

Self-Regulation of Healthy Eating:
The Role of Motivation and Approach-Avoidance Goals

by

Myles A. Maillet

B.A., The University of Western Ontario, 2014

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Supervisory Committee

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Abstract

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Research on healthy eating motivation has shown that people who are autonomously motivated tend to engage in healthier eating behaviours than people with controlled forms of motivation (Ng et al., 2012; Verstuyf et al., 2012). However, healthy eating requires both trying to eat healthy foods (i.e., approach goals) and trying to avoid unhealthy foods (i.e., avoidance goals), and previous research on the association between motivation and approach-avoidance eating goals is mixed (Harrison et al., 2011; Otis & Pelletier, 2008). In the current study, we explored the relationship between motivation and approach-avoidance goals using a 21-day daily diary design. Our findings indicated that approach goals were more difficult than avoidance goals and that higher relative autonomous motivation was associated with greater approach goal success, but not avoidance goal success. We also investigated the relationship between goal specificity, the temporal scope of approach-avoidance goals, and goal success/failure. Our findings are consistent with previous research on motivation and goal difficulty (Aitken et al., 2016; Green-Demers et al., 1997), but our approach-avoidance goal difficulty findings warrant further investigation.

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Introduction

Most people are motivated to eat healthy, but often this motivation fails to translate into action. Accordingly, less than 40% of Canadians are meeting the daily recommended fruit and vegetable consumption, despite understanding the importance of a healthy diet (Statistics Canada, 2017). As a result, over 60% of Canadian adults are overweight or obese according to recent estimates (Statistics Canada, 2015). Research has highlighted the importance of diet in weight maintenance (Rolls, Ello-Martin & Tohill, 2004; Ross et al., 2000) and for the prevention of a multitude of chronic health problems. For example, eating fruits and vegetables is associated with a lower body mass index (BMI; Tohill, Seymour, Serdula, Kettel-Khan, & Rolls, 2004) reduced risks of cardiovascular disease, hypertension, stroke, diabetes, and several forms of cancer (Boeing et al., 2012; Glade, 1999).

Healthy eating has also been associated with psychological benefits. For example, McMartin, Jacka and Colman (2013) found that people who consumed the daily recommended fruit and vegetable servings showed reduced rates of depression compared to those who consumed less. Similarly, White, Horwath and Conner (2013) found support for the old adage, “an apple a day”, showing that fruit and vegetable consumption was positively associated with positive affect on same day, as well as the following day.

Despite the growing body of research highlighting both the physical and psychological benefits of proper nutrition, many people are unable to fulfill their healthy eating intentions (Conner & Armitage, 1998). A recent study demonstrated that eating is more frequently desired than leisure, social contact, alcohol, coffee, or even some physiological drives such as sleep or sex (Hofmann, Vohs & Baumeister, 2012). Highly palatable and unhealthy foods are easily accessible and salient, making it difficult for individuals to make healthy choices. In light of these temptations, staying motivated to eat healthy is increasingly important.

To understand the role of healthy eating motivation, we review research on self-determination theory below. Specifically, differentiating between “wanting to” eat healthy and the perception of “having to”, and the resulting influence on actual eating behaviours. Subsequently, we discuss recent research extending the concepts of approach and avoidance motivation to healthy eating goals, such as “trying to eat healthy foods” versus “trying to avoid unhealthy foods”. More precisely, we discuss the efficacy of these two types of goals for people with different motivations to eat healthy. We then outline the current research objectives, design, and results. Following this, implications for the self-regulation of healthy eating are discussed.

Self-Determination Theory and Relative Autonomous Motivation

Although many people are motivated to eat healthy (Brug, 2008), people have different reasons for doing so. Research on self-determination theory (SDT; Deci & Ryan, 2012) has highlighted the importance of several antecedents and consequences of these different types of motivation. First, SDT proposes that autonomous motivation is facilitated by the satisfaction of basic psychological needs for competence (feeling effective in producing desired outcomes), autonomy (the perception of being the origin of one’s own actions), and relatedness (feeling respected, understood, and cared for by others; Deci & Ryan, 2000). Autonomous forms of motivation lie at one end of a continuum, with controlled forms of motivation at the other end, such that the continuum reflects the relative degree of self-determined functioning (see Figure 1). Autonomous forms of motivation reflect more internalized, self-determined motivation, while controlled forms of motivation reflect more external forms of regulation. Autonomous forms of motivation include intrinsic motivation (the behaviour is inherently enjoyable), integrated regulation (the behaviour is congruent with goals and values), and identified regulation (personal valuation of the behaviour’s outcomes). To behave autonomously means to act with a sense of will and volition, and to fully endorse a behaviour. In contrast, controlled motivation refers to

behaving in accordance with less internalized regulations, such as external pressures and contingencies. Controlled forms of motivation include introjected regulation (internalized pressures of guilt, shame, and self-worth) and external regulation (to assent to external pressures or rewards).

These behaviour regulation subtypes exist within each person at different levels. However, what matters is a person's relative levels of these behaviour regulation subtypes, as this reflects the person's degree of self-determined functioning. These regulation subtypes are often used accordingly by creating weighted composite scores to reflect a person's level of self-determined behaviour (i.e., a self-determination index, or relative autonomy index; Green-Demers, Pelletier, & Menard, 1997; Ryan & Connell, 1989). When computing these composite indices, researchers often place greater emphasis on the more typical regulations reflecting self-determined and non-self-determined functioning (i.e., intrinsic regulation and external regulation).

Individuals with more self-determined, or more autonomous forms of motivation may try to eat healthy because it is enjoyable, consistent with one's sense of self, or for the associated health benefits (e.g., disease prevention, well-being, weight maintenance; Hagger, Chatzisarantis, & Harris, 2006). In contrast, individuals with less self-determined, or more controlled forms of motivation may try to eat healthy to avoid feelings of guilt and shame, or because one's self-esteem is contingent on it, or because of external pressure (e.g., peer pressure, rewards and punishments; Boutelle, Neumark-Sztainer, Story, & Resnick, 2002; Thompson & Stice, 2001). SDT research has highlighted differences in behavioural outcomes and psychological adjustment resulting from autonomous and controlled forms of motivation (Ryan & Deci, 2008).

Autonomous motivation has been shown to be associated with better outcomes in domains such as education (Ryan, Connell & Plant, 1990; Wang, 2008), sport (Pelletier, Fortier, Vallerand &

Briere, 2001), and pro-environmental behaviours (Seguin, Pelletier, & Hunsley, 1999).

Autonomous motivation has also been examined in health contexts, and is associated with positive outcomes for those in psychotherapy (Zuroff et al., 2007), physiotherapy (Williams et al., 2006) and for responsible alcohol consumption (Pavey & Sparks, 2009). Importantly, research indicates that autonomous motivation is associated with greater psychological well-being and need fulfillment than controlled regulation (Sheldon, Ryan, Deci, & Kasser, 2004).

Research on Motivation and Eating Behaviours

The importance of autonomous motivation and need satisfaction has been increasingly applied to eating behaviours in response to widespread poor dietary habits and rising obesity rates (Statistics Canada, 2015, 2017). To address the role of motivation quality on intentions to exercise and eat healthy, Hagger, Chatzisarantis, and Harris (2006) assessed several aspects of behaviour regulation and self-reported diet and exercise among students. Results revealed that autonomous motivation was associated with greater intentions to eat healthy and exercise. As expected, greater intentions at baseline were associated with more self-reported exercise and healthy eating behaviours four weeks later. Whereas controlled forms of motivation were associated with fewer intentions and fewer health behaviours. Consistent with research in other behavioural domains, autonomous motivation to eat healthy was linked to better self-reported diet, mediated by intentions. People who desire to eat healthy may place more emphasis on food planning and healthy eating than those who feel pressured to eat healthy, partially explaining this observed relationship between motivation, intention, and behaviour.

A recent meta-analysis on SDT within health contexts provides insight into motivation, self-regulation and various health behaviours (Ng et al., 2012). Overall, the results were consistent with previous SDT research. Psychological need satisfaction and autonomy support were related to better physical (e.g., increased exercise, weight loss, quitting smoking, taking

medications) and psychological outcomes (e.g., positive affect, well-being). However, introjected regulation, a form of controlled motivation, was also associated with healthier eating patterns, but only in treatment settings. A treatment setting involves a practitioner, frequent monitoring, and pressure to follow a plan. While this controlled regulation seems to produce positive results in these settings, this effect does not hold true outside of treatment settings. Consequently, this finding does not generalize to the majority of the population whom are not involved in treatment settings.

Treatment settings may result in healthy eating short-term, but a problem arises when the individual exits this artificial context. When there are rewards or external contingencies for a behaviour, an individual's perceived locus of causality shifts towards the external, undermining autonomous motivation (Deci, Koestner, & Ryan, 1999; Teixeira, Patrick, & Mata, 2011). Although the given behaviour may be performed in the presence of these contingencies, once removed, motivation to engage in the behaviour diminishes. This effect has been replicated in a number of studies and contexts (Deci et al., 1999), resembling early behavioural extinction experiments (Skinner, 1963). Although controlled motivation may elicit healthy eating in treatment settings, these healthy eating behaviours will often cease upon leaving this setting. A multitude of weight loss interventions provide support for this phenomenon, given the high rates of relapse and weight regain (Clark, 2004).

Some research has examined the relationship between self-determination and healthy eating through the lens of need satisfaction and need thwarting (Verstuyf, Patrick, Vansteenkiste, & Teixeira, 2012). Satisfaction of the basic need for autonomy has been shown to facilitate autonomous motivation, resulting in eating regulation that is based on one's own values and goals (Hagger et al., 2006). In contrast, thwarting of autonomy results in controlled motivation, characterized by compensatory and disordered eating habits, body-image concerns, binge eating

episodes, and/or rigid, restrictive eating patterns (Thompson & Stice, 2001). This disordered eating style is rooted in external pressures and controlled motivation, leading to more regulation failures and subsequently poor eating habits, especially in an obesogenic environment or in the absence of self-control (Hofmann, Adriaanse, Vohs & Baumeister, 2014; Thomas, 2008).

Furthermore, people who are overweight or obese are more likely to endorse these disordered eating regulations based on external pressures and body image concerns, although the direction of this relationship is unclear (Boutelle, et al., 2002; Thompson & Stice, 2001).

Research by Pelletier and colleagues provides further evidence for this relationship between healthy eating regulation and behaviours (Pelletier, Dion, Slovinec-D'Angelo, & Reid, 2004). Results from two studies indicated that autonomous motivation was associated with healthy eating behaviours, whereas controlled motivation which was associated with dysfunctional eating behaviours such as binge eating and rigid restriction. Similar to research by White and colleagues (2013), healthy and dysfunctional eating were associated with increased and decreased psychological well-being, respectively.

Previous research highlights the benefits of autonomous motivation for eating healthy. However, trying to eat healthy may involve different types of goals. People may try to avoid eating unhealthy foods high in fat, sugar, and salt, or they may actively try to eat foods that are nutritious and facilitate healthy functioning. This distinction between approaching and avoiding certain foods lends itself to different healthy eating goals, which may be used in combination or isolation.

Approach and Avoidance Eating Goals

Approach motivation is defined as the energization by, and direction of behaviour toward positive stimuli, whereas avoidance motivation is defined as the energization by, and direction of behaviour away from negative stimuli (Elliot, 2006). The dichotomy of approach-avoidance

motivation is analogous to healthy eating, as healthy eating requires both consuming certain foods and refraining from or limiting the consumption of others. Notably, approach-avoidance motivation is hierarchical, and most relevant for the current research are the *system-* and *strategic-*levels (for a review see Scholer & Higgins, 2008). At the system-level, approach-avoidance motivation refers to the energization of behaviour by positive or negative stimuli, and can be thought of as an individual's tendency towards approach or avoidance. Building on neurobiological work by Gray (1990), the behavioural activation system (BAS) and the behavioural inhibition system (BIS) are neurobiological structures that have been proposed to reflect individual dispositions in approach-avoidance tendencies (Carver & Scheier, 2012). The BAS is sensitive to rewards, operating on dopaminergic pathways and motivating individuals toward goal attainment, whereas the BIS is sensitive to punishment, operating on monoaminergic pathways and motivating individuals away from undesired states (Carver & White, 1994). Harrison, Treasure, and Smillie (2011) demonstrated that BIS sensitivities were higher among participants with eating disorders, and BAS sensitivities were higher among healthy controls. In other words, disordered eaters were more likely to frame eating in an avoidance manner compared to healthy eaters.

At the strategic-level, approach-avoidance motivation refers to the framing of goals, means, strategies, plans, programs, or processes (often used interchangeably throughout the literature) as moving towards desired end-states or away from undesired end-states. Exploring approach-avoidance motivation at the strategic-level, research from Pelletier and colleagues (2004) found that autonomous eating regulation was associated with concern for food quality, and controlled eating regulation with concern for food quantity. As a result, researchers believed that this may lead autonomously motivated eaters to use approach goals in effort to consume high quality foods, and those with controlled motivation to use avoidance goals to refrain from

overeating. Addressing this hypothesis, a cross-sectional study found that controlled motivation was positively associated with dysfunctional eating behaviours, and this relationship was mediated by avoidance food planning (e.g., “I will not eat any sweets at the dinner party tonight”; Otis & Pelletier, 2008). In contrast, autonomous eating regulation was associated with healthy self-reported eating behaviours, mediated by approach food planning (e.g., “I will plan my meals for tomorrow”), but also mediated by avoidance food planning. This suggests that autonomously motivated individuals may effectively implement both approach and avoidance goals.

Although both approach and avoidance goals may be required to maintain a healthy diet, approach goals may be easier to attain. In a healthy eating context, approach goals involve trying to eat healthy foods, and satisfying hunger with these foods may reduce the likelihood of eating unhealthy foods by reducing hunger, cravings, and temptations (Steel, Kemps, & Tiggemann, 2006). Approach goals may also be relatively simple to enact, as they have a specific endpoint, progress to the goal is easily measured, and consequently, actions required to accomplish the goal are straightforward (e.g., eating five servings of vegetables). Given the relative simplicity and ease of engaging in approach behaviours, such goals may be effective regardless of an individual’s motivation for eating healthy.

However, as mentioned above, research indicates that the relationship between avoidance goals and healthy eating is unclear (Harrison et al., 2011; Otis & Pelletier, 2008). While avoiding unhealthy foods is important for maintaining a healthy diet, decades of research on restraint theory (Herman & Mack, 1975) suggests that avoidance goals may not always be effective (Polivy, Coleman, & Herman, 2005). Eating-related reactance may result from avoiding certain foods, increasing desires for and potentially the consumption of these denied foods, making the goal of avoiding such foods difficult (Jansen, Mulkens, & Jansen, 2007; Pham, Mandel, &

Morales, 2016). Additionally, unlike approach goals that specify an endpoint to work towards, avoidance goals only identify a stimuli to distance oneself from (i.e., an “anti-goal”), without specifying a direction for action. For example, trying to avoid sugary foods does not specify what an individual should eat, nor how long these foods should be avoided. Thus, an avoidance goal may be increasingly challenging to maintain as hunger and cravings ensue. With no clear direction, goal progress may be difficult to interpret, and actions required for goal completion may be unclear (Carver & Scheier, 2012). Therefore, avoidance goals may be more difficult than approach goals.

Furthermore, the type of motivation an individual has may impact the amount of effort they are willing to put forth towards goal attainment. For example, research in a pro-environmental context has shown that difficult behaviours (e.g., walking instead of driving, using the compost instead of the trash) are more likely to be enacted by individuals with autonomous motivation than those with controlled motivation (Aitken, Pelletier, & Baxter, 2016; Green-Demers et al., 1997). Extending these results to the current research, the role of motivation is important for healthy eating, but it may be more important for avoidance goals than approach goals.

Current Research

The literature reviewed above suggests that approach goals involve clearly specified endpoints, and that goal progress is clearly defined, whereas avoidance goals involve moving away from an “anti-goal” without specifying a direction for action, and making it difficult to monitor goal progress. Therefore, we predicted that avoidance goals would be more difficult to achieve, indicated by a lower success rate, than approach goals, presuming that success rates are reflective of goal difficulty (Hypothesis 1). Research on motivation and goal difficulty has demonstrated that relative autonomous motivation is a better predictor of achieving more

difficult goals, whereas easy goals are likely to be attained regardless of motivation (Green-Demers et al., 1997). Therefore, we hypothesized that individuals with autonomous motivation would be more effective when avoiding unhealthy foods than individuals with controlled motivation, while an individual's motivation would not influence the success rate of approach goals (Hypothesis 2).

A 21-day online daily diary was used to test these hypotheses, allowing us to examine the role of self-regulation on daily eating behaviours both within and between persons, and to maximize ecological validity (Csikszentmihalyi & Larsen, 1987). At the beginning of the study, we asked participants to complete a measure of autonomous and controlled motivations to eat health, and then instructed them to set both approach and avoidance goals by asking them to report foods that they would try to eat, and foods they would try to avoid during the course of the daily diary. The study was designed to allow participants to report both daily, and long-term approach and avoidance goals, providing some insight into temporal influences on goal adherence. To assess goal success/failure, participants reported daily consumption of the various foods that they each listed as approach and avoidance goals (see Appendix A).

Method

In the lab, participants completed a series of demographic questions and measures of healthy eating motivation and approach-avoidance motivation sensitivities. Next, participants were instructed to list three foods that they will “try to eat some or a lot of” (i.e., approach goals), and three foods they will “try to limit or not eat” (i.e., avoidance goals) over the next three weeks.

During the three week diary phase, participants received an email (and SMS reminder if desired) at 6:00 AM each morning to invite them to complete the diary survey by 1:00 PM.

Participants were also asked to complete the diary survey before having eaten breakfast. They were asked to indicate if they had eaten breakfast prior to completing the survey.

For each diary entry, participants were asked to report their previous day consumption of the initial six foods they listed during the pre-survey, and to select which approach and avoidance eating goals they endorsed for the current day (e.g., a participant may have initially listed “soup” as an approach goal during the pre-survey, but may or may not have the intention to eat soup on a given day). On each day, participants also had the option to add up to three additional foods that they intended to approach, and three additional foods they intended to avoid. If a participant added any additional foods, then they were asked to report on their consumption of those foods the next day (consumption rating corresponding to the day the goal was set), as well as the subsequent day (delayed goal; consumption rating corresponding to the day *after* the goal was set). See Figure 2 for a schematic representation of the daily diary design.

Participants

The sample consisted of 156 undergraduate psychology students at the University of Victoria, recruited through the research participant program during October and November of 2016. The sample included 88% female students, and 93% of participants were under 24 years of age ($M = 20$, $SD = 2.83$). Participants received course credits for participating. One participant did not complete any daily diary surveys, and was therefore not included in any analyses.

Measures

Self-Regulation of Eating Behaviour. The Regulation of Eating Behaviour Scale (REBS; Pelletier et al., 2004) was used to assess eating motivation. The REBS measures motivation with 24 items, asking participants why they regulate their eating behaviours. The REBS assesses the degree of each healthy eating motivation subtype, including: intrinsic motivation (“I take pleasure in fixing healthy meals”), integrated regulation (“Eating healthy is

an integral part of my life”), identified regulation (“I believe it will eventually allow me to feel better”), introjected regulation (“I would feel ashamed of myself if I was not eating healthy”), external motivation (“Other people close to me insist that I do”), and amotivation (“I can’t really see what I’m getting out of it”). Participants are asked to report their agreement on a 7-point scale ranging from (1) “Does not correspond at all” to (7) “Corresponds exactly”. Cronbach’s alphas ranged from .77 to .89 for the six factors. None of the items demonstrated skewness scores exceeding |3|, and only the amotivation subscale items demonstrated kurtosis scores exceeding |3|.

A self-determination index (SDI) was computed for each participant to reflect their relative levels of self-determination for regulating their eating behaviours. The SDI involved weightings for each REBS subscale reflective of the position on the self-determination continuum, and was computed using the following formula: $2(\text{average score of intrinsic motivation items}) + 1(\text{average score of integrated and identified regulation items}) - 1(\text{average score of introjected regulation items}) - 2(\text{average score of extrinsic motivation items})$. Following Ryan and Connell (1989), amotivation was not included in the composite index (as it signifies an absence of intention to act and not necessarily the degree of internalization), and integrated and identified regulation were combined due to conceptual proximity. Correlations between these motivation subscales reflected the simplex structure of the self-determination continuum (see Appendix B). Ryan and Connell (1989) have provided support for the construct validity of this composite index in the education domain. For this sample, SDI scores ranged from -4.38 to 15.75 ($M = 6.54$, $SD = 4.31$), with higher scores reflecting more autonomous motivation.

Approach and Avoidance Sensitivities. Given our focus on approach-avoidance eating goals (strategic-level), we chose to control for participants’ individual approach-avoidance

sensitivities (system-level) in our analyses. Approach-avoidance sensitivities were measured using the Behavioural Inhibition Scale/Behavioural Activation Scale (BIS/BAS; Carver & White, 1994). The BIS/BAS has 20 items, 7 for the BIS subscale and the remaining 13 for the BAS subscale. Participants were asked to rate the extent that they agree with each item on a 4-point scale ranging from (1) “Very true for me” to (4) “Very false for me”. An example of a BIS item is “I worry about making mistakes”, and a BAS example is “When I get something I want, I feel excited and energized”. Cronbach’s alphas were .79 for the BIS subscale and .81 for the BAS subscale. One of the BIS subscale items demonstrated a kurtosis score exceeding +3 (“I feel worried when I think I have done poorly at something important”).

Approach-Avoidance Eating Goals. At the beginning of the study, participants were asked to list three foods that they intended to eat *some* or *a lot* of (i.e., approach goals), and three foods that they intended to *limit* or *avoid* (i.e., avoidance goals) over the course of the daily diary phase. For each diary survey, participants were asked to select which of these food goals they endorsed for the current day (i.e., which foods they intended to eat, or avoid/limit). The average number of these initial foods selected on a given day (i.e., food goals endorsed) was between 3 and 4 ($M = 3.5$, median = 4). In addition, participants could propose up to three other foods to approach (i.e., eat some or a lot) and up to three other foods to avoid (i.e., limit or not eat). The majority of participants (78.2%) listed at least one additional eating goal during the 21-day diary ($M = 6$, range: 0-41).

Eating Goal Success/Failure. For the initial six foods (i.e., three approach and three avoidance goals) listed during the pre-survey and any additional foods (i.e., goals) proposed during the preceding two days, participants were asked “How much of each of the following foods did you eat yesterday?”, and provided their response on an 8-point Likert-type scale where (1) ‘I didn’t eat any’, (2) ‘Ate much less than intended’, (3) ‘Ate less than intended’, (4) ‘Ate

slightly less than intended', (5) 'Ate as much as intended', (6) 'Ate slightly more than intended', (7) 'Ate more than intended', (8) 'Ate much more than intended'. All eating goals were randomized when presented to participants.

In order to create a goal outcome variable (i.e., success/failure), the responses for each approach and avoidance food goal were recoded. For approach goals, scores ranging from (5) 'Ate as much as intended' to (8) 'Ate much more than intended' were coded (1) for Success, while remaining ratings were coded (0) for Failure. For avoidance goals, scores ranging from (1) 'I didn't eat any' to (5) 'Ate as much as intended' were coded (1) for Success, while remaining ratings were coded (0) for Failure.

In addition, three types of goal outcomes were examined, with each type differing in temporal scope (depicted in Figure 2). First, daily goal outcomes involved the success/failure of a goal set at the beginning of the day. The daily goals corresponded to any of the six initial (i.e., pre-survey) food goals that a participant may have selected (i.e., endorsed) for a given day, and any additional goals that a participant added on a given day. Second, delayed goal outcomes involved the success/failure of a goal that was set the previous day. Therefore, delayed goals were daily goal outcomes lagged by one day (i.e., the delayed goal outcome involved consumption of a food on the day after the daily goal was set).¹ Lastly, three-week goal outcomes represent success/failure of the six goals set during the pre-survey, regardless if they were selected on a given day or not.²

¹ One participant did not select any goals during the diary phase, nor did they add any additional goals, and consequently was not included in the analysis of daily or delayed goals.

² Given the design of the daily diary, it was possible (and not uncommon) for a consumption rating to correspond to a daily, delayed, and/or three-week goal. Thus, a comparison of daily, delayed, and three-week goal outcomes was not feasible, as these goals were not mutually exclusive.

Food Goal Coding. Each food goal was coded to generate variables corresponding to goal selection, goal specificity, and goal difficulty. A group of ten trained coders rated half or all the participants' goals, so each goal was rated by six independent coders.

First, food goals were coded for healthiness (i.e., "How healthy is the item?") scored on a 7-point Likert-type scale where (-3) "Very unhealthy", (-2) "Unhealthy", (-1) "Somewhat unhealthy", (0) "Neutral", (+1) "Somewhat healthy", (+2) "Healthy", and (+3) "Very healthy". The food goals were also coded for texture (i.e., "Is the item solid, liquid, or in between?"), to identify where drinks and beverages were reported, despite instructions to list *food* items. Next, each food goal was coded for specificity (i.e., "How specific is the item?") to identify where specific items or broad categories were used. Available responses were: (1) "Specific food content", (2) "Specific food type", (3) "Food type", (4) "Category", (5) "Very broad category" (e.g., an apple would be coded as a "Food type", sugar from apples would be coded as "Specific food content", and vegetables/fruits would be coded as "Very broad category"). Next, each food goal was coded (Yes/No) into several categories (i.e., "In which category does the item belong?"). The available categories were: "Fruits and vegetables", "Meat (red or white)", "Fish and seafood", "Meat alternatives (tofu, nuts, beans)", "Dairy", "Grains", "Junk food", "Drinks and beverages", "Vitamins and nutrients", and "Other". Food goals could be coded into multiple categories. Lastly, coders rated the composition of each food goal (i.e., "What is the composition of the item?") for the following compounds: "Protein", "Sugar", "Fibre", "Other carbohydrates not from sugar or fibre", "Good fat", "Bad fat", "Sodium", "Nutrients", "Caffeine", and "Alcohol". Each value was scored on a 4-point Likert-type scale where responses were (0) "None", (1) "A small amount", (2) "Some", and (3) "A lot".

For healthiness, an average health score for each food goal (across the six coders) was computed. For texture and specificity, each food goal required a consensus across all coders, and

disagreement was resolved through group discussion. For categories, strong majority agreement (5-6 coders) was required for a food goal to be coded into a category or not, and for food goals without strong majority agreement, disagreements were resolved through group discussion. For food composition, coders were allowed ± 1 point of discrepancy from a reference coder, and discrepancies ± 2 points or greater were resolved through group discussion. Following this, average food composition scores were computed. Discrepancies ± 2 points or greater were first resolved before computing average scores to reflect the combination of objectivity and subjectivity in our food composition scale (i.e., food composition is objective, but the scale used was relatively subjective).

The average interrater correlation for healthiness was 0.75, and ranged from 0.57 – 0.85 for food composition after group discussion (ranging from 0.45 – 0.78 before group discussion). This range of average interrater correlations for food composition does not include “Caffeine” and “Alcohol”, which were 0.94 and 0.99 respectively after group discussion (0.84 and 0.99 before group discussion). Prior to group discussion, the average weighted Cohen’s kappa for texture and specificity were 0.75 and 0.41, respectively. Average Cohen’s kappas for food categories ranged from 0.62 to 0.84 following group discussion (ranging from 0.47 – 0.80 prior to group discussion). Therefore, interrater reliability of the food goal coding was deemed acceptable (Landis & Koch, 1977).

Analytical Plan

Hierarchical generalized linear modeling with penalized quasi-likelihood estimation was used for all analyses due to the nested structure of the data (i.e., goals nested within days and days nested within individuals; see Bryk & Raudenbush, 1987). More specifically, logistic hierarchical modeling was used to model goal success/failure. All analyses were conducted with R Statistical software using the “lme4” package (Bates, Maechler, Bolker, & Walker, 2015). All

reported models involve three levels. Level-1 represents the goal-level, and up to 18 goals were possible each day (average number of level-1 units per day was 6.9). Each of the 21-days during the diary phase represents a level-2 unit (day-level). On average, participants completed 18 of the 21 daily diary entries (85.8% response rate). Level-3 represents the person-level, of which 155 were included in analyses, as one participant did not complete any diary entries.

We analyzed daily, delayed, and three-week goals separately. For each type of goal outcome (daily, delayed, and three-week), we started by fitting a null model that included a random intercept for each participant and day, with no predictors. We did this to determine how much of the variance in goal outcomes was at the day-level and the person-level, and to allow for subsequent model comparisons. Next, we fit a model with Goal Type (0 = approach, 1 = avoidance) as a level-1 predictor, healthy eating motivation (SDI) as a level-3 predictor, and the corresponding cross-level interaction (see Appendix C for the statistical model). To facilitate interpretation of odds ratios, SDI was grand mean centered (i.e., the average SDI score was 6.54, which is now zero). When analyzing three-week goals, we also examined the effect of endorsing a goal on a given day (i.e., selecting a goal to signal daily intentions) on the likelihood of goal Success/Failure. We did this by including Goal Select (0 = not selected, 1 = selected) as a level-1 predictor, and an interaction between the Goal Type and Goal Select. For models with significant interactions, simple effects were computed and reported. Models were assessed on the basis of improvement in model fit over simpler nested models (chi-square), and with Wald tests of significance for model coefficients. Given that there is no consensus on reporting effect sizes for generalized hierarchical linear models, we followed recommendations from both Snijders and Bosker (1999) and Tabachnick and Fidell (2013). Therefore, we report the proportion of variance in goal outcomes at each level of the model (intraclass correlation coefficients), model prediction

accuracy, McFadden's ρ^2 (values between .2 and .4 considered excellent fit; McFadden, 1974), and the odds ratio for each predictor.

Results

Daily Goal Success/Failure

To examine daily goal outcomes, we fit a null 3-level model with no predictors. The intercept of the null model indicated that the average daily goal success rate was 70.7%. Of the total variance in daily goal outcomes, 5.1% was at the day-level, and 20.2% was at the person-level. Building on this, a model with Goal Type, SDI, and the associated interaction term provided a significantly better fit than the null model, $\chi^2(3) = 586.6, p < .001$. The average daily goal success rate for approach goals was 59.7%, and a main effect of Goal Type (approach vs. avoidance) indicated that the average success rate for avoidance goals was 81.7%, which was 22% higher than approach goals, $OR = 3.02 [95\% CI = 2.75 - 3.31], p < .001$. SDI was positively associated with goal success, $OR = 1.03 [95\% CI = 1.00 - 1.06], p = .037$. An examination of the Goal Type X SDI interaction showed that participants' relative autonomous motivation moderated the outcome of approach vs. avoidance goals, $OR = 0.98 [95\% CI = 0.96 - 1.00], p = .081$. Whereas participants' relative autonomous motivation was (marginally) significantly related to successful attainment of daily approach goals, $OR = 1.03 [95\% CI = 1.00 - 1.06], p = .058$, no relation between motivation and success was observed for avoidance goals, $OR = 1.01 [95\% CI = 0.97 - 1.05], p = .604$.

Delayed Goal Success/Failure

To examine delayed goal outcomes, we fit a 3-level null model. The intercept of this null model indicated that the average delayed goal success rate was 69.1%. Of the total variance in delayed goal outcomes, 4.1% was at the day-level, and 19% was at the person-level. The model with Goal Type, SDI, and an interaction term provided a significantly better fit than the null

model, $\chi^2(3) = 639.4, p < .001$. The intercept of this larger model indicated that the average delayed goal success rate for approach goals was 56.7%. The average success rate for avoidance goals was 25.3% higher than for approach goals, at 82%, $OR = 3.48 [95\% CI = 3.14 - 3.86], p < .001$. The SDI and Goal Type X SDI terms indicated that participants' relative autonomous motivation was not related to goal success for approach or avoidance delayed goals, $OR = 1.01 [95\% CI = 0.99 - 1.05], p = .297$, and $OR = 1.00 [95\% CI = 0.97 - 1.02], p = .690$, respectively.

Three-Week Goal Success/Failure

Examining three-week goal outcomes, the intercept of the 3-level null model indicated that the average three-week goal success rate was 65.6%. Of the total variance in three-week goal outcomes, 0.2% was at the day-level, and 15.9% was at the person-level. A larger model with Goal Type, SDI, and the associated interaction term provided a significantly better fit than the null model, $\chi^2(3) = 1949.4, p < .001$. The average success rate for three-week avoidance goals was 82.7%, which was significantly higher than for approach goals, at 49%, $OR = 4.99 [95\% CI = 4.61 - 5.40], p < .001$. SDI was positively associated with goal success, $OR = 1.03 [95\% CI = 1.01 - 1.06], p = .007$. Examination of the Goal Type X SDI interaction indicated that participants' relative autonomous motivation moderated the outcome of approach vs. avoidance goals, $OR = 0.96 [95\% CI = 0.94 - 0.98], p < .001$. While participants' relative autonomous motivation was significantly related to attainment of three-week approach goals, $OR = 1.03 [95\% CI = 1.00 - 1.07], p = .043$, motivation was not associated with three-week avoidance goal outcomes, $OR = 1.00 [95\% CI = 0.96 - 1.04], p = .851$.

To examine the effect of endorsing a three-week goal on a given day, Goal Select, and the Goal Select X Goal Type interaction terms were added to the previous three-week goal model. This larger model provided a significantly better fit than the previous model, $\chi^2(2) = 273.5, p < .001$. The intercept of this larger model indicated that the average success rate for

three-week approach goals (not selected) was 38%. Approach Goals that were selected (0 = not selected, 1 = selected) on a given day more likely to be attained than those that were not selected, $OR = 2.34$ [95% $CI = 2.10 - 2.60$], $p < .001$. Examination of the Goal Select X Goal Type interaction indicated that the effect of endorsing a three-week goal on a given day was dependent on whether the goal was approach or avoidance oriented, $OR = 0.43$ [95% $CI = 0.37 - 0.50$], $p < .001$. Selecting an approach increased the likelihood of success, $OR = 2.16$ [95% $CI = 1.93 - 2.42$], $p < .001$, but selected and unselected avoidance goals were equally likely to be achieved, $OR = 1.00$ [95% $CI = 0.87 - 1.15$], $p = .989$. See Table 1 for model parameters (log odds), illustrated in Figure 3. All analyses for daily, delayed, and three-week goals were also conducted while controlling for BIS/BAS scores, and results did not differ.³

Post-Hoc Analyses

To further examine the difference in approach and avoidance goal difficulty, several post-hoc analyses were conducted. Previous research suggests that specific goals are more easily achieved than broad goals (see Sheeran & Webb, 2012). Therefore, we examined the effects of goal specificity on goal success. Approached and avoided foods did not significantly differ in their specificity, $t(566) = -0.532$, $p = .595$ (see Appendix D for characteristics of approached and avoided foods). As above, we examined daily goals, delayed goals, and three-week goals separately. To facilitate interpretation of odds ratios, Goal Specificity was centered on (3) “Food type”, such that this was now zero. Therefore, possible values for Goal Specificity ranged from -2 (“Specific food content”) to +2 (“Very broad category”).⁴

³ The effects of gender and having eaten breakfast prior to completing the survey were also examined, but were nonsignificant.

⁴ Note that higher Goal Specificity values indicate more broad goals.

The Effect of Goal Specificity on Goal Success/Failure

First, we examined the effect of Goal Specificity on approach and avoidance goal success. We did this by fitting a model with Goal Specificity, Goal Type, and the associated interaction term as predictors. Avoidance goals were more likely to be attained than approach goals, consistent across daily goals, $OR = 4.25$ [95% $CI = 3.76 - 4.81$], $p < .001$, for delayed goals, $OR = 5.53$ [95% $CI = 4.84 - 6.33$], $p < .001$, and three-week goals, $OR = 8.71$ [95% $CI = 7.85 - 9.66$], $p < .001$. A significant Goal Specificity indicated that broad goals were more likely to be attained than specific goals, consistent across daily goals, $OR = 1.23$ [95% $CI = 1.12 - 1.35$], $p < .001$, delayed goals, $OR = 1.48$ [95% $CI = 1.34 - 1.63$], $p < .001$, and three-week goals, $OR = 1.66$ [95% $CI = 1.54 - 1.80$], $p < .001$. However, examining the Goal Specificity X Goal Type term indicated that the association between Goal Specificity and Goal Success was moderated by the type of goal (approach vs. avoidance), consistent across daily goals, $OR = 0.58$ [95% $CI = 0.51 - 0.65$], $p < .001$, for delayed goals, $OR = 0.47$ [95% $CI = 0.41 - 0.53$], $p < .001$, and for three-week goals, $OR = 0.41$ [95% $CI = 0.38 - 0.46$], $p < .001$. Broad approach goals were more likely to be attained than specific approach goals for daily goals, $OR = 1.24$ [95% $CI = 1.12 - 1.38$], $p < .001$, delayed goals, $OR = 1.48$ [95% $CI = 1.32 - 1.66$], $p < .001$, and three-week goals, $OR = 1.57$ [95% $CI = 1.43 - 1.71$], $p < .001$. Compared to approach goals categorized as “Specific food type” (e.g., apples, kale) success rates for approach goals categorized as “Category” (e.g., fruit, vegetables) were 10.7%, 17.1%, and 21.5% higher among daily, delayed, and three-week goals, respectively. In contrast, specific avoidance goals were more likely to be achieved than broad avoidance goals for daily goals, $OR = 0.74$ [95% $CI = 0.67 - 0.81$], $p < .001$, delayed goals, $OR = 0.75$ [95% $CI = 0.68 - 0.83$], $p < .001$, and three-week goals, $OR = 0.77$ [95% $CI = 0.71 - 0.83$], $p < .001$. Compared to avoidance goals categorized as “Category” (e.g., sweets, salty snacks), success rates for avoidance goals categorized as

“Specific food type” (e.g., gummy candy, instant noodles) were 7.6%, 7.1%, and 5.9% higher among daily, delayed, and three-week goals, respectively. See Table 2 for model parameters (log odds), illustrated in Figure 4.

Next, we examined the interaction between SDI, Goal Type, and Goal Specificity, to determine whether motivation influenced goal success for approach or avoidance goals of different specificities. We did this by fitting a model with SDI, Goal Type, Goal Specificity, and all possible interaction terms as predictors for daily, delayed, and three-week goals. For daily goals, the inclusion of SDI and the associated interaction terms did not improve model fit, $\chi^2(4) = 5.1, p = .298$. The added terms were nonsignificant (SDI $OR = 1.02$ [95% $CI = 0.99 - 1.05$], $p = .197$, SDI X Goal Specificity $OR = 1.01$ [95% $CI = 0.99 - 1.03$], $p = .306$, SDI X Goal Type $OR = 1.00$ [95% $CI = 0.97 - 1.03$], $p = .947$, SDI X Goal Specificity X Goal Type $OR = 0.99$ [95% $CI = 0.96 - 1.02$], $p = .375$), and the terms included in the simpler model negligibly changed (Goal Specificity $OR = 1.22$ [95% $CI = 1.11 - 1.34$], $p < .001$, Goal Type $OR = 4.24$ [95% $CI = 3.75 - 4.80$], $p < .001$, Goal Type X Goal Specificity $OR = 0.58$ [95% $CI = 0.52 - 0.65$], $p < .001$). Thus, the relation between daily goal outcomes and participants’ relative autonomous motivation was not different for approach or avoidance goals varying in specificity. Notably, when controlling for Goal Specificity, the relation between motivation and Goal Success was no longer significant for daily goals.

Similarly for delayed goals, the inclusion of SDI and the associated interaction terms did not improve model fit, $\chi^2(4) = 2.1, p = .717$, all added terms were nonsignificant (SDI $OR = 1.01$ [95% $CI = 0.98 - 1.04$], $p = .531$, SDI X Goal Type $OR = 1.01$ [95% $CI = 0.98 - 1.03$], $p = .681$, SDI X Goal Specificity $OR = 1.00$ [95% $CI = 0.98 - 1.03$], $p = .770$, SDI X Goal Type X Goal Specificity $OR = 1.00$ [95% $CI = 0.97 - 1.03$], $p = .903$), and the terms included in the simpler model negligibly changed (Goal Type $OR = 5.25$ [95% $CI = 4.62 - 5.97$], $p < .001$, Goal

Specificity $OR = 1.45$ [95% $CI = 1.32 - 1.60$], $p < .001$, Goal Type X Goal Specificity $OR = 0.48$ [95% $CI = 0.42 - 0.54$], $p < .001$). Therefore, the relation between delayed goal outcomes and participants' relative autonomous motivation was not different for approach or avoidance goals varying in specificity.

However, for three-week goals, the model including SDI and all associated interaction terms demonstrated significantly better fit than the model with only Goal Type, Goal Specificity, and the associated interaction term, $\chi^2(4) = 273.5$, $p = .005$. All fixed effects for this model were significant (Goal Type $OR = 8.16$ [95% $CI = 7.39 - 9.02$], $p < .001$, Goal Specificity $OR = 1.65$ [95% $CI = 1.53 - 1.78$], $p < .001$, SDI $OR = 1.05$ [95% $CI = 1.02 - 1.08$], $p < .001$, Goal Type X Goal Specificity $OR = 0.42$ [95% $CI = 0.39 - 0.47$], $p < .001$, SDI X Goal Type $OR = 0.96$ [95% $CI = 0.93 - 0.98$], $p < .001$, SDI X Goal Specificity $OR = 0.97$ [95% $CI = 0.95 - 0.99$], $p < .001$, SDI X Goal Type X Goal Specificity $OR = 1.03$ [95% $CI = 1.00 - 1.05$], $p = .017$. Specific avoidance goals were more likely to be attained than broad avoidance goals, $OR = 0.78$ [95% $CI = 0.72 - 0.84$], $p < .001$, and motivation was not related to avoidance goal success, $OR = 1.01$ [95% $CI = 0.97 - 1.05$], $p = .670$. Examination of the Goal Specificity X SDI interaction term for three-week avoidance goals indicated that the relationship between motivation and avoidance goal success was not different for goals of different specificities, $OR = 1.00$ [95% $CI = 0.98 - 1.01$], $p = .505$. In contrast, specific approach goals were more likely to be met than broad approach goals, $OR = 1.60$ [95% $CI = 1.46 - 1.75$], $p < .001$, and participants' relative autonomous motivation was positively related to three-week goal success, $OR = 1.06$ [95% $CI = 1.03 - 1.10$], $p < .001$. Examination of the Goal Specificity X SDI interaction for three-week avoidance goals indicated that participants' relative autonomous motivation increased the likelihood of achieving specific approach goals more than broad approach goals, $OR = 0.96$ [95% $CI = 0.94 - 0.98$], $p < .001$. See Table 3 for model parameters (log odds).

Discussion

The objective of the study was to examine the role of autonomous motivation on the success rates of approach and avoidance healthy eating goals. On the basis that approach goals are more directed and progress more easily evaluated than avoidance goals, we predicted that goals framed as avoiding foods would be more difficult (i.e., lower success rate) than goals framed as approaching foods (Hypothesis 1). Previous research has shown that relative autonomous motivation is positively related to engaging in more difficult behaviours (Aitken et al., 2016; Green-Demers et al., 1997), and accordingly, we predicted that individuals with higher relative autonomous motivation would demonstrate greater goal success for these more difficult avoidance goals, (Hypothesis 2). Contrary to our prediction that avoidance goals would be more difficult than approach goals (Hypothesis 1), results indicated that the success rate for approach goals was lower than for avoidance goals. However, participants' relative autonomous motivation was positively associated with success for these more difficult approach goals, consistent with our prediction (Hypothesis 2).

We also examined whether endorsing a three-week goal on a given day was related to the likelihood of it being attained. Our findings showed that day-level endorsement of approach goals was associated with increased goal success, but there was no effect for avoidance goals. Finally, we investigated the role of goal specificity on goal success by analyzing success rates for specific and broad approach and avoidance eating goals, on the basis that specific goals are more easily achieved than broad goals (Sheeran & Webb, 2012). While specific avoidance goals (e.g., chocolate cake) were easier than broad avoidance goals (e.g., junk food), the reverse was true for approach goals, where broad approach goals (e.g., vegetables) were easier than specific approach goals (e.g., kale).

We discuss our main findings in relation to previous research on the nature of approach and avoidance goals, and the role of autonomous motivation for healthy eating. Then, we discuss the temporal scope of healthy eating goals, and how our goal specificity findings relate to previous research. Theoretical and methodological limitations are discussed throughout, followed by directions for future research on healthy eating self-regulation.

Approach and Avoidance Goal Difficulty

Given that approach goals are more directed, and progress is more easily evaluated than in avoidance goals (Carver & Scheier, 2012), we predicted that approach goals would be easier to achieve than avoidance goals (Hypothesis 1). In contrast to our prediction, approach goals were more difficult than avoidance goals. When avoiding or limiting certain foods, participants reported being successful about 80% of the time, while success rates for approaching certain foods were around 55%. Although previous studies have addressed the association between approach-avoidance strategies and eating habits (Harrison et al., 2011; Otis & Pelletier, 2008), no research (to our knowledge) has directly compared the difficulty associated with achieving healthy eating approach and avoidance goals.

Our findings can be understood by focusing on opportunities that students may have had to achieve their healthy eating goals. Trying to eat healthy foods requires encountering them in a given day, which may require several steps if they are not readily accessible (e.g., going to the grocery store, purchasing ingredients, constructing healthy meals, etc.). Conversely, trying to avoid or limit the consumption of unhealthy foods only requires an individual to refrain from eating them for a given day. Thus, in our study, approach goals may have had lower success rates than avoidance goals because of the differential accessibility that students had to healthy and unhealthy foods. Notably, these results may not be generalizable to people in a markedly different food environment (e.g., athletes in training, dieters).

Although we relied on participant's consumption of various foods within a given day to measure goal success/failure, the approach and avoidance eating goals that people set more naturally may operate on different timeframes. For example, the eating goals that people set for themselves may have longer timeframes (e.g., "try to eat more vegetables this week") and/or shorter timeframes (e.g., "try not to eat ice cream after dinner tonight"). Likewise, control theory (Carver & Scheier, 2012) does not necessarily state that approach and avoidance goals operate on the same timeframe, regardless if they exist at the same level of the goal hierarchy. Arguably, avoidance goals may operate on longer timeframes than approach goals, as avoidance goals lack directionality and may be more open-ended than approach goals. Therefore, our unexpected findings on approach and avoidance goal difficulty may have resulted from operationalizing eating goal success/failure within a given day, as opposed to providing a more flexible diary structure for participants to propose their own goal timeframes.⁵

Similarly, the design of our study did not allow us to measure *perceived* goal success. Given that goals are mental representations of desired (or undesired) outcomes (Sheeran & Webb, 2012), the perception of success/failure is inherent. Under our operationalization of goal success, if an individual is successful in avoiding a certain food on six of seven days in a week, they would need to achieve an approach goal on six days to achieve equal success rates. However, an individual's perception of their own goal success may be felt differently for these approach and avoidance goals, despite attaining equal success rates. Thus, our operationalization of goal success/failure within a given day may not correspond to an individual's perception of their goal progress and outcomes.

⁵ However, this type of participant-driven diary design would be logistically challenging, and potentially unfeasible.

Further, the avoidance goals in the current study were inherently nested in concrete approach goals, such that each avoidance goal occurred within a day, or over the course of three weeks. The theoretical basis for differentiating approach and avoidance goals in terms of difficulty (Carver & Scheier, 2001) focuses on how these goals operate separately⁶. In other words, when comparing the relative difficulty of attaining approach and avoidance goals, it is assumed that each are operating in isolation. However, an avoidance goal nested within an approach would arguably be easier than a non-nested avoidance goal, because goal progress is more easily evaluated in a nested goal. For example, the goal of “avoiding sugar” does not specify what an individual should eat, nor how long sugar should be avoided for, but the nested goal of “avoiding sugar for today” is more easily evaluated in terms of goal progress. Thus, the avoidance goals in the current study may have been easier to achieve than avoidance goals that are set more naturally by individuals seeking to eat healthy, as individuals may have perceived these avoidance goals as nested within approach goals resulting from the structure of the diary.

Furthermore, we asked participants to report on foods they would try to eat *some* or *a lot* of, and foods they would try to *limit* or *not eat*. For avoidance goals, research on restraint theory (Herman & Mack, 1975) has focused largely on the role of restrictive eating behaviours, comparable to abstinence, whereas minimal research has focused on the use of moderation goals. Presumably, abstinence and moderation goals differ in terms of endorsement, strategies, goal persistence, and goal difficulty. For example, trying not to eat any meat may require very different tactics than trying to eat less meat, and these goals may not be equally challenging.

⁶ Carver and Scheier (2001) note that non-nested avoidance goals may not truly exist. They posit that self-regulatory processes involved in trying to avoid an undesired stimuli may naturally be pulled towards approaching desired stimuli that facilitate attainment of the initial avoidance goal. Of importance for control theory is whether or not the avoidance goal is *perceived* to be nested. Technically, even the avoidance goal of “not eating junk food” in effort to “be healthy” constitutes an avoidance goal nested within an approach goal.

Although some people may prefer the flexibility of a moderation goal, abstinence goals are more concrete. Setting the goal to not eat meat is more clearly defined than setting the goal to reduce meat consumption. Therefore, abstinence goals may be easier to enact than moderation goals which may be less clearly defined, as previous research has demonstrated that concrete goals are easier to achieve than more abstract goals (Carver & Scheier, 2012). Similarly, it may be more difficult to achieve a relatively intensive approach goal to eat a lot of carrots, than a more modest goal of eating some carrots.

By not measuring the degree of approach and avoidance goals set by participants, we have no information on whether there were differences in the degrees of goals set by participants. Given the North American focus on diets and weight maintenance, it is possible that the avoidance goals selected by participants were most often abstinence goals, whereas the approach goals varied in degree. It may be easier for people to pursue a definitive abstinence goal (e.g., “avoid all sugar”) than a less clear approach goal (e.g., “eat more protein”). More specifically, aiming to eat *some* or *a lot* of a food could imply a range of intended servings (i.e., any amount greater than zero servings), while an abstinence goal clearly defines the intention to consume zero servings. Similarly, the wording of the instructions in our study may have led participants to set more vague approach goals (i.e., “foods you will try to eat *some* or *a lot* of), and more concrete avoidance goals (i.e., “foods you will try to *limit* or *avoid*”). If there were strong differences in the degrees of approach and avoidance goals set by participants in the current study, we had no way of controlling for this given the current design.

A major strength of our daily diary design was that it allowed participants to enter their own personal approach and avoidance goals. Our idiosyncratic diary design sets this research apart from the majority of studies that require participants to focus on predetermined foods such as vegetables and junk food (Adriaanse, de Ridder, & de Wit, 2009; White et al., 2013), and

previous research investigating eating behaviours using cross-sectional designs (Harrison et al., 2011; Otis & Pelletier, 2008; Pelletier et al., 2004).

The Role of Autonomous Motivation on Goal Success

Based on previous research (Aitken et al., 2016; Green-Demers et al., 1997), we expected that people with higher relative autonomous motivation would more effectively achieve avoidance goals, but that approach goal success would not be associated with a person's motivation (Hypothesis 2). Results indicated that motivation had no influence on avoidance goal success, but higher relative autonomous motivation was positively associated with approach goal success. Compared to participants with relative autonomous motivation scores one standard deviation below the mean, participants with scores one standard deviation above the mean were about 30% more likely to be successful at meeting their approach goals. Although these results were opposite our initial prediction, they align with previous research suggesting that autonomous motivation is associated with an increased willingness to engage in more difficult behaviours (Aitken et al., 2016; Green-Demers et al., 1997).

Notably, the benefits of autonomous motivation were only demonstrated for daily and three-week goals, and not delayed goals. Delayed goals were comprised of consumption ratings on a given day, for a food that was intended to be approached or avoided on the previous day. Therefore, delayed goals did not involve clearly stated goal intentions, implying that these goals were less salient. Hence, being autonomously motivated to eat healthy may increase the likelihood of engaging in more difficult eating goals, but only for more salient goals. Nonetheless, our findings are consistent with SDT research suggesting that eating regulation is most effective and associated with healthiest outcomes when it is self-determined and based on one's own values (Ng et al., 2012; Verstuyf et al., 2012).

The Temporal Scope of Goals

The design of our diary study allowed individuals to indicate which of the initial six eating goals they set they endorsed on a given day (i.e., selecting a goal). For example, a participant may have initially listed “carrots” as an approach goal, and may or may not endorse this approach goal on a given day. This allowed us to examine how daily intentions were related to success of three-week goals. Although we did not specify a hypothesis, results showed that endorsing an approach goal on a given day was associated with greater goal success. Success rates for selected approach goals were about 20% higher than for approach goals that were not selected. This is consistent with previous research on goal salience demonstrating that more immediate, salient goals are more likely to be achieved (Shah, Friedman, & Kruglanski, 2002). In the current study, selecting a goal presumably increased goal salience, subsequently increasing the likelihood of goal success. However, selecting an avoidance goal did not influence the likelihood of success. This may have been due to the relative ease of avoidance goals, such that the effect of increased goal salience was negligible.

Goal Specificity and Goal Success

Lastly, using the goal specificity variable generated from the food item coding, we investigated how setting approach and avoidance goals that were more specific, or more broad, influenced the likelihood of achieving these goals. Previous research suggests that specific goals are easier to achieve than broad goals (Sheeran & Webb, 2012), but to our knowledge, this research has not been extended to approach and avoidance goals. Our findings indicated that the likelihood of achieving specific or broad goals depended on whether they were framed as approaching or avoiding certain foods or food categories. For daily, delayed, and three-week goals, specific avoidance goals were more successful than broad avoidance goals. Hence, trying to avoid something specific (i.e., chocolate cake) is relatively easy, but trying to avoid something

broad (i.e., junk food) is more difficult. This may be because broad avoidance goals are more restrictive and involve more ways to fail, whereas specific avoidance goals allow people to satisfy their cravings with other foods of similar taste or composition (e.g., a craving for cake may be satisfied by a cookie).

In contrast, specific approach goals were less successful than broad approach goals, and this was consistent across daily, delayed, and three-week goals. Therefore, trying to approach something specific (i.e., lettuce) is relatively difficult, whereas trying to approach something broad (i.e., vegetables) is relatively easy. This may be because there are more ways to achieve goal success for broad approach goals. The likelihood of encountering foods associated with specific approach goals is presumably lower than for broad approach goals, making specific approach goals difficult in comparison. Notably, specific three-week approach goals were the most difficult (lowest success rates), and findings indicated that autonomously motivated individuals had increased success rates for these challenging goals. This finding further supports the notion that autonomous motivation results in an increased willingness to engage in more difficult behaviours (Aitken et al., 2016; Green-Demers et al., 1997). In sum, individuals seeking to maximize their healthy eating goal success should choose broad approach goals and specific avoidance goals.

Although at first these findings appear to contradict previous goal specificity research (Locke & Latham, 1990; Sheeran & Webb, 2012), a closer examination of study design highlights an important distinction. Previous studies on goal specificity have focused on approach goals, and often involved participants setting performance goals that were specific (e.g., “set a difficult but attainable goal for yourself”) or broad (e.g., “do your best”), and subsequently measuring the influence of these goals on a single outcome (e.g., work output). However, in the current study, broad healthy eating approach goals (e.g., “to eat more fruits and

vegetables”) had more means for goal success than specific approach goals (e.g., “to eat more kale”). Our findings are consistent with previous research on equifinality, where goals with more means to achieve them are more highly committed to, and more likely to be attained (Kruglanski, Pierro, & Sheveland, 2011).

Measurement Reactivity

Notably, the design of our study can be thought of as a form of intervention, by having individuals set their own eating goals. Prior to participating in our study, many of the participants may not have held all of the goals they listed, and thus the study itself may be seen as a healthy eating intervention. Similarly, following the completion of the study, many participants reported that they viewed it as a “three-week healthy eating challenge”. Participants were told clearly that all data are analyzed anonymously, and all credits earned in the study were not reflective of their eating habits. Despite these guidelines, many participants reported holding themselves more accountable, some perceived this three-week phase as a challenge, and others reported an increase in self-awareness with regards to their eating. Although these factors are not surprising given the design of the study, this limits the generalizability of the findings, such that the approach and avoidance goal success rates may not be reflective of more naturalistic eating goal regulation. On a positive note, engaging in a very short, non-intensive diary entry each morning appeared to increase eating self-awareness, which is promising for more effective healthy eating intervention studies and the development of self-regulation applications and software.

Implications for Healthy Eating

Although not a limitation of this study, it is important to note that the primary focus of this research is self-regulation, and not health outcomes. We can reasonably conclude that individual differences in healthy eating self-determination can influence the likelihood of approach goal intentions being translating into action. However, participants presumably ate (and

did not eat) many other foods during the course of this study, which does not allow us to make any inferences about dietary quality. Likewise, an individual who was more successful at achieving their healthy eating goals did not necessarily maintain a healthier diet than a less successful individual. We did not measure objective dietary consumption because the focus of this research was on self-regulation. Therefore, although highly subjective, our idiosyncratic design allowing participants to set their own healthy eating goals was a strength of this study, and not a weakness.

Future Research

There are several areas of interest for future research on the self-regulation of healthy eating. Future research could investigate the temporal scope of approach-avoidance eating goals that individuals set for themselves, and how perceptions of goal success/failure may vary between these types of goals. Researchers should also investigate how the degree of approach (i.e., mild to rigorous) and avoidance goals (i.e., moderation to abstinence) may influence the likelihood of goal success. At the person-level, researchers may consider exploring whether individuals who are autonomously motivated to eat healthy set different types of goals than individuals with controlled motivation (e.g., more strict goals, goals involving more planning), which may partially explain why they are more successful at achieving more difficult goals. For example, recent research has shown that individuals high in self-control tend to approach foods they prefer and avoid foods they like less, compared to individuals low in self-control (David & Haws, 2016). Therefore, researchers may wish to build on the current study to examine whether individuals high in autonomous motivation set goals involving foods that are more or less desirable to them than individuals high in controlled motivation.

Conclusion

Overall, results are consistent with prior SDT research indicating that people who are autonomously motivated will demonstrate greater willingness to engage in more difficult behaviours (Aitken et al., 2016; Green-Demers et al., 1997). The current study contributes to the self-regulation literature by extending these findings to healthy eating goals. To our knowledge, this is the first study to directly examine the difficulty of approach and avoidance healthy eating goals, as well as the additional role of goal specificity. Further research is required to understand how and why approach goals may be more difficult than avoidance goals, and to explore how other individual differences (e.g., self-control, mindfulness) may influence the self-regulation of healthy eating.

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Table 1

Modeling Eating Goal Outcomes as a function of Goal Type, SDI, and Goal Selecting

	Daily Goals	Delayed Goals	Three-Week Goals	
Intercept	0.39 [0.06] ***	0.27 [0.06] ***	-0.04 [0.05]	-0.49 [0.06] ***
Goal Type	1.10 [0.05] ***	1.25 [0.05] ***	1.61 [0.04] ***	2.07 [0.06] ***
SDI	0.03 [0.01] *	0.01 [0.01]	0.03 [0.01] **	0.03 [0.01] *
SDI x Goal Type	-0.02 [0.01] †	-0.01 [0.01]	-0.04 [0.01] ***	-0.04 [0.01] ***
Goal Select				0.85 [0.05] ***
Goal Select x Goal Type				-0.85 [0.08] ***
χ^2 against null	586.6 (3) ***	639.4 (3) ***	1949.4 (3) ***	2222.9 (5) ***
Prediction Accuracy	73.1 %	73.6 %	73.4 %	74.0 %
McFadden's ρ^2	.047	.058	.097	.111
Level-3 N (individuals)	154	154	155	
Level-2 N (days)	2348	2120	2769	
Level-1 N (goals)	10543	8950	15754	

Note. Goal Type (0 = approach, 1 = avoidance), SDI = Self-Determination Index (grand mean centered), Goal Select (0 = not selected, 1 = selected) *** $p < .001$, ** $p < .01$, * $p < .05$, † $p < .10$.

Table 2

Modeling Eating Goal Outcomes as a function of Goal Specificity and Goal Type

	Daily Goals	Delayed Goals	Three-Week Goals
Intercept	0.26 [0.06] *	0.03 [0.07]	-0.36 [0.15] ***
Goal Type	1.45 [0.06] ***	1.71 [0.07] ***	2.16 [0.05] ***
Goal Specificity	0.20 [0.05] ***	0.39 [0.05] ***	0.51 [0.04] ***
Goal Type X Goal Specificity	-0.55 [0.06] ***	-0.76 [0.06] ***	-0.88 [0.05] ***
χ^2 against null	783.8 (172) ***	872.3 (71) ***	2429 (125) ***
Prediction Accuracy	73.7 %	73.9 %	74.5 %
McFadden's ρ^2	.063	.080	.123
Level-3 N (individuals)	154	154	155
Level-2 N (days)	2342	2115	2769
Level-1 N (goals)	10374	8882	15632

Note. Goal Type (0 = approach, 1 = avoidance), Goal Specificity (-2 = specific food content, +2 = broad category), *** $p < .001$, ** $p < .01$, * $p < .05$.

Table 3

Modeling Eating Goal Outcomes as a function of Goal Specificity, Goal Type, and SDI

	Daily Goals	Delayed Goals	Three-Week Goals
Intercept	0.27 [0.06] ***	0.03 [0.07]	-0.35 [0.06] ***
Goal Type	1.45 [0.11] ***	1.66 [0.06] ***	2.10 [0.05] ***
Goal Specificity	0.20 [0.05] ***	0.37 [0.05] ***	0.50 [0.04] ***
Goal Type X Goal Specificity	-0.54 [0.06] ***	-0.74 [0.06] ***	-0.86 [0.05] ***
SDI	0.02 [0.02]	0.01 [0.02]	0.05 [0.01] ***
Goal Type X SDI	0.00 [0.01]	0.01 [0.02]	-0.05 [0.01] ***
Goal Specificity X SDI	0.01 [0.01]	0.00 [0.01]	-0.03 [0.01] ***
Goal Type X Goal Specificity X SDI	-0.01 [0.01]	0.00 [0.02]	0.03 [0.01] *
χ^2 against null	788.9 (176) ***	874.4 (75) ***	2454 (129) ***
χ^2 against model w/o SDI	5.1 (4)	2.1 (4)	25 (4) ***
Prediction Accuracy	73.7 %	73.9 %	74.5 %
McFadden's ρ^2	.063	.080	.123
Level-3 N (individuals)	154	154	155
Level-2 N (days)	2342	2120	2769
Level-1 N (goals)	10374	8882	15632

Note. Goal Type (0 = approach, 1 = avoidance), Goal Specificity (-2 = specific food content, +2 = broad category), SDI = Self-Determination Index (grand mean centered), *** $p < .001$, ** $p < .01$, * $p < .05$

Figure 1
The Self-Determination Continuum Showing Types of Motivation With Their Regulatory Styles, Loci of Causality, and Corresponding Processes

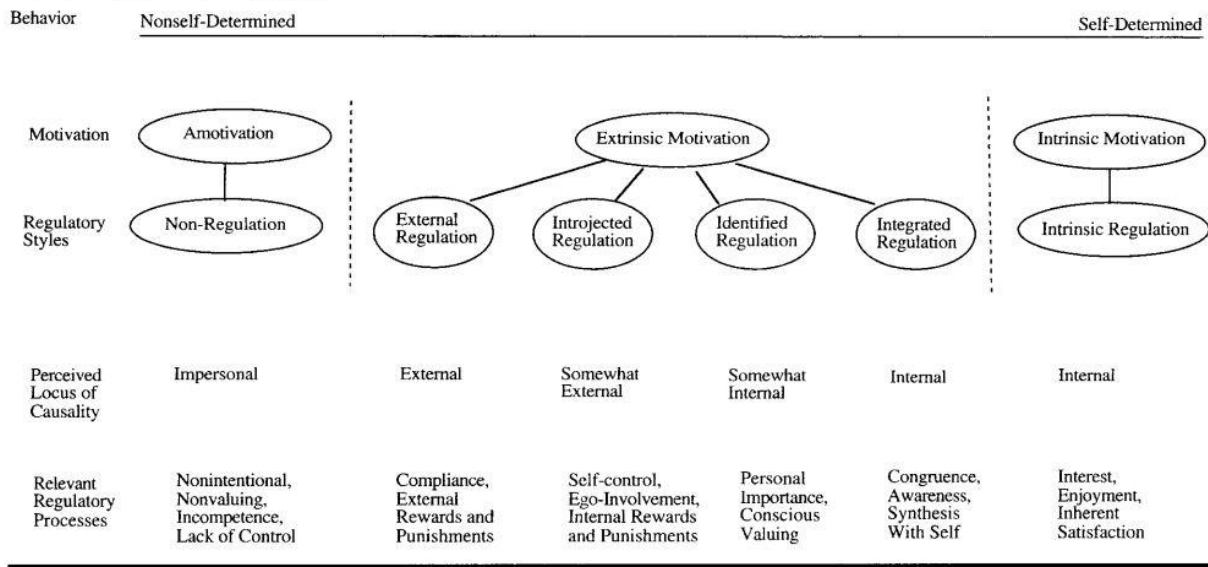


Figure 1. The self-determination continuum. From Ryan & Deci (2000).

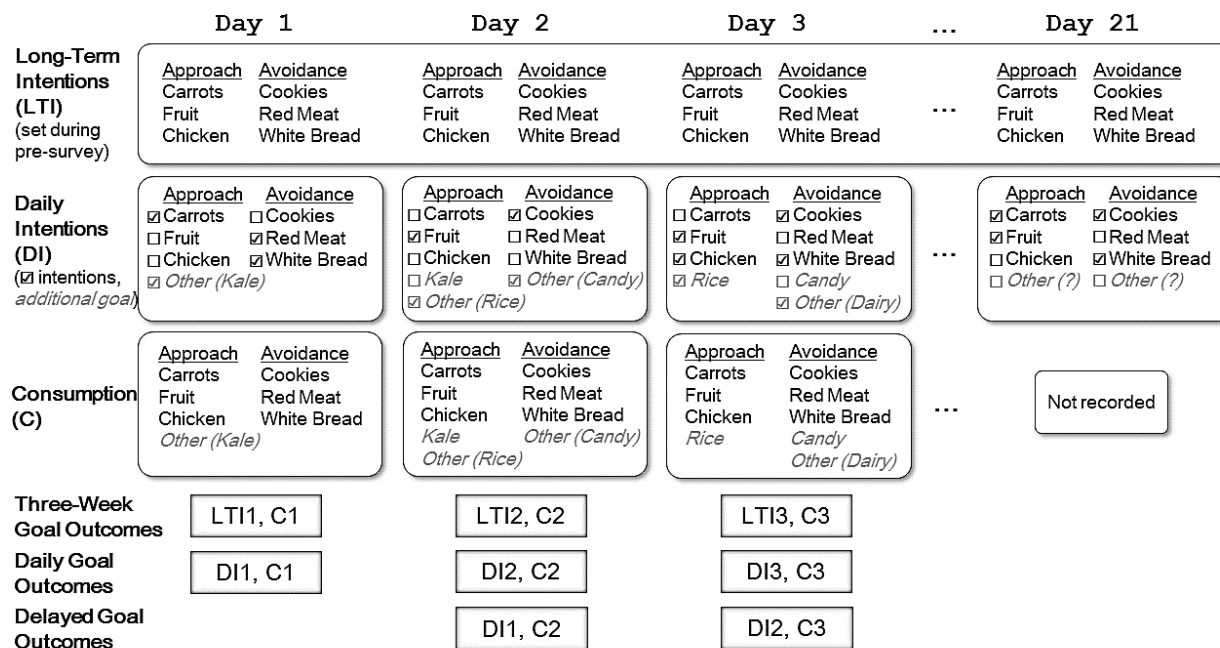


Figure 2. Schematic representation of the daily diary design outlining daily, delayed, and three-week goal outcomes.

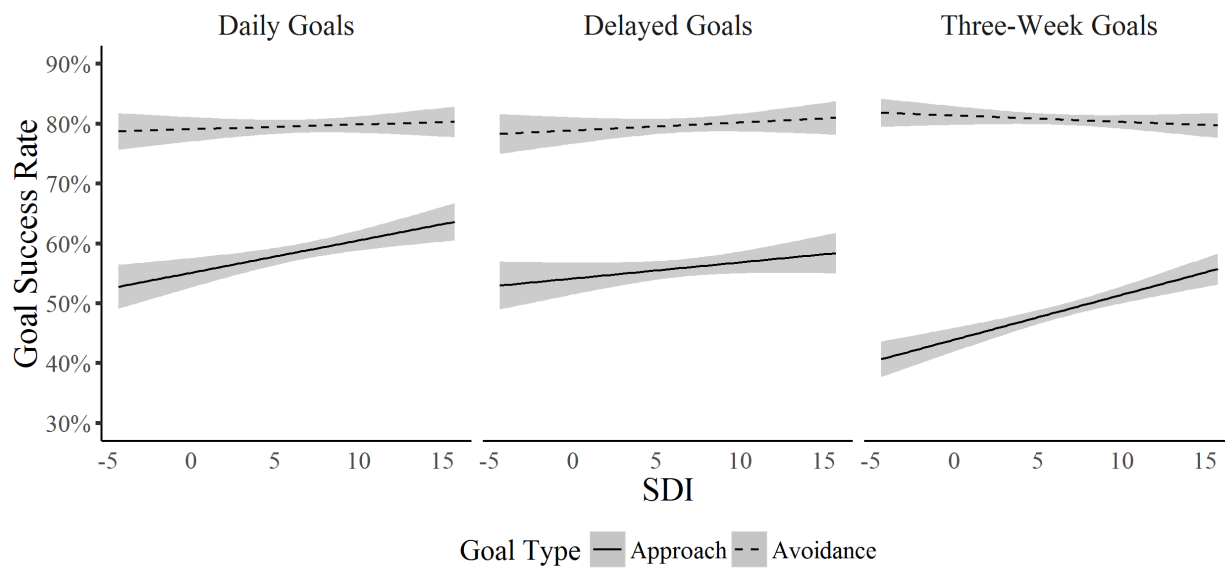


Figure 3. Average success rates of approach and avoidance goals by SDI. Grey strips represent standard errors. Simple effects of SDI for daily and three-week approach goals were significant.

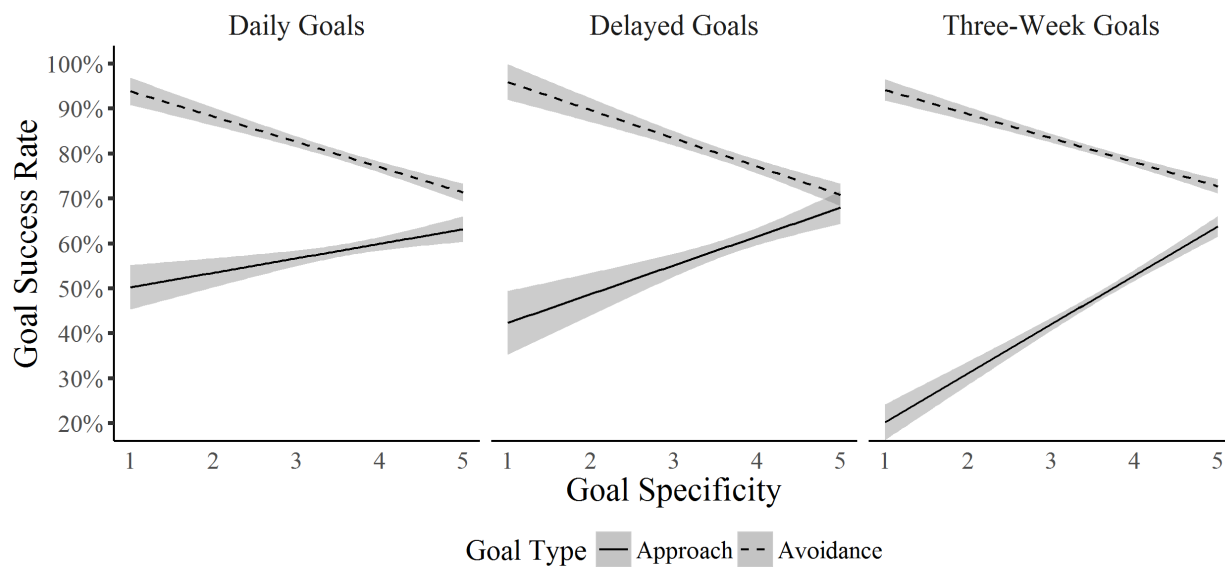


Figure 4. Average success rates of approach and avoidance goals by goal specificity. Note that lower values indicate more specific food goals (1 = “Specific food content”) and higher values indicate more broad food goals (5 = “Broad category”). Simple effects for both approach and avoidance goals at all temporal scopes were significant.

Appendix B

Correlations of REBS subscales used for computing SDI

Healthy eating regulation		1	2	3	4	5
1	Intrinsic motivation	-				
2	Integrated regulation	.74	-			
3	Identified regulation	.54	.52	-		
4	Introjected regulation	.19	.37	.38	-	
5	External motivation	-.04	.01	.08	.30	-
6	Amotivation	-.36	-.37	-.36	-.08	.23

Appendix C

Full and decomposed statistical model for testing the primary research question

Full Model

$$\text{logit}(\text{Goal Success/Failure}_{gdi}) = \beta_0 + \beta_1(\text{Goal Type}_{gdi}) + \beta_2(\text{SDI}_i) + \beta_3(\text{Goal Type}_{gdi} * \text{SDI}_i) + r_{di} + u_i$$

Decomposed Model

Level-1

$$\text{logit}(\text{Goal Success/Failure}_{gdi}) = \beta_{0di} + \beta_{1di}(\text{Goal Type}_{gdi}) + \beta_{2di}(\text{SDI}_i) + \beta_{3di}(\text{Goal Type}_{gdi} * \text{SDI}_i)$$

Level-2

$$\beta_{0di} = \gamma_{00i} + r_{di}$$

$$\beta_{1di} = \gamma_{10i}$$

$$\beta_{2di} = \gamma_{20i}$$

$$\beta_{3di} = \gamma_{30i}$$

Level-3

$$\gamma_{00i} = \delta_{000} + u_i$$

$$\gamma_{10i} = \delta_{100}$$

$$\gamma_{20i} = \delta_{200} + \delta_{201}(\text{SDI}_i)$$

$$\gamma_{30i} = \delta_{300} + \delta_{301}(\text{SDI}_i)$$

Note. Subscripts correspond to the following levels: g = goal, d = day, i = individual level.

Appendix D

Approached and avoided food goal descriptive statistics

	Approach	Avoidance
Number of unique food goals	332	236
Most common foods	fruit, vegetables, salad, eggs	chips, chocolate, candy, ice cream
Healthiness	1.92	-1.56
Specificity	3.35	3.29
<i>Food content</i>		
Protein	1.18	0.57
Sugar	0.79	1.74
Fibre	1.40	0.39
Good fat	0.65	0.43
Bad fat	0.24	1.52
Sodium	0.53	1.23
Nutrients	2.16	0.48
<i>Food Categories (%)</i>		
Fruits/vegetables	48.2 %	1.7 %
Meat	9 %	7.6 %
Fish/seafood	4.8 %	0 %
Meat alternatives	12.3 %	0.4 %
Dairy	6.3 %	14.4 %
Grains	21.4 %	19.5 %
Junk food	0.9 %	69.1 %
Drinks	6 %	9.3 %
Vitamins/nutrients	4.5 %	2.5 %
Solid food items	90.1 %	89.4 %
Containing caffeine	0.6 %	15.7 %
Containing alcohol	0.3 %	1.7 %

Note. There were 534 unique food goals, indicating that 34 foods were selected as both approach and avoidance (some examples include meat, cheese, dairy, grains, and rice). Non-percentage values represent means. Bolded values indicate significantly higher than other goal type at $p < .05$ (t-tests for means, chi-square tests of independence for percentages).