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Using Temporal Self-Regulation Theory to understand healthy and unhealthy eating intentions and behaviour

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ABSTRACT

Objectives: The present research investigated whether Temporal Self-Regulation Theory (TST) can be used to help understand healthy and unhealthy eating intentions and behaviour.
Design: A prospective design with two waves of data collection one week apart.
Method: An online survey measured the key components of TST (i.e., connectedness, timing and valence beliefs, intentions, past behaviour, habit strength, perceived environmental cues, and self-control) with respect to eating fruit and vegetables (F&V; $N = 133$) or unhealthy snacks ($N = 125$). Eating behaviour was assessed one week later.
Results: The components of TST explained significant amounts of the variance in intentions and behaviour for intake of F&Vs (22% and 64%, respectively) and unhealthy snacks (18% and 35%, respectively). Beliefs about positive and negative short-term outcomes significantly predicted intentions to perform both behaviours. Intentions and past behaviour significantly predicted consumption of F&Vs, and past behaviour moderated the relationship between intention and behaviour which became stronger as past behaviour increased. Past behaviour and habit strength significantly predicted unhealthy snacking.
Conclusions: The findings suggest that TST may be a useful framework for understanding eating intentions and behaviour. However, research did not find support for all of the hypothesised relationships (e.g., self-regulatory capacity did not significantly predict eating behaviour and also failed to moderate the relationships between intentions and behaviour). Research using alternative measures of self-regulatory capacity, along with experimental manipulations of TST variables, may be needed to further understand eating intentions and behaviour.
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Lifestyle factors, including diet, have the potential to improve or compromise long-term health (World Health Organisation, 2015). Evidence suggests that eating fruit and vegetables (F&V) protects against chronic diseases, including cardiovascular disease and diabetes, while eating too much saturated fat, sugar, and salt exacerbates health problems (Oyebode, Gordon-Dseagu, Walker, & Mindell, 2014; Slavin & Lloyd, 2012). On average, adults in the United Kingdom (UK) do not meet the government's guidelines to eat 5 portions of F&V per day and exceed recommended levels of saturated fat and sugar (Public Health England, 2014). Interventions to improve dietary patterns are therefore needed. This, however, requires an understanding of the determinants of eating behaviours, especially those that are potentially amenable to change, such as peoples' beliefs. As such, the present research investigated whether Temporal-Self Regulation Theory (TST; Hall & Fong, 2007) can help to understand the determinants of healthy and unhealthy eating intentions and behaviour.

1. Temporal Self-Regulation Theory

TST was developed by Hall and Fong (2007) to provide a comprehensive account of health behaviour; including a motivational and volitional stage. In the motivational stage, intentions (representing individuals' conscious expressions of the direction and intensity of their motivation to engage in a behaviour; Ajzen, 1991) are hypothesised to be determined by beliefs about the connectedness, timing, and valence of anticipated outcomes of an action. Connectedness beliefs refer to how likely an outcome of behaviour is believed to be (e.g., "If I eat unhealthy snacks, then it is

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likely that I will gain weight"). Valence beliefs refer to whether the outcomes are believed to be positive or negative (e.g., "It would be good/bad if I gained weight"). Timing beliefs refer to when the outcomes are believed to occur (e.g., "If I gain weight it would occur shortly after/a long time after"). TST proposes that individuals intend to pursue behaviours that they believe are likely to have positive, immediate consequences (Ainslie, 1975; Hall & Fong, 2007; Schwarzer, 2008; Shapiro, 2005).

This proposal helps to explain undesirable eating patterns because unhealthy eating is typically associated with immediate positive outcomes such as pleasant tastes (Deliens, Clarys, De Bourdeaudhuij, & Deforche, 2014) which, according to TST, shape intentions more than the long-term (potentially more negative) consequences, such as weight gain. In contrast, healthy eating is typically associated with immediate negative outcomes such as inconvenience or high cost which, according to TST, will shape intentions more than beliefs about long-term health benefits (Hall & Fong, 2007; Herbert, Butler, Kennedy, & Lobb, 2010).

In line with TST, beliefs about the outcomes of behaviour have been found to explain intentions to eat healthily (Renner & Schwarzer, 2005; Schwarzer & Renner, 2000; Schwarzer et al., 2007). Beliefs about positive outcomes (e.g., physical wellbeing) of eating behaviour have been linked to positive intentions, while beliefs about negative outcomes (e.g., bad taste) have been linked to negative intentions (Hankonen, Kinnunen, Absetz, & Jallinoja, 2013). In addition, research shows that the tendency to focus on future outcomes rather than immediate outcomes is associated with healthier eating (Dassen, Houben, & Jansen, 2015; Onwezen, Van't Riet, Dagevos, Sijtsema, & Snoek, 2016; van Beek, Antonides, & Handgraaf, 2013).

In the volitional stage of TST, intention is hypothesised to be a proximal determinant of behaviour (Hall & Fong, 2007). Prospective studies indicate that intention is correlated with eating behaviour ($r_+ = 0.38$ - 0.45; Guillaumie, Godin, & Vezina-Im, 2010; McEachan, Lawton, & Conner, 2011; McDermott et al., 2015; Sleddens et al., 2015). Nonetheless, changes in intentions are not always translated into behaviour (for a review, see Webb & Sheeran, 2006). TST therefore includes two further direct predictors of behaviour; namely, i) behavioural prepotency; the individual's default response to cues in the environment (Hall & Fong, 2007) and ii) self-regulatory capacity; the individual's trait and state cognitive ability to monitor and control their thoughts, emotions, and behaviour in order to override undesired responses (Duckworth & Kern, 2011; de Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012). TST further proposes that behavioural prepotency and self-regulatory capacity moderate the relationship between intention and behaviour. For example, cues that elicit undesirable pre-potent responses should weaken the intention-behaviour relationship because pre-potent responses are typically fast and automatic, and may influence behaviour before reflective processing of intentions, which is typically slower and more cognitively demanding (Orbell & Verplanken, 2015; Strack & Deutsch, 2004). In contrast, high self-regulatory capacity should strengthen the intention-behaviour relationship because it enables an individual to inhibit undesired responses (de Ridder et al., 2012).

Behavioural prepotency can be measured by assessing past behaviour, habits (i.e., responses that have been repeated frequently in a stable context and are activated quickly and automatically when the specific context is encountered; Lally, van Jaarsveld, Potts, & Wardle, 2009; Verplanken & Orbell, 2003; Wood, Quinn, & Kashy, 2002) and the presence of internal or external cues that trigger behaviour (Hall & Fong, 2010). In line with TST, past behaviour frequency has been found to be moderately-to-strongly correlated with future behaviour ($r = 0.39$, Ouellette & Wood, 1998) and to predict F&V and unhealthy snack consumption (e.g., Blanchard et al., 2009; Collins & Mullan, 2011; Danner, Aarts, & Vries, 2008). Moreover, intentions have been shown to be less predictive of future behaviour, as the frequency of past behaviour increases (e.g., Ouellette & Wood, 1998). Similarly, habit strength has been found to correlate with both healthy and unhealthy dietary behaviours ($r_+ = 0.41$; Gardner, de Bruijn, & Lally, 2011) and to moderate the relationship between intentions and behaviour such that it becomes weaker as habit strength increases (e.g., Brug, de Vet, de Nooijer, & Verplanken, 2006; de Bruijn, 2010). The presence of cues can also elicit pre-potent responses and increase food intake (e.g., the context of a cinema can trigger the habit of eating popcorn; Neal, Wood, Wu, & Kurlander, 2011). Evidence further suggests that people who are more sensitive to food cues eat more than those who are less sensitive (Verhoeven, Adriaanse, Evers, & de Ridder, 2012). Cues can elicit responses that are consistent or inconsistent with an individual's goal and therefore can support or discourage behaviour in line with intentions (Hall et al., 2015).

Self-regulatory capacity can be measured through self-report, executive function tasks, and neuroimaging techniques and has been found to be relate to initiating healthy eating and inhibiting unhealthy eating (Allom & Mullan, 2014; Limbers & Young, 2015; Lowe, Hall, & Staines, 2014; de Ridder et al., 2012). Specifically, evidence suggests that people with stronger executive functions (e.g., response inhibition) are more likely to behave in line with their intentions, consistent with the moderation hypothesis proposed in TST (Hall, Fong, Epp, & Elias, 2008).

2. The present research

TST has a number of strengths as a model of health behaviour and has been described as a "viable, integrative framework for contemporary research" (Webb & Sheeran, 2010). TST synthesises ideas from psychology, behavioural economics, and neuroscience into a comprehensive model that seeks to explain the 'intention-behaviour gap' (Sheeran, 2002) as well as temporal and environmental influences on behaviour (Hall & Fong, 2007). By so doing, TST identifies determinants of eating behaviours that can be targeted in behaviour change interventions (Bruyneel & Dewitte, 2016; Duckworth, Gendler, & Gross, 2016; Enriquez-Geppert, Huster, & Herrmann, 2013; Lally et al., 2009; Reuter et al., 2010). However, previous research using TST has tended to focus on the predictive ability of one or two factors in isolation (for a review, see Norman & Conner, 2015).

The present research therefore sought to investigate the extent to which TST could be used to understand healthy (F&V) and unhealthy (snacking) eating intentions and behaviour. The research focused on university students because the transition to university is typically accompanied by changes in students' social and physical environments (e.g., limited budget and responsibility for preparing meals) that are associated with reduced F&V consumption and increased 'junk food' consumption (Graham, Pelletier, Neumark-Sztainer, Lust, & Laska, 2013; Tanton, Dodd, Woodfield, & Mabhala, 2015). Moreover, the health habits that are established in early adulthood often persist into later life and have the potential to impact on long-term health outcomes (Friedman et al., 2008; Horwarth, 1991; Wiium, Breivik, & Wold, 2015).

The present research tested the following hypotheses derived from TST: i) intentions will be predicted by beliefs about the outcomes of the behaviour, ii) behaviour will be predicted by intentions, behavioural prepotency (past behaviour, habit, and perceived cues) and self-regulatory capacity, and iii) behavioural prepotency and self-regulatory capacity will moderate the intention-behaviour relationship.

3. Method

3.1. Participants and procedure

Potential participants from a 'volunteers' list at a university in the UK were emailed with details of the study and a link to the online questionnaire. The details were also posted on a webpage for students interested in participating in research. Participation was voluntary, but was incentivised by the offer of a £50 prize draw for those who responded at both time points. Ethical approval was granted by the university ethics committee.

After providing consent, participants were randomised to complete questionnaires on either F&V or unhealthy snack consumption. Subsequently, participants read either the UK government's guidelines to eat 5 portions of F&V per day or to limit unhealthy snacking. An 'unhealthy snack' was defined as all foods consumed between the three main meals (i.e., breakfast, lunch, and dinner) containing high levels of fat, sugar and/or salt, and low levels of micronutrients (Verhoeven, Adriaanse, de Vet, Fennis, & de Ridder, 2014). Example portion sizes were given for each behaviour. Participants then reported their beliefs regarding the likelihood, timing, and valence of potential outcomes of eating F&V/unhealthy snacks before completing measures of their intention to eat F&V/unhealthy snacks, self-control, habit strength, past behaviour, and perceived cues in the environment. Finally, participants reported demographic details. One week later participants were emailed a link to the follow-up questionnaire which assessed their consumption of F&V or unhealthy snacks over the previous week.

Baseline questionnaires were completed by 267 students, although nine were subsequently excluded from data analysis due to extreme values (>3 *SD*s above the mean) on past behaviour or behaviour at follow-up. For F&V consumption, the baseline sample included 133 participants (age $M = 23.92$, $SD = 7.40$; $n = 91$ (68.4%) female), of whom 115 (86.5%) responded at follow-up. For unhealthy snacking, the baseline sample included 125 participants (age $M = 23.10$, $SD = 5.18$; $n = 91$ (72.8%) female), of whom 109 (87.2%) responded at follow-up. Power analyses indicated that the sample sizes would be sufficient to detect the following small-to-medium effect sizes (Cohen, 1992) in the regression analyses predicting F&V intentions, $f^2 = 0.09$, F&V intake, $f^2 = 0.15$, snacking intentions, $f^2 = 0.10$, and snacking behaviour, $f^2 = 0.16$, with 80% power and alpha set at 0.05.

3.2. Measures

Demographics. Participants reported their age, gender, height, weight, nationality, ethnicity, and living conditions (e.g., with parents or in catered university accommodation).[1]

Beliefs. Participants were asked about their beliefs concerning the outcomes of eating F&Vs or unhealthy snacks. These outcomes were identified though an elicitation study in which 27 students were asked to list the positive and negative, short- and long-term outcomes of eating F&Vs and unhealthy snacks. Responses were coded by two raters, with 89.6% agreement. Discrepancies were resolved through discussion. For each behaviour, the three most frequently cited short-term negative, long-term negative, short-term positive and long-term positive outcomes were included in the questionnaire.

***Connectedness beliefs*:** Beliefs about the likelihood of each outcome were measured by presenting participants with the stem "How likely are you to experience the following outcomes from eating fruit and vegetables/unhealthy snacking?" followed by a list of the potential outcomes. Participants rated the likelihood of each outcome on a scale from 1 (*very unlikely*) to 7 (*very likely*).

Valence beliefs: Beliefs about valence of the outcomes were measured by presenting participants with the stem "If you were to experience the following outcomes from eating fruit and vegetables/unhealthy snacks, to what extent would they be bad *(1)* or good *(7)*?" followed by a list of the potential outcomes.

Timing beliefs: Beliefs about the timing of the outcomes were measured by presenting participants with the stem "If you were to experience the following outcomes from eating fruit and vegetables/unhealthy snacks, when do you think you would experience them?" followed by a list of the potential outcomes. Participants responded on a scale from 1 (*immediately or shortly after*) to 7 (*non-immediately or a long time after*).

Composite belief measures: Composite measures were created by averaging the strength of the connectedness beliefs for short-term negative, long-term negative, short-term positive and long-term positive outcomes, respectively (for each behaviour). Paired samples t-tests confirmed that the outcomes that were classified as short-term were rated as significantly more immediate than those classified as long-term for both F&V consumption ($M_{ST} = 3.13$, $SD = 1.04$; $M_{LT} = 4.83$, $SD = 0.85$), $t(132) = 18.68$, $p < 0.001$, and unhealthy snacking ($M_{ST} = 2.46$, $SD = 0.93$; $M_{LT} = 4.42$, $SD = 0.85$), $t(125) = 21.20$, $p < 0.001$. Similarly, outcomes classified as positive were rated as significantly more positive than outcomes classified as negative for F&V consumption ($M_{POS} = 6.34$, $SD = 0.73$; $M_{NEG} = 2.42$, $SD = 0.76$), $t(132) = 34.36$, $p < 0.001$, and unhealthy snacking ($M_{POS} = 5.23$, $SD = 1.10$; $M_{NEG} = 2.20$, $SD = 0.83$), $t(125) = 22.71$, $p < 0.001$.

Intentions: Three items were used to measure intentions (e.g., "I intend to eat unhealthy snacks over the next week"). Responses were given on 7-point scales with high scores indicating more positive intentions. The internal reliability was high in both samples (F&V $\alpha = 0.95$; unhealthy snacks $\alpha = 0.89$).

Behavioural prepotency: Three measures of behavioural prepotency were included. First, *past behaviour frequency* was assessed by asking participants to estimate their F&V or snack intake (e.g., "In the past week, how many portions of fruit and vegetables did you eat/times did you eat unhealthy snacks on an average day?"; Evans, Kawabata, & Thomas, 2015).

Second, *habit strength* was measured using the four-item Self-Report Behavioural Automaticity Index (SRBAI; Gardner, Abraham, Lally, & de Bruijn, 2012). Participants rated the extent to which eating F&V or unhealthy snacks was, for example, something that they 'do automatically' (rated 1 = *strongly disagree* to 7 = *strongly agree*). Items were averaged to form a score for habit strength where higher scores indicated stronger habits. The scale shows good predictive, construct, and convergent validity with the Self-Report Habit Index (Verplanken & Orbell, 2003) from which it was derived (Galla & Duckworth, 2015; Gardner et al., 2012) and the internal reliability of the SRBAI was high in both samples (F&V $\alpha = 0.90$; unhealthy snacks $\alpha = 0.90$).

Third, for each behaviour, *perceived cues* in the environment were assessed by asking participants how frequently (1 = *less than once* per *week* to 7 = *several times* per *day*) they experienced three factors that support the behaviour (e.g., "cheap price", "wide

[1] Associations between demographic variables and eating intentions and behaviour were tested for F&V intake and unhealthy snacking. Gender was significantly associated with F&V intentions; females reported higher intentions than males, $t(131) = 3.51$, $p < 0.001$. Nationality was significantly associated with unhealthy snacking intentions; British participants had higher intentions than those from other countries, $t(123) = 0.3.40$, $p < 0.001$. Age was significantly correlated with snacking behaviour; snacking at follow-up decreased with increasing age, $r(109) = -0.19$, $p = 0.04$. No other associations were significant. The regression analyses were re-run controlling for these variables, but this had no effect on the predictive significance of variables specified by TST and so we report the analyses without these variables, for ease of interpretation.

availability"). The cues were identified though the earlier elicitation study. Higher scores indicated that facilitating cues were perceived more often.

Self-regulatory capacity: The 13-item Brief Self-Control Scale (Tangney, Baumeister, & Boone, 2004) was used to measure self-regulatory capacity. Participants were asked to rate the extent to which the statements reflected their typical behaviour, for example "I have a hard time breaking bad habits" (reverse coded) or "I am good at resisting temptations" (rated 1 = *not at all* to 5 = *very much*). The Brief Self-Control Scale has good psychometric properties, higher ecological validity than performance based measures of self-regulatory capacity (de Ridder et al., 2012; Limbers & Young, 2015), and had high internal reliability in both samples (F&V $\alpha = 0.84$; unhealthy snacks $\alpha = 0.82$).

Future Behaviour. At follow-up, the amount of F&V or unhealthy snacks consumed over the prior week was measured in the same way as past behaviour at baseline.

4. Results

4.1. F&V intake

Participants reported eating an average of 3.39 portions of F&Vs per day at follow-up ($SD = 1.50$, range = 0–8 portions), comparable to the national average for 16–24 year olds in the UK ($M = 3.0$; $SE = 0.10$; Health & Social Care Information Centre, 2015).

Predicting F&V intentions. As shown in Table 1, beliefs about the short-term (i.e., mental health benefits, feeling healthy, and better quality of life) and long-term (i.e., physical health benefits, weight loss, and being healthy) positive outcomes were significantly and positively correlated with F&V intentions. In addition, beliefs about short-term negative outcomes (i.e., not feeling full, bad tastes and high sugar levels) were significantly and negatively correlated with F&V intentions. The correlation between beliefs about long-term negative outcomes (i.e., dental, bowel and digestive problems) and F&V intentions was not significant.

In order to test whether TST could predict F&V intentions, beliefs regarding the short-term negative, long-term negative, short-term positive and long-term positive outcomes of F&V were entered into a regression analysis. The model explained 22.4% of variance in intentions; beliefs about short-term positive and negative outcomes significantly predicted intentions, $F(4,128) = 10.52$, $p < 0.001$. Thus, participants who believed that eating F&Vs would have short-term positive outcomes were significantly more likely to intend to consume F&Vs, while those who believed that there would be short-term negative outcomes were less likely to intend to consume F&Vs (see Table 2).

Predicting F&V intake. Behaviour at follow-up was significantly correlated with intentions, habit strength, past behaviour, and perceived cues in the environment, but not with self-control (see Table 3). Individuals who reported higher F&Vs intake at follow-up tended to have more positive intentions, stronger habits, higher previous consumption frequency, and to perceive more cues in the environment that supported behaviour. The regression model accounted for 64.4% of variance in F&V consumption; intentions, past behaviour, and the interaction between intentions and past behaviour emerged as significant predictors, $F(9,104) = 20.88$, $p < 0.001$ (see Table 4).

Given the significant interaction between intentions and past behaviour, simple slopes were plotted to examine the relationship between intentions and behaviour at low (mean - 1 *SD*), moderate (mean) and high (mean + 1 *SD*) levels of past behaviour (Aiken & West, 1991). There was a significant positive association between intentions and F&V intake at all levels of past behaviour. However, the slope of the line was steeper for high, $B = 0.53$, $t(113) = 10.87$, $p < 0.001$, and moderate, $B = 0.34$, $t(113) = 10.64$, $p < 0.001$, than for low levels of past behaviour, $B = 0.16$, $t(113) = 2.17$, $p = 0.03$. Thus, past behaviour moderated the intention-behaviour relationship such that the relationship became stronger as the frequency of past behaviour increased.

Table 1
Means, standard deviations and correlations between TST beliefs and intentions to consume F&V.

	2.	3.	4.	5.	*M*	*SD*
1. Intention	-0.25**	-0.07	0.45***	0.35***	5.17	1.67
2. Short-term negative beliefs		0.32**	-0.12	-0.05	3.40	0.87
3. Long-term negative beliefs			-0.12	-0.01	2.67	1.02
4. Short-term positive beliefs				0.68***	5.65	0.98
5. Long-term positive beliefs					5.46	0.91

Note. **$p < 0.01$. ***$p < 0.001$.

Table 2
Regression analysis predicting intentions to consume F&V.

	B	*SE B*	β
Short-term negative beliefs	-0.44	0.13	-0.36**
Long-term negative beliefs	0.02	0.15	0.02
Short-term positive beliefs	0.41	0.16	0.25*
Long-term positive beliefs	0.03	0.16	0.02

Note. $R^2 = 0.22$, $p < 0.001$. *$p < 0.05$. **$p < 0.01$.

Table 3
Means, standard deviations, and correlations between TST variables for F&V intake.

	2.	3.	4.	5.	6.	*M*	*SD*
1. Intention	0.14	0.52***	0.42***	0.41***	0.65***	5.17	1.67
2. Self-control		0.29**	0.01	0.12	0.12	4.40	0.67
3. Habit strength			0.46***	0.37***	0.50***	4.51	1.64
4. Past behaviour				0.33***	0.58***	3.76	1.84
5. Perceived cues					0.39***	4.93	1.14
6. F&V						3.39	1.50

Note. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

4.2. Unhealthy snacks

Participants reported eating an average of 1.80 unhealthy snacks per day over the past week at follow-up ($SD = 1.19$, range = 0–5).

Predicting intentions to eat unhealthy snacks. As shown in Table 5, beliefs about short-term (i.e., pleasant taste, positive emotions, and a sugar rush) and long-term (i.e., a balanced diet, positive memories, and a happier life) positive outcomes were significantly and positively correlated with unhealthy snacking intentions. In addition, beliefs about short-term negative outcomes (e.g., feeling guilty, ill or negative emotions) were significantly and

Table 4
Regression analysis predicting F&V intake.

	B	*SE B*	β
Intention	0.35	0.07	0.39***
Self-control	-0.07	0.15	-0.03
Habit	0.06	0.07	0.07
Past-Behaviour	0.43	0.07	0.49***
Cues	0.12	0.09	0.09
Intention*Self-control	0.07	0.08	0.05
Intention*Habit	-0.01	0.04	-0.03
Intention*Past behaviour	0.11	0.03	0.29***
Intention*Cues	0.01	0.01	0.01

Note. $R^2 = 0.64$, $p < 0.001$. ***$p < 0.001$.

Table 5
Means, standard deviations and correlations between TST beliefs and intentions to consume unhealthy snacks.

	2.	3.	4.	5.	*M*	*SD*
1. Intention	-0.37***	-0.16	0.27**	0.21*	3.73	1.77
2. Short-term negative beliefs		0.58***	-0.04	-0.19*	4.27	1.45
3. Long-term negative beliefs			0.15	0.01	4.21	1.18
4. Short-term positive beliefs				0.49***	5.40	1.07
5. Long-term positive beliefs					3.39	1.05

Note. $^{*}p < 0.05$. $^{*}p < 0.01$. $^{***}p < 0.001$.

negatively correlated with unhealthy snacking intentions. The correlation between beliefs about long-term negative outcomes (e.g., weight gain, health issues, and energy drop) and unhealthy snacking intentions was not significant.

In order to test whether TST could predict intentions to eat unhealthy snacks, beliefs regarding the short-term negative, long-term negative, short-term positive and long-term positive outcomes of unhealthy snacking were entered into a regression model. The model explained 17.5% of variance, with beliefs about the short-term positive and negative outcomes of unhealthy snacking emerging as significant predictors, $F(4,120) = 7.56$, $p < 0.001$. Participants who anticipated short-term positive consequences of snacking had significantly higher intentions, where as those who anticipated short-term negative outcomes had significantly lower intentions to snack. There were no other significant predictors (see Table 6).

Predicting unhealthy snacking behaviour. The consumption of unhealthy snacks at follow-up was significantly and positively correlated with intentions (to consume unhealthy snacks), habit strength, and past behaviour and was significantly and negatively correlated with self-control (see Table 7). The model accounted for 34.6% of variance in behaviour, $F(9,99) = 5.81$, $p < 0.001$; however, only habit strength and past behaviour were significant predictors (see Table 8). Thus, participants with stronger unhealthy snacking habits and those who had eaten unhealthy snacks more frequently in the past were more likely to eat unhealthy snacks at follow-up.

5. Discussion

The present research investigated whether TST could be used to identify the determinants of, and thus be used to help understand, healthy and unhealthy intentions and behaviour. Variables identified by TST explained large, and significant, amounts of the variance in intentions to eat F&Vs and unhealthy snacks. Specifically, the findings indicated that beliefs about the likelihood of positive and negative short-term outcomes are important determinants of intentions. These findings support theories and research which suggests that the perceived immediate or short-term consequences are disproportionately valued in decision making compared to longer-term outcomes (e.g. Ainslie, 1975; Chapman & Elstein, 1995). They do, however, stand in contrast to the findings of Schwarzer (2008) who reported that beliefs about the positive outcomes of action were sufficient to predict intentions and that the addition of beliefs about negative outcomes did not improve predictions.

Table 6
Regression analysis predicting intentions to consume unhealthy snacks.

	B	*SE B*	β
Short-term negative beliefs	-0.40	0.16	-0.21*
Long-term negative beliefs	0.07	0.14	0.04
Short-term positive beliefs	0.63	0.18	0.37**
Long-term positive beliefs	0.17	0.19	0.09

Note. $R^2 = 0.18$, $p < 0.001$. $^{*}p < 0.05$. $^{**}p < 0.01$.

Table 7
Means, standard deviations and correlations between TST variables for unhealthy snack intake.

	2.	3.	4.	5.	6.	*M*	*SD*
1. Intention	-0.12	0.21*	0.38***	0.21*	0.22*	3.73	1.77
2. Self-control		-0.37***	-0.30**	-0.30**	-0.32**	4.38	0.66
3. Habit strength			0.37***	0.18*	0.41***	3.00	1.64
4. Past behaviour				0.21*	0.50***	1.53	0.94
5. Perceived cues					0.04	4.60	1.34
6. Snacking						1.80	1.19

Note. $^{*}p < 0.05$. $^{*}p < 0.01$. $^{***}p < 0.001$.

Table 8
Regression analysis predicting unhealthy snack intake.

	B	*SE B*	β
Intention	0.01	0.06	0.00
Self-control	-0.29	0.18	-0.16
Habit	0.16	0.07	0.22**
Past-Behaviour	0.45	0.12	0.37***
Cues	-0.08	0.09	-0.08
Intention*Self control	0.04	0.10	0.04
Intention*Habit	0.01	0.03	0.02
Intention*Past-Behaviour	-0.02	0.07	-0.02
Intention* Cues	0.04	0.05	0.08

Note. $R^2 = 0.35$, $p < 0.001$ $^{**}p < 0.01$. $^{***}p < 0.001$.

The variables specified by TST also explained variance in participants' F&V and unhealthy snack intake. Different variables, however, predicted each behaviour; intentions and past behaviour predicted F&V intake, while habit strength and past behaviour predicted unhealthy snacking. Such findings are consistent with research showing that health behaviours with different characteristics have different determinants (Collins & Mullan, 2011). Specifically, unhealthy snacking is often habitual or impulsive and typically requires little time or organisation, while the consumption of F&Vs requires more planning and cooking skills (Caruso, Klein, & Kaye, 2014; Larson, Perry, Story, & Neumark-Sztainer, 2006). As such, it might be expected that unconscious processes including habits would play a stronger role in consumption of unhealthy snacks than F&Vs, whereas strong intentions and previous experience may promote F&V consumption (Verhoeven et al., 2012).

The present research also found that past behaviour strengthened the relationship between intentions and F&V. At first glance, this finding might appear contrary to research which suggests that intentions are *less* predictive when people have performed the behaviour frequently in the past (e.g., Ouellette & Wood, 1998). However, this positive interaction may be explained by the fact that intentions and past behaviour were *congruent* in the present research (i.e., both supported performance of the behaviour). In this situation, an individual may form goals or intentions by observing and interpreting their past behaviour; for example, if they have eaten F&V in the past then they may infer that they are a healthy person and intend to behave consistently in the future (Bem, 1972; Festinger, 1957; Webb & Sheeran, 2006). When the opportunity to act on their intention arises, the individual's desire to maintain a coherent self-identity and commitment to act in line with past behaviour can maintain the behaviour (Bech-Larsen & Kazbare, 2014; Fennis, Andreassen & Lewis-Olsen, 2015). In contrast, past behaviour that is not in line with current goals is likely to undermine intentions and hinder behaviour change (Ouellette & Wood, 1998; Webb & Sheeran, 2006).

One surprising finding, given the predictions of TST, was that

self-regulatory capacity did not predict either behaviour. One possible explanation may be that the Brief Self-Control Scale (Tangney et al., 2004) is not sufficiently sensitive to the particular dimensions of self-regulatory capacity that are relevant to specific eating behaviours. For example, research using measures of executive function based on task performance has found that F&V consumption is related to the dimensions of switching and updating, unhealthy eating is related to inhibitory control (Allan, Johnston, & Campbell, 2011; Allom & Mullan, 2014). In addition, the Brief Self Control Scale assesses trait level self-regulatory capacity and does not measure state levels of self-control that might be important during eating-related decisions. For example, Vohs and Heatherton (2000) reported that individuals whose self-regulatory resources had been (temporarily) depleted consumed more ice cream in a subsequent taste-test than those who self-regulatory resources had not been depleted, consistent with the idea that state levels of self-regulatory capacity are important in controlling responses to tempting foods. Therefore, future research using TST to understand eating behaviour may consider assessing of self-regulatory capacity based on performance and/or state-specific measures.

An alternative explanation for the finding that self-regulatory capacity was not predictive in the present research may be that self-regulatory capacity was not needed to direct behaviour because, overall, participants reported that they experienced facilitating cues in the environment. Indeed, Hall and Fong (2007) suggest that self-regulatory capacity is most likely to influence behaviour in contexts that *do not* support the behaviour. This prediction was tested by Booker and Mullan (2013) who found that self-regulatory capacity significantly predicted healthy lifestyle behaviours in environments that were perceived to be unsupportive of behaviour, but not in more supportive environments.

5.1. Implications for intervention

The present findings have implications for interventions. For example, campaigns to promote healthy eating often focus on the long-term benefits of dietary choices (e.g., "Living Longer"; Department of Health, 2016). However, the finding that beliefs about the short-rather than long-term outcomes of behaviour predicted intentions to eat both F&Vs and unhealthy snacks suggests that this may be an unsuitable strategy to change eating behaviours. Instead, and in line with previous studies (e.g. de Bruijn & Budding, 2016), the present findings suggest that campaigns may be more effective if they target beliefs about the likely short-term outcomes of behaviour. The content of such campaigns should, however, be considered carefully. For instance, although short-term outcomes such as negative emotions (e.g., feelings of guilt or regret) have been shown to reduce unhealthy behaviour (Sandberg, Hutter, Richetin, & Conner, 2016), they have also been linked to eating disorder psychopathology and unsuccessful weight management (Kuijer & Boyce, 2014; Sassaroli et al., 2005).

The finding that past behaviour significantly predicted eating behaviour also has implications for behaviour change interventions. For example, many interventions appeal to reasoned processes (e.g., by providing information or incentives, Herman & Polivy, 2011). However, these techniques may not be effective if behaviour is primarily driven by prepotent responses and is a relatively automatic process. An alternative strategy would be to change how people appraise their past behaviour. Rothman (2000) proposes that maintenance of behaviour primarily depends on perceived satisfaction with received outcomes (e.g., Kassovou, Turner, Hamborg, & French, 2014) and evidence suggests that asking people to reflect on past food choices that have made them feel positive and proud can be more motivating than reflecting on past food choices that have made them feel negative and guilty (Reynolds, Webb, Benn, Chang, & Sheeran, 2017). Interventions could, therefore, encourage individuals to reflect on the positive outcomes of their pervious healthy eating behaviours in an effort to increase satisfaction and promote continued performance of the behaviour.

5.2. Limitations

A number of limitations mean that the above conclusions are made with some caution. First, a sample of students participated in the research, which means that the findings may not be generalizable to other samples (e.g., those who are more experienced in preparing food for themselves). Second, the self-report measures used in the present research may have led to socially desirable or inaccurate responses. The present research used measures that have shown to be reliable and valid and that are typically used in research in the field (e.g., the Brief Self-Control Scale); nonetheless, they could be combined with alternative measures (e.g., the Stroop task) in future research (Gardner, 2015; de Ridder et al., 2012). Third, the data in the present research is correlational. Future research could examine if *changes* in any of the components predict *changes* in behaviour to provide a stronger, experimental, test of TST, as has been provided in relation to other social cognition models (e.g., Sniehotta, 2009).

6. Conclusions

The present research found that the constructs specified by TST were able to explain significant variance in both healthy and unhealthy eating intentions and behaviours. Consistent with the predictions of TST, intentions to eat F&V and unhealthy snacks were influenced by beliefs about the likelihood of short-term outcomes of each behaviour. However, the research did not find support for all of the hypothesised relationships (e.g., self-regulatory capacity was not associated with performance of either behaviour). Thus, in conclusion, the present research suggests that TST may be a useful framework for understanding the determinants of health behaviour; however, further research is required to replicate and extend the current findings by using alternative measures of self-regulatory capacity and/or conducting experimental tests of TST.

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