the lack of significance of age and sex/gender as predictors in Studies 3 and 5. Both of these studies had high proportions of female participants (75.6% in Study 3 and 71.7% in Study 5), and as these studies used samples of university students the majority of participants were aged 18-25 (91.1% in Study 3 and 84.8% in Study 5). However, Studies 1 and 4 had approximately even gender balances and Studies 1, 2, and 4 had a greater range of ages. These studies still did not find consistent evidence of age, sex/gender, or BMI as a predictor. It therefore seems that lack of significance of age, sex/gender, and BMI as predictors of eating outcomes is not due to restricted ranges of values. Rather, these variables appear to not be reliable predictors of eating-related behaviour in this thesis.

Attitudes and Subjective Norms

Attitudes towards healthy eating and subjective norms for healthy eating were included in Model 2 in the regression analyses. However, attitudes and subjective norms were not consistent predictors of eating-related outcomes in the regression models. Attitudes were positively associated with more healthy past eating behaviour (scale) in Study 1, healthier menu choices in Study 4, and more healthy past eating behaviour (single item) in Study 5. Attitudes also predicted fruit and vegetable and wholegrain intake in the Study 3 multi-level models. Subjective norms were positively associated with servings of fruits and vegetables in Study 4 and past eating behaviour (single item) and healthier menu choices in Study 5. Subjective norms also predicted unhealthy food intake in the Study 3 multi-level models. Apart from these results, attitudes and subjective norms were not significant predictors in the regression models. This was unexpected, as previous research has found attitudes and subjective norms to predict eating behaviour directly as well as indirectly through behavioural intentions (McDermott, Oliver, Simnadis, et al., 2015; Noia & Cullen, 2015; Stok et al., 2015; Wengreen et al., 2017).

Although attitudes and norms were largely non-significant in the regression models, these predictors were correlated with many of the eating-related outcomes across the five studies. In particular, attitudes was correlated with the majority of the outcomes measured, although most of these relationships were no longer significant in the regression models. Subjective norms were associated with fewer eating outcomes but was still correlated with the scale measure of past eating behaviour (Study 1), the single-item measure of past eating behaviour (Studies 1 and 3) fruit and vegetable intake (Study 3), menu choice and serves of fruits and vegetables (Study 4), and past eating behaviour (single item) and menu choice (Study 5), despite not being a significant predictor of these outcomes in the regression models. Although attitudes and norms appeared to be associated with eating-related behaviour, then, they were outperformed by other predictors in the regression models.

Association Between Implicit and Explicit Identity

Interestingly, explicit and implicit identity were generally not correlated with each other. Explicit healthy identity was measured in all studies except for Study 2. In Studies 1, 4, and 5 explicit and implicit identity were not significantly correlated. In Study 3 explicit identity was not significantly correlated with implicit unhealthy identity, but there was a moderate positive correlation between implicit healthy identity and explicit healthy identity.

Previous research on the agreement between implicit and explicit identity measures has found mixed results. Several studies have found no significant correlations between implicit and explicit identity (Frings et al., 2016; Perugini & Leone, 2009), while other studies have found these different measures to be significantly correlated (Asendorpf et al., 2002; Hawkins & Nosek, 2012; Lindgren, Gasser, et al., 2016; Lindgren, Neighbors, et al., 2016). Meta-analyses typically find small to moderate positive implicit-explicit correlations (Greenwald & Lai, 2020; Hofmann et al., 2005).

Several reasons for differences in implicit-explicit correlations have been identified. Variation in the relationship between implicit and explicit predictors could be due to individual differences in traits such as awareness of internal motives, preference for consistency, and concern with the social environment (Thrash et al., 2007). These traits were not measured in this thesis, and so it is unclear whether any of these factors may have affected the observed implicit-explicit correlations. Characteristics of the measures used may also affect the strength of implicit-explicit correlations. These correlations are typically lower when thematic words (e.g. ‘web’ to represent the target ‘spider’) and pronouns are used as stimuli in the IAT (Hofmann et al., 2005). The implicit measures in this thesis all used thematic words to represent the categories of healthy and unhealthy eating, and also used pronouns to represent the categories of self and other; this may help explain why significant implicit-explicit correlations were generally not found. Nosek (2005) argued that implicit and explicit attitudes are related but distinct concepts and that the relationship between implicit and explicit predictors is moderated by a variety of factors. Correspondence between implicit and explicit attitudes was stronger when a) self-presentation concern was low, b) attitudes were stronger, c) attitudes were more bipolar than unipolar, and d) attitudes were more distinct compared to the perceived norm (Nosek, 2005). These moderators could potentially also apply to implicit identity as well as implicit attitudes. Regarding the findings of this thesis, it is possible to identify with healthy and unhealthy eating simultaneously, and questioning about eating behaviours may trigger self-presentation concerns. These characteristics of the measures may have contributed to lower implicit-explicit correlations.

Explicit Identity

Bivariate correlations indicate that explicit identity is strongly associated with eating-related outcomes. Explicit identity was significantly correlated with all eating except for unhealthy food intake in Study 3 and wholegrain intake in Studies 4 and 5. This is consistent with previous research, which has found significant associations between explicit identity and measures of eating behaviour (Allom & Mullan, 2012; Blake et al., 2013; Carfora et al., 2017; Strachan & Brawley, 2009).

Despite being highly correlated with eating-related outcomes, explicit identity was not included in the regression models due to its consistently strong correlation with habit strength. The correlation between healthy explicit identity and healthy habit ranged between $r = .70$ and $r = .85$ across the four studies which included these measures (explicit identity was not measured in Study 2), and explicit identity was therefore left out of the regression models to avoid problems resulting from redundancy (Tabachnick & Fidell, 2014). However, it is important to note that when regression analyses were repeated with explicit identity included instead of habit strengths, the significance of implicit identity as a predictor did not change except in Study 1 where unhealthy implicit identity was no longer a significant predictor of past eating behaviour (scale). Previous research has also found a significant association between identity and habit (McCarthy et al., 2017). This suggests that there may be some overlap in processes relating to the formation of explicit identity and the development of habits. Identities are confirmed when a person repeatedly acts in a way that is consistent with their identity; the repeated enactment of identity-consistent behaviours is therefore a key part in strengthening explicit identities (Burke, 2006; Burke & Stets, 2009; Stryker & Burke, 2000). Habits involve the repeated performance of behaviours in certain contexts and increase the likelihood that these behaviours will be performed in similar contexts in the future (Lin et al., 2016; Neal et al., 2013; Neal et al., 2011; Verplanken & Orbell, 2003). Eating habits may therefore help people confirm and strengthen their eating-related identities through the increased performance of certain eating behaviours. Alternatively, people may be more likely to behave in accordance with their identities and these behaviours may become habitual with repeated enactment over time.

Self-Control

Self-control was significantly correlated with the majority of outcome measures used in the five studies. Notably, it was significantly and positively correlated with past eating behaviour and PBC in all five studies and with servings of fruits and vegetables in Studies 2-4. Correlations were also significant with menu choice and the Block fat and fruit and fibre screeners in Study 1, servings of unhealthy foods in Study 2, servings of wholegrains in Study 3, menu choice and servings of wholegrains and unhealthy foods in Study 4, and snack choice and menu choice in Study 5. All correlations were in the expected direction, with self-control predicting more healthy eating behaviours and fewer unhealthy eating behaviours. Interestingly, adding self-control to the regression analyses did not consistently improve the prediction of eating-related outcomes. Although no specific hypotheses were made about self-control as a predictor, previous research has found self-control to predict eating behaviour (Adriaanse et al., 2014; Gerrits et al., 2010; Ha et al., 2016; Keller & Siegrist, 2014; Sproesser et al., 2011; Tomasone et al., 2015; Wills et al., 2007). Self-control was a significant predictor in regression models predicting the scale measure of past eating behaviour (Studies 2 and 3), the single-item measure of past eating behaviour (Studies 3, 4, and 5), and PBC (Studies 1, 3, 4, and 5). However, self-control did not consistently predict these outcomes across all 5 studies and was not a significant predictor of the other outcome measures.

The finding that self-control predicted PBC in all studies except for Study 2, but was not generally a significant predictor of the other eating outcomes in regression models, raises the question of whether self-control may increase people's perceptions of their ability to eat healthily without translating into actual healthy eating behaviours. One reason that self-control may not have reliably predicted eating behaviour is that all five studies measured trait self-control. Trait self-control refers to stable individual differences in the ability to perform goal-directed behaviours, which differs from momentary fluctuations in self-control strength (de Ridder et al., 2018). Trait self-control may actually reflect the use of less effortful strategies, such as routines and habits, that increase the performance of goal-directed behaviours without relying on effortful control of behaviour (de Ridder et al., 2018; Galla & Duckworth, 2015). The measure of trait self-control used in this thesis may therefore not have added to the prediction of eating-related outcomes as habit strength was already included in the regression model.

While there are stable differences in self-control between individuals, there can also be temporary fluctuations in self-control strength (Baumeister et al., 1998; de Ridder et al., 2018; Muraven & Baumeister, 2000). Self-control strength has been compared to a 'muscle' which is temporarily reduced after performing a self-control task (Baumeister et al., 1998; Muraven & Baumeister, 2000). The measure of trait self-control used in this thesis was unable to capture momentary fluctuations in self-control strength across the day, although these may affect eating behaviours. As eating is a behaviour that is performed multiple times per day it is unlikely that participants had the same level of self-control strength at each eating occasion.

Stress

Stress measured at baseline was correlated with past eating behaviour (single item) Studies 3 and 5, past eating behaviour (scale) in Study 3, and with past eating behaviour (scale), PBC, and menu choice in Study 5. Correlations with other outcomes in these studies were not significant, and the average of the daily diary measure of stress in Study 3 was also not significantly correlated with any outcome measure. Adding stress in the Study 3 and Study 5 regression analyses did not improve the prediction of eating-related outcomes, except for the scale measure predicting past eating behaviour in Study 5. The daily diary measure of stress predicted fruit and vegetable intake in the multi-level models but did not predict wholegrain intake or consumption of unhealthy foods. The inconsistent correlations between stress and outcome measures and the lack of significant findings regarding stress in the regression and multi-level models were unexpected; while no specific hypotheses were made about stress as a predictor, previous research has shown stress to be predictive of eating behaviour (Adam & Epel, 2007; Groesz et al., 2012; Isasi et al., 2015; O'Connor et al., 2008; Rutters et al., 2009; Sominsky & Spencer, 2014).

One reason the studies in this thesis may have failed to find a consistent stress-eating relationship is that the impact of stress on eating may depend on a variety of individual differences. While some people experience increased eating following stress, others experience decreased eating (Stone & Brownell, 1994). Factors that may influence the nature of the stress-eating relationship include individual differences in negative affect, restrained eating, emotional eating, and individual sensitivity to chronic stress (Klatzkin et al., 2019; O'Connor et al., 2008; Rutters et al., 2009; Wallis & Hetherington, 2004). Pannicke et al. (2021) found that while stress itself did not predict eating behaviour, perceived ability to cope with stress did. Participants who felt better able to cope with stressors were more likely to subsequently show goal-congruent eating behaviours. The ability to cope with stress was also a significant predictor in a study by Mason et al. (2019), who found that mothers' perceived stress coping ability was associated with their own food intake as well as their child's. Thus, the relationship between stress and eating behaviour may not be the same for all people, which may explain why we did not find a consistent relationship between self-reported stress and eating behaviour in this thesis.

Strengths and Limitations of this Thesis

Limitations of this thesis have been discussed throughout this chapter. A notable limitation discussed earlier in this chapter was the potential for differences in how individuals may define healthy and unhealthy eating, which could mean that people who identify as healthy eaters could show very different eating behaviours. While the impact of this limitation could have been reduced by using more specific measures of implicit identity and eating behaviour (for example, looking at implicit identification with chocolate as a predictor of chocolate consumption), this would have reduced the generalisability and usefulness of the findings. Other limitations that were previously discussed include a lack of outcome measures promoting automatic processing and the use of only trait (rather than trait and state) measures of self-control. In this section, some additional limitations will be discussed alongside some strengths of the studies in this thesis.

Sample Diversity

This thesis used a range of different samples, including American adults (Studies 1 and 4), New Zealand university students (Studies 3 and 5), and a New Zealand adult community sample (Study 2). These samples had different age ranges and gender ratios. Studies 1 and 5, conducted over MTurk, were relatively gender balanced (48.3% males in Study 1 and 44.9% males in Study 5). This was in contrast to Studies 2, 3, and 5, which recruited participants from undergraduate Psychology classes or the wider community and which had larger proportions of female participants (27.4% males in Study 2, 2.3% males in Study 3, 27.3% males in Study 5). Studies 3 and 5, which used university student samples, had a mean age of 21.32 and 22.47 respectively. This was considerably lower than the mean age in Study 1 (M_{age} = 41.30), Study 2 (M_{age} = 50.44), and Study 4 (M_{age} = 41.81). Sex, age, and nationality are all factors which are associated with differences in eating behaviour (Dao et al., 2020; Olsen et al., 2015; Rozin et al., 2003; Thompson et al., 2011; Wardle et al., 2004). The use of different samples was therefore a strength of this research, as it ensured the findings were consistent in both Americans and New Zealanders, in males and females, in student and community samples, and across a wide range of ages. The use of New Zealand and community samples was a particular strength, as American student samples are over-represented in psychological research and may differ from non-student samples and from other Western countries (Henrich et al., 2010; Rad et al., 2018).

It is important to note that while the studies in this thesis used a variety of samples, the samples studied were not fully representative of the New Zealand and American populations. In particular, the proportion of Māori participants sampled in the three New Zealand studies was generally lower than the proportion of Māori in the New Zealand population. 2018 census data found 16.5% of New Zealanders identify as Māori (Statistics New Zealand), whereas the proportion of participants that identified as Māori was 4.8% in Study 2, 11.1% in Study 3, and 7.1% in Study 5. In addition, New Zealand European participants were overrepresented in Studies 2 and 3. 2018 census data found 70.2% of New Zealanders identify as New Zealand European (Statistics New Zealand), whereas 86.9% of participants in Study 2 and 84.4% of participants in Study 3 identified as New Zealand European. In the American studies the proportion of participants identifying as non-Hispanic White was also higher in Study 1 (75.9%) and Study 4 (84.6%) than in the general population (60.0%) (United States Census Bureau, n.d.). The studies used in this thesis mainly used convenience samples to provide an initial test of the hypothesis that implicit eating-related identity. However, future research is needed using more representative samples to ensure that results apply across the New Zealand and American populations.

It is important to note that both the New Zealand and American samples used in this thesis would be categorised as ‘WEIRD’ (Western, educated, industrialized, rich, and democratic), which are over-represented samples in psychological research but differ in important ways from other cultures (Henrich et al., 2010; Rad et al., 2018). Importantly for this research, motives for behaviour – including self-concepts – differ between cultures (Henrich et al., 2010; Smith, 2015). It is possible, then, that the importance of implicit identity as a predictor of eating behaviour could vary between different cultural groups. Thus, findings regarding self-identity as a behavioural predictor may be culturally dependent and results from this thesis may not generalize to different cultures. Further research is therefore needed to determine whether self-identity, including implicit measures of self-identity, is a useful and appropriate predictor of eating behaviour across cultures.

Another limitation is the use of a Mechanical Turk sample in Studies 1 and 4. Although Mechanical Turk is commonly used by researchers as a fast and affordable way of obtaining a large sample size with an even gender balance, these samples may have particular characteristics that are not typical of a general population (Buhrmester et al., 2018; Chan & Holosko, 2016).

Design

A further strength of this thesis was the use of both cross-sectional and longitudinal designs, including a seven-day diary measure in Study 3. The use of these different designs allowed the assessment of whether implicit identity could predict eating-related outcomes at several different time points. Identities are theorised to be fairly stable over time, with any change likely to be small and slow to occur (Burke, 2006), and so identity measures should be able to predict behaviour into the future. However, some research has suggested that implicit measures may be less stable over time than explicit measures (Gawronski et al., 2017), in which case a delay between the completion of the implicit and outcome measures may reduce the predictive ability of the implicit measure. The use of both cross-sectional and longitudinal study designs was a strength in this thesis as it allowed for both possibilities. Cross-sectional designs were used in Studies 1, 4, and 5 to measure whether implicit identity can predict eating behaviour measured immediately after completion of the implicit measure. In addition, Study 2 assessed whether implicit identity was able to predict eating behaviour 3 months later, and Study 3 used a diary design to assess whether implicit identity at baseline was able to predict eating behaviour over 7 days. By using measuring eating-related outcomes and different time points following the implicit measure, this thesis was able to look for long-term relationships between implicit identity and eating behaviour while allowing for the possibility that any relationship may only be significant in the short-term.

Procedure

Studies 1-4 were completed by participants in their own time and in their own home. This means that the research environment was not controlled and participants may have been distracted while completing the measures. This would be a particular issue for the SC-IATs and IAT, which uses response latencies and accuracy to measure implicit identity. However, participants were excluded if they had particularly long response times or high error rates, making it unlikely that distraction would be an issue for those participants who were retained for analysis. In addition, Study 5 used a more controlled laboratory setting and still replicated the major findings of earlier studies.

Statistical Power

All five studies in this thesis had high power (< 90%) to detect a medium effect size; however, power to detect a small effect size was low. Therefore, a potential criticism of this research is that small associations between implicit identity and eating-related outcomes may have been missed. In recognition of this possibility, a series of mini meta-analyses were conducted following the recommendations of Goh et al. (2016). Results from these additional analyses are reported in Appendix P. Meta-analytic correlations between implicit identity and eating-related outcomes were small and largely non-significant, supporting the conclusion that implicit identity is not a reliable predictor of eating behaviour.

Implicit Measures

Another strength of this research was the use of two types of implicit measure. Two SC-IATs were used to measure absolute strength of implicit identification with healthy and unhealthy eating in Studies 1-3, while an IAT was used to measure relative strength of implicit identification with healthy and unhealthy eating in Studies 4-5. As implicit eating-related identity is a largely unstudied construct, it was not clear whether absolute or relative identification with the two forms of eating behaviour would be most predictive of behaviour. The use of both types of implicit measure in this thesis allowed us to examine whether findings were consistent across both measures, or whether the implicit measures differed in their ability to predict eating-related outcomes. Future research could also test different implicit measures, such as versions of the Extrinsic Affective Simon Task (de Houwer, 2003) or the Go/No Go Association Task (Nosek & Banaji, 2001).

The stimuli used in both implicit measures were words representing self and others (e.g. ‘me’, ‘they’) and words representing healthy and unhealthy foods (e.g. ‘apple’, ‘cake’). It is possible that different stimuli may better measure implicit identification with healthy eating. While words are commonly used as stimuli in implicit measures, other implicit measures use picture stimuli (de Bruijn et al., 2012; Gray et al., 2011; Lindgren, Neighbors, et al., 2016; Prestwich et al., 2011). If pictures of food tap into the concept of healthy or unhealthy eating more strongly than food-related words, IATs using picture stimuli may be better measures of implicit identification. In addition, as previously discussed, implicit identification with the specific food stimuli used may not equate to implicit identification with the concepts of healthy and unhealthy eating more broadly. Future research should test alternative IAT stimuli to assess whether different stimuli would better measure implicit identification with eating behaviour.

Eating Outcome Measures

This thesis used a variety of different eating-related outcome measures, including self-report surveys, hypothetical food choices, and actual food choices. In addition, these measures included measurement of past behaviour, current behaviour, and perceived control over behaviour. Using a variety of different measurement methods is a strength of this thesis because each type of measure has different advantages and limitations. All five studies used a retrospective recall measure of past eating behaviour, which is an easy-to-administer measure that previous research has shown is an accurate estimate of eating behaviours measured by a two-week food diary (Kuijer & Boyce, 2012). However, this measure relies on recall of past behaviour, which may not be accurate. The measure is also unable to identify consumption of specific foods or food groups. Measures of past behaviour may not align with current eating identity; however, identities typically change gradually over time, rather than suddenly, so it is unlikely that identity would have changed over the measurement period (Burke, 2006). In addition, other measures of current behaviour (the menu choices in Studies 1, 4, and 5 and the snack choice in Study 5) were used to measure current behaviour and still did not find significant results. All studies in this thesis also used a self-report measure of perceived behavioural control of healthy eating. This measure is also easy to administer and highly correlated with measures of eating behaviour (Kuijer et al., 2015) but is not a direct measure of eating behaviour. A food frequency measure which asked participants about their eating over the past month was used in Study 1. Retrospective food frequency measures are useful for estimating a participant's usual intake of certain foods, but are limited to the food items listed in the measure. Because they ask about past eating behaviour, participants are unable to alter their behaviour as a result of being measured; however, the measure is subject to inaccurate recall and self-presentation biases. Three studies (Studies 2, 4, and 5) asked participants about servings of different food items eaten yesterday. 24-hour food recall measures rely less on long-term past memory, which may reduce inaccuracies in recall. As they measure past behaviour, participants are unable to alter their behaviour as a result of being measured, although their reporting may be altered as a result of self-presentation bias. A notable limitation of these measures is that because they focus on a single 24-hour period they are unable to account for day-to-day variations in eating. Studies 1, 4, and 5 used a hypothetical menu choice measure and Study 5 also used a snack choice measure. These measures provided a useful estimate of eating behaviour at the time of completing the implicit identity measure. However, these measures were limited to the choice of a few food types, which lacks ecological validity. Findings may not generalise to real-life situations in which participants are faced with a much greater range of foods to choose from. In addition, because the choice is a one-time event, the food choice may not reflect typical eating behaviour. Finally, Study 3 used a 7-day food diary completed in the week following the implicit measure. This provided an estimate of whether implicit identity can predict future behaviour. Because participants report foods on the day they eat them, the measure is less impacted by inaccurate recall than measures of past behaviour such as food frequency questionnaires. However, eating behaviour may be consciously or unconsciously altered as a result of being measured and thus may not be a fully accurate representation of typical eating. Although each type of measure of eating behaviour has its own strengths and limitations, the use of a range of different measures suggests that the findings in this thesis are not affected by the type of outcome measure used. Rather the finding that implicit eating-related identity is not associated with eating-related outcomes appears to be robust using a range of different measurement types.

An unexpected finding of this thesis was that neither implicit identity nor any of the other variables measured in this thesis were good predictors of wholegrain consumption. This thesis assessed predictors relating to healthy eating in general rather than wholegrain-specific predictors. It may be that wholegrain consumption is better predicted by items specifically targeting this food group (e.g. implicit identification with wholegrains, attitudes towards wholegrains) rather than items targeting the concept of healthy eating. One reason that wholegrain consumption may not be predicted by predictors relating to healthy eating in general is that some participants may not see wholegrains as healthy, for example due to perceptions that they cause digestive problems or a belief that low-carbohydrate diets are healthy (Clarke & Best, 2017; Kamiński et al., 2020; Kuznesof et al., 2012; McMackin et al., 2013). Therefore, both consumption or avoidance of wholegrains could be consistent with a healthy eating identity, depending on an individual's beliefs about the healthfulness of wholegrains. This further illustrates the previously-discussed difficulty of measuring healthy and unhealthy eating, as people may have considerably different views on what these behaviours involve.

Explicit Identity

This study included a measure of healthy explicit identity but not a measure of unhealthy explicit identity. The measure of healthy explicit identity was based on research by Blake et al. (2013), which did not include a scale for measuring unhealthy explicit identity.

Unhealthy explicit identity was consequently not measured in this thesis. This largely does not affect the main findings of this study, as healthy explicit identity was strongly correlated with habit and was therefore not included in the regression models predicting eating-related outcomes. Unhealthy habit was also measured, and so it is likely that unhealthy explicit identity would also not have been included in the regression models. Nevertheless, it would have been interesting to examine the relationship between implicit and explicit unhealthy identities. Future research is needed to develop and test a scale measuring explicit unhealthy eating-related identity.

Future Research

Ideas for future research have been discussed throughout this Discussion chapter. This section will describe some additional directions for future research that have come out of this thesis. Implicit research is a messy and evolving area, with recent meta-analyses remaining inconclusive regarding the predictive utility of the IAT (Greenwald & Lai, 2020; Oswald et al., 2013). Researchers have also debated whether the IAT actually measures unconscious cognitive associations at all (Kurdi et al., 2021; Schimmack, 2021; Vianello & Bar-Anan, 2021). Complicating the issue further, implicit research has been criticised for methodological issues such as low power (Kurdi et al., 2019). Therefore, there are numerous avenues for further research to clarify issues related to implicit measurement. Some key areas for further research relevant to this thesis will be discussed below.

Implicit Prediction Research

Overall, the results of the five studies suggest that implicit identity as a healthy and unhealthy eater is not a significant predictor of eating behaviour and other eating-related outcomes. However, it could be that these general concepts are not key components of people's identity and other eating-related identities – such as implicit identification with dieting or vegetarianism – could be more useful in predicting eating-related outcomes. Future research could investigate this possibility. This thesis also found that self-control and stress were not reliable moderators of the implicit identity-behaviour relationship. Implicit research in other areas has identified additional moderators of the relationship between implicit processes and behaviour, such as mindfulness (Levesque & Brown, 2007); perceived controllability of the behaviour (Ellis et al., 2016); and opportunity and motivation to control the behaviour (Friese, Hofmann, & Schmitt, 2008). Future research could assess potential moderators such as these and examine whether they interact with implicit identity to predict eating behaviour.

Studies 1-3 tested the hypothesis that implicit identification with healthy foods and unhealthy foods are best tested separately, using two SC-IATs. Another possibility, which was not tested in this thesis, is that it is combinations of these identities that predict eating behaviour. For example, people who have high implicit identification with healthy foods and low implicit identification with unhealthy foods may exhibit healthier eating behaviours than people with different implicit identification profiles. While beyond the scope of this thesis, this possibility could be tested in future research using a latent profile analysis (Osborne & Sibley, 2017).

As discussed previously, Payne et al. (2017a, 2017b) conceptualise IAT scores as reflecting social and situational differences rather than individual differences. Consequently, they argue that the IAT is best used to study associations at a group level, rather than to predict individual outcomes based on the individual's IAT score (Payne et al., 2017a). However, other researchers argue that IAT scores best reflect individual differences, albeit with substantial measurement error (Connor & Evers, 2020). Further research is therefore required to determine at what level implicit constructs are best considered. Importantly for this thesis, research and debate in this area has focused on implicit biases rather than implicit eating-related identities, and it is therefore unclear to what extent implicit eating-related identities are representative of individual versus group differences. Research using aggregated group-level implicit identity scores to predict group-level eating outcomes is needed to explore whether implicit eating-related identity could also be seen as resulting from social and situational differences. One possibility would be to use data from Project Implicit (n.d.), which collects large samples of IAT data and makes this data, alongside participant country of residence and postcodes, publicly available. While an eating identity IAT is not currently provided by Project Implicit, related IATs – such as the Healthy Food IAT measuring implicit attitudes towards healthy and unhealthy foods – have been researched (Project Implicit). While beyond the scope of this thesis, this data could be aggregated at the level of the community and used to predict community outcomes such as obesity rates.

IAT Measures

Within the IAT literature, there is ongoing debate about the usefulness of the IAT and its variants as predictors of behaviour. There is a lack of consensus regarding several key aspects of the IAT. First, meta-analyses indicate that average correlations between IAT tasks and outcome measures across a variety of domains are small (Greenwald et al., 2009; Oswald et al., 2013). While small effect sizes may have considerable real-world implications, for example if they affect large numbers of people (Greenwald et al., 2015), there is currently a lack of evidence as to whether this actually occurs in practice for IAT effects (Oswald et al., 2015). Therefore, it is unclear whether IAT measures are useful in predicting real-world outcomes, and further research is needed to clarify this. The five studies in this thesis largely found the SC-IATs and IAT to be unable to predict eating behaviour; while implicit identity was significantly correlated with past eating behaviour (scale) and PBC in Study 1, past eating behaviour (single item) in Study 2, and past eating behaviour (scale and single item) and PBC in Study 3, correlations with other outcome measures in Studies 1-3 and with all outcome measures in Studies 4-5 were not significant. This suggests that implicit identity may not be a useful predictor of eating behaviour and therefore would not have real-world implications. Consistent with this interpretation, implicit identity was not significantly correlated with BMI – a real-world outcome associated with eating behaviour – in any of the five studies.

Secondly, concerns have been raised regarding the reliability and validity of implicit measures. A recent paper, published after the studies in this thesis were conducted, raised concerns over a lack of evidence for construct validity in implicit attitude measures (Schimmack, 2021), although this has been debated (Vianello & Bar-Anan, 2021). The studies in this thesis add to these concerns; across the five studies, there were few significant correlations between implicit eating-related identity and related constructs including eating outcomes, explicit eating-related identity, attitudes towards healthy and unhealthy foods, subjective norms for healthy eating, and eating habits. The test-retest reliability of IAT measures has also been questioned, with research suggesting that implicit measures have lower temporal stability than explicit measures (Gawronski et al., 2017). A recent review by Greenwald and Lai (2020) found that the major implicit measures, including the IAT and its variants, have reliability coefficients that are suitable for correlational research but cannot be used to predict individual outcomes. Other authors have also supported the argument that IAT measures are not suitable for individual-level decisions while noting that these measures are still suitable for correlational research, which is how the measures were used in this thesis (Carlsson & Agerström, 2016; Schnabel et al., 2008).

Thirdly, there is a lack of consensus regarding the theoretical underpinnings of implicit measures. In addition, there are several possible explanations for associations between IAT scores and behavioural outcomes, and there is currently a lack of evidence supporting one explanation over the others (Greenwald & Lai, 2020). It may be that implicit measures tap into automatic mental processes; however, it is also possible that they are an indirect way of measuring the same constructs as self-report measures (Greenwald & Lai, 2020; Rothermund et al., 2020). For example, some research has found that people are able to predict their IAT scores, suggesting that attitudes as measured by the IAT are not fully unconscious (Hahn et al., 2014). Complicating the issue further, there are many different conceptualisations of dual-process theories and these are not sufficiently well-specified to allow research comparing them (Greenwald & Lai, 2020). As implicit measures like the IAT are based on dual-process theories, this means that the theoretical basis for these measures is currently unclear. Consequently, it is unclear what the lack of significant findings in this thesis mean for the concept of implicit measurement as a whole.

Despite the current limitations of these implicit measures, there is general agreement that IAT tasks are able to measure group differences in the relative strength of associations and may be a useful addition to research in socially sensitive areas (Schimmack, 2021; Schnabel et al., 2008). In addition, many of these concerns can be viewed as areas for further research rather than as reasons to avoid using IAT measures (Rothermund et al., 2020). For example, further research may be beneficial in developing implicit measures with greater test-retest reliability, or on further developing and testing dual-process theories (Greenwald & Lai, 2020; Rothermund et al., 2020). Most research in this area to date has been conducted on implicit attitudes, and further research is therefore required on effect sizes, reliability, validity, and underlying theory for measures of implicit identity. Initial evidence from this thesis suggests that the eating identity SC-IATs and IAT likely lack convergent validity with related outcomes and are unrelated to behavioural and other outcome measures, but the studies in this thesis were not designed to examine these issues. Further research is therefore required to investigate these concerns with implicit eating identity measures as well as implicit identity measures in other domains.

Implicit Intervention Research

While this thesis did not find robust evidence for implicit identity as a predictor of eating behaviour, other research indicates that implicit attitudes towards healthy and unhealthy foods can predict behaviour (Goldstein et al., 2014; Houben et al., 2010, 2012; Mai et al., 2015; Prestwich et al., 2011). Based on this finding, research has begun to look at interventions to change implicit eating-related attitudes (Kemps et al., 2013; Walsh & Kiviniemi, 2014). For instance, in one study participants were shown pictures of palatable but unhealthy snacks, and in the intervention group these were paired with images depicting negative consequences of healthy eating (Hollands et al., 2011). After the intervention, the intervention group showed a marginally significant implicit preference for fruit compared to the control group (controlling for baseline attitudes) and were significantly more likely to choose fruit over an unhealthy snack in a food choice test (Hollands et al., 2011). Participants who experienced the greatest changes in implicit attitudes were more likely to show behaviour change (Hollands et al., 2011). In another study, an IAT-based task to change implicit attitudes towards healthy foods was found to interact with self-control; participants with high self-control were not affected by the intervention, while the intervention was successful for participants with low self-control (Haynes et al., 2015). The relationship between implicit attitude change and behaviour change may depend on factors such as explicit attitude strength (Mattavelli et al., 2017) and baseline strength of implicit attitudes (Hollands et al., 2011). However, not all research has found behaviour change resulting from implicit attitude change (Lebens et al., 2011). A meta-analysis on implicit bias change found that procedures that attempt to change implicit bias by targeting associations, depleting mental resources, or inducing goals typically led to implicit change, but with small and inconsistent effect sizes and with no evidence that implicit change led to changes in behaviour (Forscher et al., 2019). However, this meta-analysis examined a range of implicit biases and so results may not be applicable to implicit eating-related measures (Forscher et al., 2019). Research is therefore needed to determine which interventions can change implicit eating-related attitudes and related behaviours, as well as the circumstances in which implicit attitude change is most likely to translate into eating behaviour change.

While the studies in this thesis did not find evidence for implicit identity as a predictor of eating behaviour, research has found implicit identity to predict other forms of behaviour. For example, research suggests that implicit identity is a significant predictor of alcohol use and related outcomes (Frings et al., 2016; Lindgren, Foster, et al., 2013; Lindgren, Gasser, et al., 2016; Lindgren et al., 2017; Lindgren, Neighbors, et al., 2016; Lindgren et al., 2015; Montes et al., 2018). Further studies are needed to evaluate whether interventions can change implicit identity in areas where implicit identity does predict behaviour, such as alcohol use.

Conclusion

Increasing healthy eating and decreasing unhealthy eating are important for a variety of health outcomes. One potential predictor of eating-related behaviours is implicit identity, which refers to self-identity that a person is not consciously aware of. A series of five studies investigated whether implicit identity can predict eating related behaviours. Contrary to hypotheses, across the five studies there was no consistent evidence for a relationship between implicit eating-related identity and eating behaviours. While some significant results were found initially in Study 1, these were not consistent across all outcome measure and were not able to be replicated in any of the subsequent four studies. Also contrary to hypotheses, there was a lack of evidence for interactions between implicit identity and self-control and stress when predicting eating outcomes. Rather, habit strength was a key predictor of eating behaviour across all five studies. There are several possible explanations for the null findings involving implicit identity, including that implicit identity is best considered at a group level; that different implicit measures or stimuli may be needed; and that differences in people's food preferences and definitions of healthy eating may affect findings. It may also be the case that for the outcome of eating behaviour, implicit identity is not a useful predictor and other variables (such as habit strength) are more important in determining this behaviour. Future research is needed to assess the predictive ability of different implicit measures and different conceptualisations of eating-related identities, to test different moderator variables, and to develop interventions to strengthen healthy eating habits. Future research would also benefit from using more diverse samples.

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Appendix A: Ethics Approval for Studies 1 and 5

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE
Secretary, Rebecca Robinson
Telephone: +64 03 369 4588, Extn 94588
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2018/01

8 February 2018

Jessica Gunby
Psychology
UNIVERSITY OF CANTERBURY

Dear Jessica

The Human Ethics Committee advises that your research proposal "Implicit Identity as a Predictor of Healthy and Unhealthy Eating" has been considered and approved.

Please note that this approval is subject to the incorporation of the amendments you have provided in your email of 6th February 2018.

Best wishes for your project.

Yours sincerely

[redacted]

pp.

Professor Jane Maidment
Chair

University of Canterbury Human Ethics Committee

Appendix B: Study 1 Information and Debrief Sheets

Personality and Eating Behaviours Information Sheet

Thank you for your interest in this study!

My name is Jessica Gunby and I'm a PhD student at the University of Canterbury. I'm looking for participants in a confidential study looking at personality and eating. Participation will involve completing an online personality and a categorisation task, and should take around 30-45 minutes.

What will participation involve?

Participation will involve completing questions on the sort of person you are, your likes and dislikes, and your behaviour. There will also be a task in which you will be asked to quickly respond to different words and images.

Is there a reward for participation?

Each participant will receive US $1.50 following completion of the questionnaire and response task.

Who can participate?

Anyone who is over 18, fluent in English, and does not have an eating disorder can participate in this study.

If you do not fulfil these criteria, please exit the survey now.

What happens to the information I provide?

The results of the study will be used to write a thesis and may be published in scientific journals or used in conference presentations, but you may be assured of the complete confidentiality of the data gathered in this study. Data will stored in a secure office in the Department of Psychology at the University of Canterbury. Only the researchers and their supervisor will have access to the data. The data will be stored securely for 10 years following the completion of the project and will then be destroyed.

Participation is voluntary and you have the right to withdraw from the study at any point. If you withdraw, we will remove all information you have provided.

Are there any risks involved?

It is not anticipated that participation in this study will pose any risk. The questionnaire has been reviewed and approved by the University of Canterbury Human Ethics Committee. Participation is voluntary and all data will be anonymous.

If at any point you do not wish to continue your participation in the study, simply exit the survey and your responses will not be recorded. If you experience any concern about your eating behaviours, please contact your GP for advice.

Who are the researchers?

This research is being carried out as part of a PhD in Psychology by Jessica Gunby, who can be contacted at jessica.gunby@pg.canterbury.ac.nz. The research is supervised by Associate Professor Roeline Kuijer, who can be contacted at roeline.kuijer@canterbury.ac.nz, and Dr Kumar Yogeeswaran, who can be contacted at kumar.yogeeswaran@canterbury.ac.nz. They will be pleased to discuss any questions or concerns you might have about participation in the project.

Consent

I have read and understood the description of the above-named study. On this basis I agree to participate, and I consent to publication of the results of this study with the understanding that confidentiality will be preserved. I understand that my participation is entirely anonymous and that I may withdraw from the study at any point before I submit my responses.

- I agree to participate (please go to the next page to start the questionnaire)
- I have decided NOT to participate (please exit the questionnaire by closing this window)

Personality and Eating Behaviours Debriefing Sheet

Thank you for completing the study! This page contains some information about the purpose of this study and what we hope to find.

The main aim of the study is to see whether a person's identity as a healthy eater predicts their eating decisions. Identity refers to the type of person you think you are. Some people see being a healthy eater as a key part of their identity, and we expect people who have this type of identity to choose healthier foods. We also expect people who identify as an unhealthy eater to choose unhealthy foods. In this study we measured your identity by asking you whether you saw yourself as a healthy or unhealthy eater and also by measuring how easily you classified yourself as a healthy or unhealthy eater on the response task. We measured your eating choices by asking you to choose a meal from the hypothetical menu and by asking about typical eating behaviour. When we analyse the data, we expect to see that people who said they are healthy eaters and who were faster to classify themselves as a healthy eater also chose healthier meals from the menu. Similarly, we expect that people who said they were unhealthy eaters and who were faster to classify themselves as an unhealthy eater chose less healthy meals from the menu.

If you have any questions or concerns about this study please feel free to contact us. This study is being carried out as part of a PhD in Psychology by Jessica Gunby, who can be contacted at jessica.gunby@pg.canterbury.ac.nz. The research is supervised by Associate Professor Roeline Kuijer, who can be contacted at roeline.kuijer@canterbury.ac.nz.

Thank you once again for your participation. Please click 'submit' to submit your data for analysis, or close this window to exit the survey without submitting your data.

Appendix C: Study 1 Menu Choice

Imagine you are having lunch at a cafe. Which item on the sandwich menu below would you choose? [12]

SANDWICH MENU

All sandwiches available on white bread or wheat bread. Gluten free options available also.

Your choice (1):

- **Smoked Turkey Breast**. High in flavour and low in fat, our sliced Turkey Breast sandwich is great with crisp veggies and your choice of fat-free condiments.

- **Italian B.M.T.** The sandwich to conquer all hunger. Served on freshly baked bread, this sandwich is bursting with sliced salami, pepperoni, ham, and your choice of salad and condiments. It's a sandwich you can really sink your teeth into.

- **Roast Beef.** Piled high with lean roast beef, this sandwich is sure to please. Served on freshly baked bread with your choice of salad and sauces.

- **Chicken and Bacon Melt.** Try this delicious sandwich, packed full of tender chicken, crispy bacon, and melted cheddar cheese. Served with your choice of salads and condiments, this sandwich makes a delicious meal.

- **Veggie Delite.** Crispy, crunchy, and delicious. The veggie delite sandwich is a delicious combination of lettuce, tomatoes, green capsicums, onions, olives, and pickles with your choice of fat-free condiments. Served on freshly baked bread.

- **Veggie Patty.** Whether by choice, or simply for a delicious change, a full-flavoured veggie patty with your favourite combination of oven-fresh bread, salad, and sauces hits the mark!

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[12] Based on Castañeda (2015) and Hoyt et al. (2014).

Appendix D: Study 2 Ethics Approval

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE
Secretary, Rebecca Robinson
Telephone: +64 03 369 4588, Extn 94588
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2018/24

27 June 2018

Associate Professor Roeline Kuijer
Psychology
UNIVERSITY OF CANTERBURY

Dear Roeline

The Human Ethics Committee advises that your research proposal "Health, Well-Being and Health Behaviour" has been considered and approved.

Please note that this approval is subject to the incorporation of the amendments you have provided in your emails of 12th and 19th June 2018.

Best wishes for your project.

Yours sincerely

[redacted]

Professor Jane Maidment
Chair
University of Canterbury Human Ethics Committee

University of Canterbury Private Bag 4800, Christchurch 8140, New Zealand. **www.canterbury.ac.nz**

Appendix E: Study 2 Information Sheet

Health, Well-being and Health Behaviour

Recently you registered your interest in participating in health-related research. Thank you so much for doing so! We would now like to invite you to participate in our first study on *Health, Well-being and Health Behaviour.* This study aims to examine health, well-being and a number of health-related behaviours (such as smoking, diet, weight control) among a large representative sample.

What does participation involve?

Participation involves completing three online questionnaires and a short computer task over the next 12 months. In these questionnaires we will ask you questions about:

- your health and well-being (such as your views about your health, how you feel, how well you are able to do your usual activities, and whether or not you suffer from any chronic health conditions)
- healthy and unhealthy behaviours (such as whether you smoke, your diet, your weight and how much you exercise)
- questions about the type of person you are
- questions about stress in your life

The computer task is a categorization task (you will be asked to categorize words into one of two categories). To do this task, you will be asked to download a computer file onto your computer. This is safe and will not harm your computer. You will only complete the computer task once during the study. The computer task cannot be completed on a mobile device. If you do not have access to a computer (laptop or desktop), you can still participate in the study and complete the rest of the material.

The first questionnaire (including the computer task) will take around 25-35 minutes to complete (please see below for a link to the questionnaire). The second questionnaire (to be completed 3 months from now) is very short and will only take 5-10 minutes to complete. The final questionnaire (to be completed 12 months from now) will take around 20-30 minutes to complete.

As a small token of our appreciation, participants who complete the first and third questionnaire will receive a $10 voucher after the completion of each questionnaire. Participants who complete the second (very short) questionnaire will go into a draw to win one of 4 vouchers (there are 2 $100 vouchers and 2 $50 vouchers available).

Confidentiality and Right to Withdraw

The results of the project may be published, but you may be assured of the complete confidentiality of the data gathered in this investigation. We will not ask for any identifying information in the questionnaires.

Participation is voluntary and you have the right to withdraw without penalty. If you start the questionnaire and decide that you do not want to continue, please exit the questionnaire. Your incomplete questionnaire will then be withdrawn from the data base. However, once you have electronically submitted the questionnaire your data can no longer be removed.

If you complete the first questionnaire, we will contact you again by email 3 and 12 months from now for the follow-up questionnaires. If you do not complete the first (or second) questionnaire we will not contact you for any follow-up questionnaires for this study.

Risks

It is not anticipated that participation in the study will involve any risk to you. However, if after completing this questionnaire you are concerned about health issues or you would like advice on how to change a health behavior (such as quitting smoking, or eating healthier) we suggest you contact your general practitioner, or phone the Healthline (0800 611 116) or the Quitline (0800 – 778778) for advice.

Who are the researchers?

This study is carried out by Associate Professor Roeline Kuijer who works at the Department of Psychology, University of Canterbury. Jessica Gunby, PhD student in the Department of Psychology, is involved in the study as a research assistant and will use some of data gathered in this study for her PhD research. If you have any questions about participating please do not hesitate to contact us by email or phone.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

If you agree to participate please click on the link at the bottom to this email. This link will take you to the questionnaire (this includes a link to the computer task). If you are reading this email on a mobile device it is best to switch to a laptop or desktop computer if possible to proceed with the questionnaire.

Your participation is much appreciated.

Sincerely,

Associate Professor Roeline Kuijer

Email; roeline.kuijer@canterbury.ac.nz

Phone: 03 369 4362

Jessica Gunby

jessica.gunby@pg.canterbury.ac.nz

Appendix F: Ethics Approval for Studies 3 and 5

UC UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE

Secretary, Rebecca Robinson

Telephone: +64 03 369 4588, Extn 94588

Email: human-ethics@canterbury.ac.nz

Ref: HEC 2018/65 16 July 2018

Jessica Gunby

Psychology

UNIVERSITY OF CANTERBURY

Dear Jessica

The Human Ethics Committee advises that your research proposal "Implicit Identity as a Predictor of Healthy and Unhealthy Eating" has been considered and approved.

Please note that this approval is subject to the incorporation of the amendments you have provided in your email of 10th July 2018.

Best wishes for your project.

Yours sincerely

[redacted]

pp.

Professor Jane Maidment

Chair

University of Canterbury Human Ethics Committee

Appendix G: Servings Eaten Yesterday Measure (Studies 2, 4, and 5)

The following questions are about what you ate YESTERDAY. Please try to remember as accurately as you can the food you ate yesterday, including all the food you ate at meal times as well as the food you ate in-between meals.[13]

1. How many servings of **fruit** did you eat yesterday? Please include all fresh, frozen, canned and stewed fruit. Do not include fruit juice or dried fruit.

1 serving = 1 medium piece or 2 small pieces of fruit or 1/2 cup of stewed fruit. For example, 1 apple + 2 small apricots = 2 servings.

- 0 serves
- <1 serving
- 1 serving
- 2 servings
- 3 servings
- 4 or more servings

2. How many servings of **vegetables** did you eat yesterday? Please include all fresh, frozen, and canned vegetables. Do not include vegetable juices or hot chips (French fries).

1 serving = 1/2 cup of cooked vegetables or 1 cup of salad vegetables or 1 medium potato/kumara. For example, 2 medium potatoes + 1/2 cup of peas = 3 servings.

- 0 serves
- <1 serving
- 1 serving
- 2 servings
- 3 servings
- 4 or more servings

3. How many servings of **wholegrain cereals or bread** did you eat yesterday? (e.g., Weetabix, bran flakes, oatmeal, wheatmeal bread)

1 serving = 2 Weetbix or 1 cup of wholegrain cereal or 1 slice of wholegrain bread

- 0 serves
- <1 serving
- 1 serving
- 2 servings
- 3 servings
- 4 or more servings

[13] Based on Conner et al., 2015; Russell et al., (1999); White et al., 2013

4. How many servings of **crisps (potato chips), corn snacks or corn chips** did you eat yesterday?

1 serving = 1 small packet (40-45g), 4 servings = 1 large packet

- 0 serves
- <1 serving
- 1 serving
- 2 servings
- 3 servings
- 4 or more servings

5. How many servings of **hot chips, French fries, or wedges** did you eat yesterday?

1 serving = 1 cup or 1 small fast food serving, 2 servings = 2 cups or a large fast food serving

- 0 serves
- <1 serving
- 1 serving
- 2 servings
- 3 servings
- 4 or more servings

6. How many servings of **lollies (candy), sweets, chocolate, or other confectionery items** did you eat yesterday?

1 serving = 1 regular sized chocolate bar (approx. 50g) or the amount that would fit in the palm of your hand

- 0 serves
- <1 serving
- 1 serving
- 2 servings
- 3 servings
- 4 or more servings

7. How many servings of **biscuits (cookies), cake, muffins, or buns** did you eat yesterday?

1 serving = 1 or 2 biscuits or a small piece of cake or a small muffin

- 0 serves
- <1 serving
- 1 serving
- 2 servings
- 3 servings
- 4 or more servings

Appendix H: Study 3 Information and Debrief Sheets for Student Participant Pool

Personality and Eating Behaviours Information Sheet

Thanks for your interest in this study!

This study is looking at the link between personality and various health behaviours. **Participation involves 3 steps: a survey, a brief 7-day diary measure, and 3 short multiple choice questions.** The total time involved will be around 60 minutes and you will receive 3 credits for PSYC105 for your participation.

You can sign up for the study here, and then we will send you an email with some more information and a link to a survey. The survey will take around 25-35 minutes to complete, and will ask you questions about your personality and health behaviours. **As part of the survey you will need to complete a categorisation task, which requires access to a desktop or laptop computer** (no mobile devices). After you've done the survey there will be 7 days of daily diary measures. These will only take a few minutes per day to complete and will be emailed out each day starting on the Monday after you complete the survey. Finally, as part of your PSYC105 course credit, you will be emailed three short multiple choice questions about this study. These will be sent out after you've completed the last food diary, and once you've answered the questions then we'll assign your course credit (3 credits).

- o I have been given a full explanation of this project and have had the opportunity to ask questions.
- o I understand what is required of me if I agree to take part in the research.
- o I understand that participation is voluntary and I may withdraw at any time without penalty. Withdrawal of participation will also include the withdrawal of any information I have provided should this remain practically achievable.
- o I understand that any information or opinions I provide will be kept confidential to the researchers and that any published or reported results will not identify the participants. I understand that a thesis is a public document and will be available through the UC Library.
- o I understand that all data collected for the study will be kept in locked and secure facilities and/or in password protected electronic form and will be destroyed after ten years.
- o I understand the risks associated with taking part and how they will be managed.
- o I understand that I can contact the researcher (Jessica Gunby; Jessica.gunby@pg.canterbury.ac.nz) or supervisor (Roeline Kuijer; roeline.kuijer@canterbury.ac.nz) for further information. If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch, New Zealand (human-ethics@canterbury.ac.nz)
- o I agree to participate (please go to the next page to start the questionnaire)
- o I have decided NOT to participate (please exit the questionnaire by closing this window)

Personality and Eating Behaviours Debriefing Sheet

Thank you for completing the study! This page contains some information about the purpose of this study and what we hope to find.

The main aim of the study is to see whether a person's identity as a healthy eater predicts their eating decisions. Identity refers to the type of person you think you are. Some people see being a healthy eater as a key part of their identity, and we expect people who have this type of identity to choose healthier foods. We also expect people who identify as an unhealthy eater to choose less healthy foods. In this study we measured your identity by asking you whether you saw yourself as a healthy or unhealthy eater and also by measuring how easily you classified yourself as a healthy or unhealthy eater on the response task. The questions about eater identity were a measure of explicit (conscious) identity, something that previous research has linked to eating behaviour. However the response task measured implicit (subconscious) identity, which has not yet been researched. We measured your eating choices by asking you to complete a 7-day food diary and by asking about typical eating behaviour. When we analyse the data, we expect to see that people who said they are healthy eaters and who were faster to classify themselves as a healthy eater also made healthier eating decisions. Similarly, we expect that people who said they were unhealthy eaters and who were faster to classify themselves as an unhealthy eater made less healthy eating decisions.

If you have any questions or concerns about this study, or would like to withdraw your data from the study, please feel free to contact us. This study is being carried out as part of a PhD in Psychology by Jessica Gunby, who can be contacted at jessica.gunby@pg.canterbury.ac.nz. The research is supervised by Associate Professor Roeline Kuijer, who can be contacted at roeline.kuijer@canterbury.ac.nz, and Dr Kumar Yogeeswaran, who can be contacted at kumar.yogeeswaran@canterbury.ac.nz.

Appendix I: Study 3 Information and Debrief Sheets for General Participants

Personality and Eating Behaviours Information Sheet

Thanks for your interest in this study!

This study is looking at the link between personality and various health behaviours. **Participation involves 3 steps: a survey, a brief 7-day diary measure, and 3 short multiple choice questions.** The total time involved will be around 60 minutes and you will receive 3 credits for PSYC105 for your participation.

You can sign up for the study here, and then we will send you an email with some more information and a link to a survey. The survey will take around 25-35 minutes to complete, and will ask you questions about your personality and health behaviours. **As part of the survey you will need to complete a categorisation task, which requires access to a desktop or laptop computer** (no mobile devices). After you've done the survey there will be 7 days of daily diary measures. These will only take a few minutes per day to complete and will be emailed out each day starting on the Monday after you complete the survey. Once the last diary measure is complete, that's it! We will post your $10 voucher to you and we'll draw the winner of the $100 voucher once all participants have completed the study.

- I have been given a full explanation of this project and have had the opportunity to ask questions.
- I understand what is required of me if I agree to take part in the research.
- I understand that participation is voluntary and I may withdraw at any time without penalty. Withdrawal of participation will also include the withdrawal of any information I have provided should this remain practically achievable.
- I understand that any information or opinions I provide will be kept confidential to the researchers and that any published or reported results will not identify the participants. I understand that a thesis is a public document and will be available through the UC Library.
- I understand that all data collected for the study will be kept in locked and secure facilities and/or in password protected electronic form and will be destroyed after ten years.
- I understand the risks associated with taking part and how they will be managed.
- I understand that I can contact the researcher (Jessica Gunby; jessica.gunby@pg.canterbury.ac.nz) or supervisor (Roeline Kuijer; roeline.kuijer@canterbury.ac.nz) for further information. If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch, New Zealand (human-ethics@canterbury.ac.nz)
- I agree to participate (please go to the next page to start the questionnaire)
- I have decided NOT to participate (please exit the questionnaire by closing this window)

Personality and Eating Behaviours Debriefing Sheet

Thank you for completing the study! This page contains some information about the purpose of this study and what we hope to find.

The main aim of the study is to see whether a person's identity as a healthy eater predicts their eating decisions. Identity refers to the type of person you think you are. Some people see being a healthy eater as a key part of their identity, and we expect people who have this type of identity to choose healthier foods. We also expect people who identify as an unhealthy eater to choose less healthy foods. In this study we measured your identity by asking you whether you saw yourself as a healthy or unhealthy eater and also by measuring how easily you classified yourself as a healthy or unhealthy eater on the response task. The questions about eater identity were a measure of explicit (conscious) identity, something that previous research has linked to eating behaviour. However the response task measured implicit (subconscious) identity, which has not yet been researched. We measured your eating choices by asking you to complete a 7-day food diary and by asking about typical eating behaviour. When we analyse the data, we expect to see that people who said they are healthy eaters and who were faster to classify themselves as a healthy eater also made healthier eating decisions. Similarly, we expect that people who said they were unhealthy eaters and who were faster to classify themselves as an unhealthy eater made less healthy eating decisions.

If you have any questions or concerns about this study, or would like to withdraw your data from the study, please feel free to contact us. This study is being carried out as part of a PhD in Psychology by Jessica Gunby, who can be contacted at jessica.gunby@pg.canterbury.ac.nz. The research is supervised by Associate Professor Roeline Kuijer, who can be contacted at roeline.kuijer@canterbury.ac.nz, and Dr Kumar Yogeeswaran, who can be contacted at kumar.yogeeswaran@canterbury.ac.nz.

Appendix J: Study 3 Food Diaries

Personality and Health Behaviours Study Daily questionnaire

MONDAY
Please complete the questions just before you go to bed.

How did you feel today?

I felt stressed

- Not at all
- A little
- Moderately
- Quite a bit
- Extremely

What did you eat today?[14]

1. Since waking up this morning**,** how many servings of **fruit** have you eaten? Please include all fresh, frozen, canned and stewed fruit. Do not include fruit juice or dried fruit.

1 serving = 1 medium piece or 2 small pieces of fruit or 1/2 cup of stewed fruit. For example, 1 apple + 2 small apricots = 2 servings.

- 0 serves
- <1 serving
- 1 serving
- 2 servings
- 3 servings
- 4 or more servings

2. Since waking up this morning, how many servings of **vegetables** have you eaten? Please include all fresh, frozen and canned vegetables. Do not include vegetable juices or hot chips (French fries).

1 serving = 1/2 cup of cooked vegetables or 1 cup of salad vegetables or 1 medium potato/kumara. for example, 2 medium potatoes + 1/2 cup of peas = 3 servings.

- 0 serves
- <1 serving
- 1 serving
- 2 servings
- 3 servings
- 4 or more servings

[14] Based on Based on Conner et al., 2015; Russell et al., (1999); White et al., 2013

3. Since waking up this morning, how many servings of **wholegrain cereals or bread** have you eaten? (e.g., Weetbix, bran flakes, porridge, wheatmeal bread)

1 serving = 2 weetbix or 1 cup of wholegrain cereal or 1 slice of wholegrain bread

- 0 serves
- <1 serving
- 1 serving
- 2 servings
- 3 servings
- 4 or more servings

4. Since waking up this morning, how many servings of **crisps** (potato chips), **corn snacks or corn chips** have you eaten?

1 servings = 1 small packet (40-45 g), 4 servings = 1 large packet

- 0 serves
- <1 serving
- 1 serving
- 2 servings
- 3 servings
- 4 or more servings

5. Since waking up this morning, how many servings of **hot chips, French fries or wedges** have you eaten?

1 serving = 1 cup or 1 small fast food serving, 2 servings = 2 cups or a large fast food serving

- 0 serves
- <1 serving
- 1 serving
- 2 servings
- 3 servings
- 4 or more servings

6. Since waking up this morning, how many servings of **lollies (candy), sweets, chocolate or other confectionary items** have you eaten?

1 serving = one regular sized chocolate bar (approx. 50g) or the amount that would fit in the palm of your hand

- 0 serves
- <1 serving
- 1 serving
- 2 servings
- 3 servings
- 4 or more servings

7. Since waking up this morning, how many servings of **biscuits, cake, muffins or buns** did you eat today?

1 serving = 1 or 2 biscuits or a small piece of cake or a small muffin

- 0 serves
- <1 serving
- 1 serving
- 2 servings
- 3 servings
- 4 or more servings

That's it for today! Thank you. We'll be in touch again tomorrow.

Appendix K: Study 4 Information and Debrief Sheets

Personality and Eating Behaviours Information Sheet

Thank you for your interest in this study!

I'm Jessica Gunby and I'm a PhD student at the University of Canterbury in New Zealand. I'm looking for participants to complete an anonymous study looking at personality and eating. Participation will involve completing an online personality survey and a categorisation task, and should take around 30-45 minutes.

What will participation involve?

Participation will involve completing questions on the sort of person you are, your likes and dislikes, and your behavior. There will also be a task in which you will be asked to quickly respond to different words.

In order to complete the response task, you will need to open another tab and download a small file onto your computer. This must be done on a computer - a mobile phone cannot be used. If you do not wish to do this, please exit the study now.

Is there a reward for participation?

Each participant will receive US $2.00 following completion of the questionnaire and response task. The questionnaire and task must be completed in full and all participant codes must be entered correctly into the survey and into Mechanical Turk order to receive payment.

Who can participate?

Anyone who is over 18 and fluent in English can complete the study.

If you do not fulfill these criteria, please exit the survey now.

What happens to the information I provide?

The results of the study will be used to write a thesis and may be published in scientific journals or used in conference presentations, but you may be assured of the complete confidentiality of the data gathered in this study. Data will stored in a secure office in the Department of Psychology at the University of Canterbury. Only the researchers and their supervisor will have access to the data. The data will be stored securely for 10 years following the completion of the project and will then be destroyed.

Participation is voluntary and you have the right to withdraw from the study at any point. If you withdraw, we will remove all information you have provided.

Are there any risks involved?

It is not anticipated that participation in this study will pose any risk. The questionnaire has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch, New Zealand (human-ethics@canterbury.ac.nz). Participation is voluntary and all data will be anonymous.

If at any point you do not wish to continue your participation in the study, simply exit the survey and your responses will not be recorded. If you experience any concern about your eating behaviours, please contact your Family Practitioner for advice. Unfortunately we are unable to reimburse you for any related costs. There are also several online healthy eating resources that you may like to use:

- United States Department of Agriculture: https://www.nutrition.gov
- USDA Center for Nutrition Policy and Promotion: https://www.choosemyplate.gov/myplate-tip-sheets
- The American Heart Association: http://www.heart.org/HEARTORG/HealthyLiving/HealthyEating/Healthy-Eating_UCM_001188_SubHomePage.jsp
-

Who are the researchers?

This research is being carried out as part of a PhD in Psychology by Jessica Gunby, who can be contacted at jessica.gunby@pg.canterbury.ac.nz. The research is supervised by Associate Professor Roeline Kuijer, who can be contacted at roeline.kuijer@canterbury.ac.nz, and Dr Kumar Yogeeswaran, who can be contacted at kumar.yogeeswaran@canterbury.ac.nz. They will be pleased to discuss any questions or concerns you might have about participation in the project.

Consent

- o I agree to participate (please go to the next page to start the questionnaire)
- o I have decided NOT to participate (please exit the questionnaire by closing this window)

Personality and Eating Behaviours Debriefing Sheet

Thank you for completing the study! This page contains some information about the purpose of this study and what we hope to find.

The main aim of the study is to see whether a person's identity as a healthy eater predicts their eating decisions. Identity refers to the type of person you see yourself as being. Some people see being a healthy eater as a key part of their identity, and we expect people who have this type of identity to choose healthier foods. We also expect people who identify as an unhealthy eater to choose less healthy foods. In this study we measured your identity by asking you whether you saw yourself as a healthy or unhealthy eater and also by measuring how easily you classified yourself as a healthy or unhealthy eater on the categorization task. We measured your eating choices by asking you to choose a meal from the hypothetical menu and by asking about typical eating behaviour. When we analyse the data, we expect to see that people who said they are healthy eaters and who were faster to classify themselves as a healthy eater also chose healthier meals from the menu. Similarly, we expect that people who said they were unhealthy eaters and who were faster to classify themselves as an unhealthy eater chose less healthy meals from the menu. We also asked questions about your typical level of self-control; we expect that the relationship between identity and eating behaviours will be lower in people with strong self-control.

If you have any questions or concerns about this study please feel free to contact us. This study is being carried out as part of a PhD in Psychology by Jessica Gunby, who can be contacted at jessica.gunby@pg.canterbury.ac.nz. The research is supervised by Associate Professor Roeline Kuijer, who can be contacted at roeline.kuijer@canterbury.ac.nz, and Dr Kumar Yogeeswaran, who can be contacted at kumar.yogeeswaran@canterbury.ac.nz.

Thank you once again for your participation. Please click the arrow to submit your data for analysis, or close this window to exit the study without submitting your data.

Appendix L: Menu Choice Measure (Studies 4 and 5)

Menu Choice

Imagine you are at a restaurant having dinner. You are shown the menu and asked to choose your drink, main course, and dessert. Which of the options below would you choose?

First, what would you like to drink?

- A soft drink or soda

- Water (still or sparkling)

Next, choose the main course that you would like.

- Grilled salmon and a side salad

- Woodfired pizza

- Loaded burger with wedges and slaw

- Roast vegetable salad with feta cheese

Finally, which dessert would you choose?

- Chocolate gateaux with a dark chocolate ganache

- Greek yoghurt with berries and figs

- Key lime pie with whipped cream and berry drizzle

- Lemon-lime sorbet with mint garnish

What factors did you consider when making your meal choice? (please do not leave this question blank).

Appendix M: Study 5 Information and Debrief Sheets for Participant Pool

<u>Personality and Health Behaviour Information Sheet</u>

Thank you for your interest in this study!

I'm Jessica Gunby and I'm a PhD student at the University of Canterbury in New Zealand. I'm looking for participants to complete a confidential study looking at personality and eating. The purpose of this study is to identify factors that predict the sorts of food people eat; this could help with designing future interventions. Participation will involve completing a personality survey and a categorisation task.

What will participation involve?

First, the study will be explained to you and you will have the opportunity to ask any questions you may have before giving consent to participate. Then there will be an online questionnaire that will ask questions about the sort of person you are, your likes and dislikes, and your behaviour. There will also be a task in which you will be asked to quickly respond to different words and images.

Is there a reward for participation?

Each participant will receive 2 credits for PSYC106 following completion of the lab session.

Who can participate?

Anyone who is over 18, fluent in English, and has no food allergies can complete the study. You must be enrolled in PSYC106 in order to receive course credit.

What happens to the information I provide?

The results of the study will be used to write a thesis and may be published in scientific journals or used in conference presentations, but you may be assured of the complete confidentiality of the data gathered in this study. The identity of each participant is confidential to the researcher, and all data will be anonymised prior to publication. Data will stored in a secure office in the Department of Psychology at the University of Canterbury. Only the researcher and their supervisors will have access to the data. The data will be stored securely for 10 years following the completion of the project and will then be destroyed.

Participation is voluntary and you have the right to withdraw from the study at any point. If you withdraw, we will remove all information you have provided.

Are there any risks involved?

It is not anticipated that participation in this study will pose any risk. The questionnaire has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch, New Zealand (human-ethics@canterbury.ac.nz). Participation is voluntary and all data will be anonymous.

If at any point you do not wish to continue your participation in the study, simply exit the survey and your responses will not be recorded. If you experience any concern about your eating behaviours, please contact your GP for advice. The following resources are also available:

- UC Health Centre: 03 369 4444
- Lifeline: 0800 543 354
- Ministry of Health information on healthy lifestyles: https://www.health.govt.nz/your-health/healthy-living/food-activity-and-sleep
-

Who are the researchers?

This research is being carried out as part of a PhD in Psychology by Jessica Gunby, who can be contacted at jessica.gunby@pg.canterbury.ac.nz. The research is supervised by Associate Professor Roeline Kuijer, who can be contacted at roeline.kuijer@canterbury.ac.nz, and Dr Kumar Yogeeswaran, who can be contacted at kumar.yogeeswaran@canterbury.ac.nz. They will be pleased to discuss any questions or concerns you might have about participation in the project.

- ○ I have been given a full explanation of this project and have had the opportunity to ask questions.
- ○ I understand what is required of me if I agree to take part in the research.
- ○ I understand that participation is voluntary and I may withdraw at any time without penalty. Withdrawal of participation will also include the withdrawal of any information I have provided should this remain practically achievable.
- ○ I understand that any information or opinions I provide will be kept confidential to the researchers and that any published or reported results will not identify the participants. I understand that a thesis is a public document and will be available through the UC Library.
- ○ I understand that all data collected for the study will be kept in locked and secure facilities and/or in password protected electronic form and will be destroyed after ten years.
- ○ I understand the risks associated with taking part and how they will be managed.
- ○ I understand that I can contact the researcher (Jessica Gunby; Jessica.gunby@pg.canterbury.ac.nz) or supervisor (Roeline Kuijer; roeline.kuijer@canterbury.ac.nz) for further information. If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch, New Zealand (human-ethics@canterbury.ac.nz)
- ○ I agree to participate (please go to the next page to start the questionnaire)
- ○ I have decided NOT to participate (please exit the questionnaire by closing this window)

<u>Personality and Health Behaviour Debriefing Sheet</u>

Thank you for completing the study! This page contains some information about the purpose of this study and what we hope to find.

The main aim of the study is to see whether a person's identity as a healthy eater predicts their eating decisions. Identity refers to the type of person you think you are. Some people see being a healthy eater as a key part of their identity, and we expect people who have this type of identity to choose healthier foods. We also expect people who identify as an unhealthy eater to choose less healthy foods. In this study we measured your identity by asking you whether you saw yourself as a healthy or unhealthy eater and also by measuring how easily you classified yourself as a healthy or unhealthy eater on the response task. We measured your eating choices by asking you to choose a snack at the end of the study and by asking about typical eating behaviour. When we analyse the data, we expect to see that people who said they are healthy eaters and who were faster to classify themselves as a healthy eater also chose healthier snacks at the end of the study. Similarly, we expect that people who said they were unhealthy eaters and who were faster to classify themselves as an unhealthy eater chose less healthy snacks. We also asked questions about your typical level of self-control; we expect that the relationship between identity and eating behaviours will be lower in people with strong self-control.

If you have any questions or concerns about this study, or would like to withdraw your data from the study, please feel free to contact us. This study is being carried out as part of a PhD in Psychology by Jessica Gunby, who can be contacted at jessica.gunby@pg.canterbury.ac.nz. The research is supervised by Associate Professor Roeline Kuijer, who can be contacted at roeline.kuijer@canterbury.ac.nz, and Dr Kumar Yogeeswaran, who can be contacted at kumar.yogeeswaran@canterbury.ac.nz.

Appendix N: Study 5 Information and Debrief Sheets General Participants

<u>Personality and Health Behaviour Information Sheet</u>

Thank you for your interest in this study!

I'm Jessica Gunby and I'm a PhD student at the University of Canterbury in New Zealand. I'm looking for participants to complete a confidential study looking at personality and eating. The purpose of this study is to identify factors that predict the sorts of food people eat; this could help with designing future interventions. Participation will involve completing a personality survey and a categorisation task.

What will participation involve?

First, the study will be explained to you and you will have the opportunity to ask any questions you may have before giving consent to participate. Then there will be an online questionnaire that will ask questions about the sort of person you are, your likes and dislikes, and your behaviour. There will also be a task in which you will be asked to quickly respond to different words and images.

Is there a reward for participation?

Each participant will receive a $10 supermarket voucher.

Who can participate?

Anyone who is over 18, fluent in English, and has no food allergies can complete the study.

What happens to the information I provide?

The results of the study will be used to write a thesis and may be published in scientific journals or used in conference presentations, but you may be assured of the complete confidentiality of the data gathered in this study. The identity of each participant is confidential to the researcher, and all data will be anonymised prior to publication. Data will stored in a secure office in the Department of Psychology at the University of Canterbury. Only the researcher and their supervisors will have access to the data. The data will be stored securely for 10 years following the completion of the project and will then be destroyed.

Participation is voluntary and you have the right to withdraw from the study at any point. If you withdraw, we will remove all information you have provided.

Are there any risks involved?

It is not anticipated that participation in this study will pose any risk. The questionnaire has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch, New Zealand (human-ethics@canterbury.ac.nz). Participation is voluntary and all data will be anonymous.

If at any point you do not wish to continue your participation in the study, simply exit the survey and your responses will not be recorded. If you experience any concern about your eating behaviours, please contact your GP for advice. The following resources are also available:

- UC Health Centre: 03 369 4444
- Lifeline: 0800 543 354
- Ministry of Health information on healthy lifestyles: https://www.health.govt.nz/your-health/healthy-living/food-activity-and-sleep
-

Who are the researchers?

This research is being carried out as part of a PhD in Psychology by Jessica Gunby, who can be contacted at jessica.gunby@pg.canterbury.ac.nz. The research is supervised by Associate Professor Roeline Kuijer, who can be contacted at roeline.kuijer@canterbury.ac.nz, and Dr Kumar Yogeeswaran, who can be contacted at kumar.yogeeswaran@canterbury.ac.nz. They will be pleased to discuss any questions or concerns you might have about participation in the project.

- ○ I have been given a full explanation of this project and have had the opportunity to ask questions.
- ○ I understand what is required of me if I agree to take part in the research.
- ○ I understand that participation is voluntary and I may withdraw at any time without penalty. Withdrawal of participation will also include the withdrawal of any information I have provided should this remain practically achievable.
- ○ I understand that any information or opinions I provide will be kept confidential to the researchers and that any published or reported results will not identify the participants. I understand that a thesis is a public document and will be available through the UC Library.
- ○ I understand that all data collected for the study will be kept in locked and secure facilities and/or in password protected electronic form and will be destroyed after ten years.
- ○ I understand the risks associated with taking part and how they will be managed.
- ○ I understand that I can contact the researcher (Jessica Gunby; Jessica.gunby@pg.canterbury.ac.nz) or supervisor (Roeline Kuijer; roeline.kuijer@canterbury.ac.nz) for further information. If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch, New Zealand (human-ethics@canterbury.ac.nz)
- ○ I agree to participate (please go to the next page to start the questionnaire)
- ○ I have decided NOT to participate (please exit the questionnaire by closing this window)

Personality and Health Behaviour Debriefing Sheet

Thank you for completing the study! This page contains some information about the purpose of this study and what we hope to find.

The main aim of the study is to see whether a person's identity as a healthy eater predicts their eating decisions. Identity refers to the type of person you think you are. Some people see being a healthy eater as a key part of their identity, and we expect people who have this type of identity to choose healthier foods. We also expect people who identify as an unhealthy eater to choose less healthy foods. In this study we measured your identity by asking you whether you saw yourself as a healthy or unhealthy eater and also by measuring how easily you classified yourself as a healthy or unhealthy eater on the response task. We measured your eating choices by asking you to choose a snack at the end of the study and by asking about typical eating behaviour. When we analyse the data, we expect to see that people who said they are healthy eaters and who were faster to classify themselves as a healthy eater also chose healthier snacks at the end of the study. Similarly, we expect that people who said they were unhealthy eaters and who were faster to classify themselves as an unhealthy eater chose less healthy snacks. We also asked questions about your typical level of self-control; we expect that the relationship between identity and eating behaviours will be lower in people with strong self-control.

If you have any questions or concerns about this study, or would like to withdraw your data from the study, please feel free to contact us. This study is being carried out as part of a PhD in Psychology by Jessica Gunby, who can be contacted at jessica.gunby@pg.canterbury.ac.nz. The research is supervised by Associate Professor Roeline Kuijer, who can be contacted at roeline.kuijer@canterbury.ac.nz, and Dr Kumar Yogeeswaran, who can be contacted at kumar.yogeeswaran@canterbury.ac.nz.

Appendix O: Additional Multi-Level Model Analyses

The multi-level models from Study 3 were repeated to conduct two exploratory analyses. First, Model 5 was re-tested for each outcome variable specifying interactions between implicit identity and time instead of interactions between implicit identity and stress. This did not change the significance of predictors for any outcome variable, and the interactions between time and implicit identity were all non-significant (see Tables 46-48). Secondly, Model 5 was re-tested for each outcome variable specifying random slopes for healthy and unhealthy implicit identity, stress, and the interactions between implicit identity and stress (see Tables 49-51). Covariance structures were specified as autoregressive errors, homogenous, at level 1and level 2.

Interactions between implicit identity and time.

Fruit and vegetable intake.

In this model, time, age, attitudes, healthy and unhealthy habit, and stress were significant predictors of fruit and vegetable intake. Fruit and vegetable consumption was higher earlier in the week and was higher when people were younger, had more positive attitudes to healthy eating, had stronger healthy eating habits and weaker unhealthy eating habits, and were less stressed. The interaction between time and implicit identity was not a significant predictor.

Wholegrain intake.

In this model, gender, attitudes, and healthy habit were significant predictors of wholegrain intake. Males, people with more positive attitudes to healthy eating, and people with stronger healthy eating habits reported eating more serves of wholegrains. The interaction between time and implicit identity was not a significant predictor.

Unhealthy foods intake.

In this model, time and subjective norms were significant predictors. People reported eating more unhealthy foods later in the week and when they had weaker subjective norms for healthy eating. The interaction between time and implicit identity was not a significant predictor.

Random slopes models.

Fruit and vegetable intake.

Time, age, attitudes, healthy habit, and stress were significant predictors. Fruit and vegetable consumption was higher earlier in the week, in younger people, in people with positive attitudes towards healthy eating, in people with healthy eating habits, and in people with less stress. Implicit identity was not a significant predictor, and the interactions between implicit identity and stress were not significant.

Wholegrain intake.

Gender, attitudes, and healthy habit were significant predictors. Males, people with more positive attitudes to healthy eating, and people with stronger healthy eating habits reported eating more serves of wholegrains. Implicit identity was not a significant predictor, and the interactions between implicit identity and stress were not significant.

Unhealthy foods intake.

Time, subjective norms, and healthy implicit identity were significant predictors. Consumption of unhealthy foods was higher later in the week and in those with low subjective norms for healthy eating. Unexpectedly, participants with stronger healthy eating identities reported consuming more serves of unhealthy foods. As this result was not repeated in any other multi-level model, or in any other study in this thesis, this finding may represent a Type 1 error.

Table 46
Exploratory Multi-Level Model Predicting Fruit and Vegetable Intake Including Interactions with Time

-2LL	AIC	Predictors	*b*	*SE*	*p*	95% CI	
						LL	*UL*
1790.39	1824.39	Intercept	3.56	0.11	<.001	3.34	3.79
		Time	-0.06	0.02	.006	-0.10	-0.02
		Age	-0.05	0.02	.004	-0.09	-0.02
		Gender	-0.03	0.12	.789	-0.28	0.21
		BMI	-0.00	0.02	.883	-0.04	0.04
		Attitudes	0.36	0.08	<.001	0.21	0.51
		Norms	0.03	0.05	.607	-0.07	0.12
		Healthy habit	0.41	0.06	<.001	0.29	0.53
		Unhealthy habit	-0.14	0.06	.019	-0.26	-0.02
		Healthy implicit	0.26	0.24	.283	-0.22	0.74
		Unhealthy implicit	0.15	0.20	.460	-0.25	0.55
		Stress	-0.07	0.03	.026	-0.14	-0.01
		Time*healthy implicit	-0.07	0.07	.307	-0.21	0.07
		Time*unhealthy implicit	-0.05	0.06	.379	-0.18	0.07

Note: BMI = body mass index.

Table 47
Exploratory Multi-Level Model Predicting Wholegrain Intake Including Interactions with Time

-2LL	AIC	Predictors	*b*	*SE*	*p*	95% CI	
						LL	*UL*
2276.19	2310.19	Intercept	3.67	0.16	<.001	3.35	3.99
		Time	-0.02	0.03	.498	-0.08	0.04
		Age	-0.04	0.02	.135	-0.09	0.11
		Gender	-0.60	0.18	<.001	-0.95	-0.26
		BMI	0.04	0.03	.119	-0.01	0.10
		Attitudes	0.41	0.11	<.001	0.20	0.62
		Norms	-0.08	0.07	.241	-0.22	0.05
		Healthy habit	0.21	0.09	.017	0.04	0.38
		Unhealthy habit	0.04	0.09	.681	-0.13	0.20
		Healthy implicit	-0.47	0.35	.177	-1.16	0.21
		Unhealthy implicit	0.09	0.29	.765	-0.49	0.67
		Stress	-0.07	0.05	.149	-0.16	0.02
		Time*healthy implicit	-0.02	0.10	.825	-0.21	0.17
		Time*unhealthy implicit	0.01	0.09	.924	-0.16	0.18

Note: BMI = body mass index.

Table 48

Exploratory Multi-Level Model Predicting Unhealthy Foods Intake Including Interactions with Time

-2LL	AIC	Predictors	*b*	*SE*	*p*	95% CI	
						LL	*UL*
932.81	966.81	Intercept	1.56	0.07	<.001	1.42	1.70
		Time	0.03	0.01	.018	0.00	0.05
		Age	-0.01	0.01	.548	-0.03	0.01
		Gender	-0.05	0.07	.508	-0.19	0.10
		BMI	0.00	0.01	.961	-0.02	0.02
		Attitudes	-0.01	0.04	.831	-0.10	0.08
		Norms	-0.06	0.03	.046	-0.11	-0.00
		Healthy habit	-0.04	0.04	.265	-0.11	0.03
		Unhealthy habit	-0.01	0.04	.739	-0.08	0.06
		Healthy implicit	0.21	0.16	.191	-0.10	0.52
		Unhealthy implicit	-0.12	0.13	.376	-0.39	0.15
		Stress	0.01	0.02	.707	-0.03	0.04
		Time*healthy implicit	0.01	0.04	.889	-0.07	0.08
		Time*unhealthy implicit	-0.00	0.03	.951	-0.07	0.07

Note: BMI = body mass index.

Table 49

Exploratory Multi-Level Model Predicting Fruit and Vegetable Intake with Random Slopes

-2LL	AIC	Predictors	*b*	*SE*	*p*	95% CI	
						LL	*UL*
1773.82	1809.82	Intercept	3.59	0.12	<.001	3.35	3.83
		Time	-0.06	0.02	.006	-0.10	-0.02
		Age	-0.05	0.02	.007	-0.09	-0.01
		Gender	-0.06	0.14	.655	-0.33	0.21
		BMI	-0.01	0.02	.755	-0.05	0.04
		Attitudes	0.36	0.08	<.001	0.20	0.52
		Norms	0.02	0.05	.673	-0.08	0.13
		Healthy habit	0.41	0.07	<.001	0.28	0.54
		Unhealthy habit	-0.13	0.07	.055	-0.26	0.00
		Healthy implicit	0.06	0.21	.759	-0.35	0.47
		Unhealthy implicit	0.06	0.17	.734	-0.28	0.39
		Stress	-0.07	0.03	.043	-0.14	-0.00
		Stress*healthy implicit	0.18	0.11	.101	-0.03	0.39
		Stress*unhealthy implicit	-0.09	0.10	.388	-0.30	0.11

Note: BMI = body mass index.

Table 50

Exploratory Multi-Level Model Predicting Wholegrain Intake with Random Slopes

-2LL	AIC	Predictors	*b*	*SE*	*p*	95% CI	
						LL	*UL*
2259.49	2295.49	Intercept	3.70	0.17	<.001	3.36	4.04
		Time	-0.02	0.03	.475	-0.08	0.04
		Age	-0.04	0.03	.146	-0.09	0.01
		Gender	-0.63	0.19	<.001	-1.00	-0.26
		BMI	0.04	0.03	.142	-0.01	0.10
		Attitudes	0.41	0.11	<.001	0.19	0.64
		Norms	-0.07	0.07	.329	-0.22	0.07
		Healthy habit	0.20	0.09	.036	0.01	0.38
		Unhealthy habit	0.04	0.09	.657	-0.14	0.22
		Healthy implicit	-0.51	0.29	.079	-1.09	0.06
		Unhealthy implicit	0.08	0.24	.732	-0.38	0.55
		Stress	-0.06	0.05	.192	-0.16	0.03
		Stress*healthy implicit	-0.00	0.15	.998	-0.30	0.30
		Stress*unhealthy implicit	0.01	0.15	.969	-0.28	0.29

Note: BMI = body mass index.

Table 51

Exploratory Multi-Level Model Predicting Unhealthy Foods Intake with Random Slopes

-2LL	AIC	Predictors	*b*	*SE*	*p*	95% CI	
						LL	*UL*
924.55	960.55	Intercept	1.56	0.07	<.001	1.41	1.70
		Time	0.03	0.01	.008	0.01	0.05
		Age	-0.01	0.01	.481	-0.03	0.13
		Gender	-0.05	0.08	.540	-0.20	0.10
		BMI	-0.00	0.01	.893	-0.03	0.02
		Attitudes	-0.02	0.05	.667	-0.11	0.07
		Norms	-0.06	0.03	.033	-0.12	-0.01
		Healthy habit	-0.04	0.04	.285	-0.11	0.03
		Unhealthy habit	-0.00	0.04	.927	-0.08	0.07
		Healthy implicit	0.23	0.12	.047	0.00	0.46
		Unhealthy implicit	-0.12	0.09	.225	-0.30	0.07
		Stress	0.01	0.02	.664	-0.03	0.04
		Stress*healthy implicit	0.07	0.06	.217	-0.04	0.18
		Stress*unhealthy implicit	-0.06	0.05	.286	-0.16	0.05

Note: BMI = body mass index.

Appendix P: Mini Meta-Analysis Results

A series of mini meta-analyses were conducted for the correlations between each implicit measure (healthy SC-IAT, unhealthy SC-IAT, and IAT) and the outcome measures common across the five studies, following the recommendations of Goh et al (2016). Meta-analyses for the outcomes of past eating behaviour scale, past eating behaviour single item, and PBC were conducted for the three SC-IAT studies and meta-analyses for the outcomes of past eating behaviour scale and single item, PBC, menu choice, fruit/vegetable servings, wholegrain servings, and unhealthy food servings were conducted for the two IAT studies. A fixed effects approach was used in which the mean effect size (i.e. the mean correlation) was weighted by sample size. All correlations were Fisher's *z* transformed for analyses and converted back to Pearson correlations for presentation. Significance levels were determined using the Stouffer's Z test. Results are presented in Table 52. Overall, results largely supported the conclusion that implicit identity is not reliably associated with eating behaviour. Meta-analyses were repeated using a random effects approach (Goh et al, 2016), which also found largely non-significant associations between implicit identity and eating-related outcomes (significance was tested using one-sample *t*-tests against zero). Some results differed depending on whether the fixed or random effects approach was used. It should be emphasised that these mini meta-analyses looked at bivariate correlations rather than the multiple regression output, as meta-analysis with multiple regression requires a larger number of studies (Goh et al, 2016).

Table 52

Mini Meta-Analysis for Studies 1-3 and 4-5

Implicit Measure	Outcome	# studies	Combined *N*	*Mr* Fixed		*Mr* Random	
				r	*p*	*r*	*p*
H implicit identity SC-IAT	Past EB (scale)	3	364	.06	.191	.08	.509
	Past EB (1 item)	3	363	.05	.504	.02	.862
	PBC	3	364	.14	.009	.14	.171
U implicit identity SC-IAT	Past EB (scale)	3	364	-.00	.925	-.01	.968
	Past EB (1item)	3	363	-.11	.029	-.13	.312
	PBC	3	364	-.10	.060	-.08	.300
Implicit identity IAT	Past EB (scale)	2	282	.08	.218	.07	.496
	Past EB (1 item)	2	282	.06	.321	.06	.022
	PBC	2	282	-.03	.553	-.04	.251
	Menu choice	2	282	.02	.827	.01	.756
	FV intake	2	282	.01	.764	.03	.680
	Wholegrain intake	2	282	.04	.352	.07	.596
	Unhealthy intake	2	282	-.04	.463	-.05	.029

Note: H = healthy, U = unhealthy, SC-IAT = single-category implicit association test, IAT = implicit association test, PBC = perceived behavioural control, FV = fruit/vegetable.