Predicting breakfast consumption: An application of the theory of planned behaviour and the investigation of past behaviour and executive function

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Objectives. The objective of the current study is to examine the determinants of breakfast consumption with the application of the Theory of Planned Behaviour (TPB; 1991) and investigate the additional variables of past behaviour and executive function.

Design. A prospective 1-week study investigating the predictive ability of TPB variables, past behaviour and executive function was utilized.

Methods. Ninety-six participants were administered two measures of executive function (response inhibition and planning) and completed self-report questionnaires regarding their attitudes, subjective norms, perceived control, intentions and past behaviour of breakfast consumption. One week later, participants returned a follow-up questionnaire on their behaviour.

Results. The result of the study showed that the TPB significantly predicted intentions and prospective behaviour of breakfast consumption, however, past behaviour was found to be the strongest predictor of future behaviour. Considering executive function, response inhibition was not found to predict behaviour; however, planning ability explained unique variance in behaviour and moderated the association between intention and behaviour.

Conclusions. The findings support the use of the TPB in explaining breakfast eating habits, and suggest that executive function of planning may be somewhat useful to predict this behaviour. The significance of past behaviour also suggests that breakfast consumption may commonly be a stable, habitual behaviour that may undermine the need for self-regulation. Implications for creating behavioural-change interventions are discussed.

The influence of behaviour on health is evident in the dramatic shift in the leading causes of death in the world throughout the 20th century (Cervone, Shadel, Smith, & Fiori, 2006). Acute illnesses have given way to chronic illnesses such as heart disease,
stroke and cancer (Cervone et al., 2006) which are currently the major causes of death in Australia (Mathers, Vos, Stevenson, & Begg, 2001) and the Western World (Murphy, 2000). Behavioural or 'life-style' factors are known to play a large role in the acquisition and management of chronic disease (Cervone et al., 2006).

This study focuses on breakfast consumption as a prototype for health-protective behaviour. The seminal Alameda County study (Belloc & Breslow, 1972), found that seven specific behaviours or health habits, commonly referred to as the 'Alameda 7' of never smoking, drinking less than five drinks per sitting, sleeping 7-8 h a night, exercising, maintaining a healthy weight, avoiding snacks and eating breakfast regularly, were related to concurrent and subsequent physical health status and long-term survival. Eating a regular, healthy breakfast has been found to significantly contribute to the daily recommended intake of essential nutrients such as calcium, iron and thiamine. Breakfast consumption is associated with a higher frequency of other health-promoting behaviours such as regular exercise (Keski-Rahkonen, Kaprio, Rissanen, Virkkunen, & Rose, 2003); teeth brushing (Yang, Wang, Hsieh, & Chen, 2006); and overall diet quality (Ortega et al., 1998; Williams, 2005). In spite of this, studies have found that the frequency of breakfast consumption has declined over the past half century (Haines, Guikey, & Popkin, 1996) and an Australian study reported that 15% of adolescents and nearly a quarter of Australian adults regularly skipped breakfast (Williams, 2005).

Further, research has shown that skipping breakfast is associated with poorer school performance in children (Yang et al., 2006) and positively correlated with other health-risk behaviours such as smoking, alcohol use, infrequent exercise, less sleep, higher behavioural disinhibition (Keski-Rahkonen et al., 2003; Schoenborn, 1986; Yang et al., 2006) higher body mass index (BMI; Rampersaud, Pereira, Girard, Adams, & Metzl, 2005) and binge eating (Masheb & Grilo, 2006). Missing breakfast may also have long-term negative effects such as depressive symptoms, stress, weakened immune system, obesity and chronic disease (Timlin & Pereira, 2007; Yang et al., 2006).

The evidence indicates that breakfast eating is a beneficial behaviour to target in health promotion. However idiosyncratic aspects need to be elucidated, such as the personal and motivational factors behind regular breakfast consumption. This has important clinical implications in creating interventions to increase the frequency of breakfast consumption.

There are a number of social-cognitive models that attempt to understand these factors behind behaviour. The Theory of Planned Behaviour (TPB) is among the most cited theoretical frameworks for predicting a wide range of behaviours (Hall & Fong, 2007), and is arguably the most researched (Armitage & Conner, 2001). The TPB developed out of the earlier Theory of Reasoned Action (TRA; Fishbein & Ajzen, 1975) and focuses on the cognitive factors that determine motivation or 'behavioural intention'. Intentions are the immediate antecedent to performing a specific behaviour. In general, the stronger the intention to engage in behaviour, the more likely it will be performed (Ajzen, 1991). The TPB includes three independent predictors of behavioural intention. The first is attitude that reflects the degree a person has a favourable or unfavourable evaluation of the behaviour. The second is subjective norm that refers to the perceived social pressure to perform or not perform the behaviour. Lastly is perceived behavioural control (PBC) that reflects the individual's perceptions of the ease or difficulty of performing the behaviour of interest. Ajzen (1991) argues that PBC influences intentions and directly affects behaviour, particularly in situations, where behaviour is not under total volitional control.
The TPB has received considerable attention in predicting behaviour (Armitage & Conner, 2001). It has been successfully applied to explain a variety of health behaviours including exercise (Norman, Conner, & Bell, 2000), smoking (Conner, Sandberg, McMillan, & Higgins, 2006), drug-use (Umeh & Patel, 2004), HIV/STI prevention behaviours (Gredig, Nideroest, & Parpan-Blaser, 2006) and eating habits (Payne, Jones, & Harris, 2005). A meta-analysis of 161 studies using the TPB (Armitage & Conner, 2001) found that attitudes, subjective norms and PBC accounted for 39% variance in intentions, whilst intentions accounted for 25% variance in behaviour. PBC predicted an additional 2% of behaviour over intention alone, a small but significant increase. While the TPB has not been used to directly predict actual breakfast consumption, it has been shown to significantly predict intentions and healthy versus unhealthy food (milk and bread) choices at breakfast time in children (Berg, Jonsson, & Conner, 2000).

Although the research confirms the importance of intentions in predicting likelihood of future behaviour it also highlights the fact not all intentions are translated into behaviour (Abraham et al., 1999). Reviews of the TPB in health behaviour domains conclude that TPB variables better predict intentions than behaviour (Godin & Kok, 1996). Human beings inconsistently perform behaviours despite their intentions, leaving what is commonly referred to as the ‘intention-behaviour gap’ (Hall, Fong, Epp, & Elias, 2008; Sniehotta, Scholz, & Schwarzer, 2005). This is particularly true for health behaviours that require endurance of inconvenience, discomfort or have negative immediate outcomes (Sniehotta et al., 2005).

Consequently the TPB can be criticized as an incomplete model and many researchers have striven to increase the proportion of variance explained with the inclusion of additional variables (Conner & Armitage, 2002). Numerous studies have investigated the roles of additional variables or moderators of the intention–behaviour link. One of the most common is past behaviour. Studies have found past behaviour to be the strongest predictor of future behaviour, often exceeding the predictive power of behavioural intention and other established constructs (Ouellette & Wood, 1998). Past behaviour of breakfast consumption is likely to be a strong determinant of future behaviour due to the habitual nature of eating (Conner, Norman, & Bell, 2002).

More recently, the role of self-regulation on behaviour has been considered. Self-regulation refers to any efforts undertaken in order to alter behaviour (Cameron & Leventhal, 2003). Individuals must constantly monitor behaviour and make necessary adjustments to maintain the concurrence between what they intend and what they would like to do (Bermudez, 2006). Therefore, it appears that there may be a number of self-regulatory processes that lie between intention and behaviour (Abraham et al., 1999). These post-intentional processes are largely ignored by social-cognitive models such as the TRA and TPB, but may distinguish between intimenders that act and those who do not (Abraham et al., 1999).

The Researchers have primarily focused on the social-cognitive factors of self-regulation, for example goal setting and self-monitoring (Scheier & Carver, 2003), but few have looked at the neurocognitive basis for these operations that are essentially executive functions (Hall et al., 2008). ‘Executive function’ is the blanket term for the brain’s ‘top-down’ control processes of behaviour (Hall et al., 2008). These are reflected in developing plans for future action, holding those plans and action sequences in working memory until they are executed, inhibiting irrelevant actions and controlling behaviour (Singer & Bashir, 1999). There is significant overlap between executive function and self-regulation, which are both primarily facilitated by the frontal cortex (Koechlin, Ody, & Koechlin, 2003; Singer & Bashir, 1999).
In a novel study, Hall, Epp, Elias and Crossley (2006) suggest that neurocognitive variables may be an additional factor in explaining the intention-behaviour continuum. Given that a key facet of executive function is the ability to regulate behaviour, the authors propose that individual differences in executive function may explain individual differences in health behaviour patterns. Hall et al. (2006) examined the association between the Stroop test and indicators of health-risk behaviour. After controlling for demographics and IQ, they found that executive function predicted unique variance for smoking, alcohol consumption and sleeping behaviours. In a prospective behaviour study, Hall et al. (2008) found that individual differences in a Go-NoGo (GNG) executive function task explained unique variance in fruit and vegetable consumption, and physical activity over and above intention alone. The independent and interactive effects of intention and executive function accounted for 61% of variance in dietary behaviour, which compares favourably to the variance typically accounted for by TPB in meta-analyses (Armitage & Conner, 2001; Godin & Kok, 1996).

The authors suggest that it is possible that specific facets of executive function may be differentially predictive for consistent performance of health-protective behaviour and avoidance of health-risk behaviour (Hall et al., 2006). The current study investigates this claim and hypothesizes that response inhibition, and planning may be specific key executive functions for health behaviour due to the self-regulatory nature of needing to plan ahead, implement sub-goals to achieve the intended goal, and inhibit bad habits.

Response inhibition is defined as the state, or trait like capacity to inhibit impulses or prepotent responses when faced with novel or desirable stimuli, or in favour of a less salient response (Barton & Schwebel, 2007; Blair & Razza, 2007). Planning is a necessary process in problem solving and refers to the 'volitional organisation of behaviour for the attainment of a specific goal' (Dagher, Owen, Boecker, & Brooks, 1999, p. 1973). The ability to plan efficiently may be especially useful in health-protective behaviours, for example setting aside time to prepare meals, and making plans to exercise. Both these executive functions are thought to be afforded by the prefrontal cortex and anterior cingulate cortex (van Veen & Carter, 2006) and are measured by neuropsychological tests such as the GNG task and the Tower of Hanoi.

In relation to eating breakfast, response inhibition may be involved in conscious effort to consume breakfast regularly and maintaining the behaviour without falling back into old habits. As research has found the most common reason for skipping breakfast is lack of time (Shaw, 1998), it appears likely that some level of planning ahead may be involved in the ability to eat a regular and healthy breakfast.

Therefore the main aim in the present study is to examine, whether the additional variables of past behaviour and biologically imbued self-regulation or executive function (including response inhibition and planning) will improve the predictive value of the TPB model in predicting actual breakfast consumption.

**Method**

**Participants**

Participants in the study were 96 undergraduate psychology students from an Australian University. The mean age was 19.46 years ($SD=2.17$), ranging from 17 to 30 years. Students gained course credit for participation in the research. The University's Human Research Ethics Committee approved this study.
**Procedure**

Participants completed two executive function tasks - the Go-NoGo task which measures response inhibition, and the Tower of Hanoi task measuring planning ability. Participants also completed the TPB questionnaire on breakfast consumption. The order of the participants completed the sections was counterbalanced so that half the participants completed the executive function tasks first and the questionnaire second, and vice versa.

One week later, participants completed a follow-up questionnaire that measured their breakfast consumption behaviour.

**Measures**

**TPB Questionnaire**

In accordance with the TPB guidelines (Fishbein & Ajzen, 1975), attitude, subjective norm and PBC were measured using questionnaire items with 7-point response scales.

*Attitude* was assessed as the mean of four items each measured on a 7-point semantic differential scale, e.g. 'I think eating breakfast regularly is... good-bad, harmful-beneficial, unnecessary—necessary, unenjoyable—enjoyable; all scored +1 to +7. The four items had a high internal consistency (Cronbach’s $\alpha = .747$).

*Subjective norm (SN)* was assessed by a single item on a 7 point Likert scale (scored +1 to +7): ‘People who are important to me think I should eat breakfast everyday,’ *Very unlikely—very likely.*

*Perceived Behavioural Control (PBC)* was measured as the mean of three 7-point unipolar items (+1 to +7) that assessed self-efficacy, confidence and controllability of the behaviour. These included statements ‘for me, eating breakfast everyday is... very difficult—very easy’; ‘the decision to eat breakfast everyday is beyond my control’, *strongly disagree—strongly agree*; and ‘I am confident I can eat breakfast everyday if I wanted to,’ *strongly disagree—strongly agree.* Cronbach’s $\alpha$ of these three items was .712.

*Intention (INT):* Intentions to eat breakfast was measured by a single item, ‘Over the following week, I intend to eat breakfast on the following days.’ Participants had to indicate which days of the week from Monday to Sunday they intended to eat breakfast in the following week.

*Past behaviour.* Perceived past behaviour was also assessed with the single item: ‘Last week I ate breakfast on the following days...’ Participants indicated which days they had eaten breakfast the previous week.

*Behaviour.* Behaviour was measured 1-week later with a follow-up questionnaire that was emailed to each participant. Participants indicated which days they had eaten breakfast during the previous week (‘Over the past week, I have eaten breakfast on the following days...’).

Participants were also asked for their main reason if they did not eat breakfast on the days they had intended.

**Executive Function Measures**

The GNG is a neuropsychological test designed to measure behavioural self-regulation and response inhibition. The visual GNG paradigm in this study was adapted from the design used by Kirmizi-Alsan et al. (2006). The paradigm requires individuals to provide speeded responses to ‘go’ stimuli and effortlessly inhibit responses to ‘no-go’ stimuli (Wodka et al., 2007). Studies using the paradigm have found the task to have
good reliability with split half coefficients ranging from .73 to .95 (Schweiger, Abramovitch, Doniger, & Simon, 2007). In this study, the GNG task consisted of 150 stimuli of the letters ‘A’ and ‘Z’ appearing in random order. Each stimulus was presented on the screen as a letter in a white box with an inter-stimulus interval that ranged randomly between 1,000 and 2,000 msecs. Reaction times were computed for correct responses to ‘A’s and for incorrect responses to ‘Z’s and given the speed-accuracy trade off, a performance index (PI; [NoGo accuracy/RT] × 100) was computed for each participant to capture performance in terms of both accuracy and RT (Schweiger et al., 2007).

Mental planning is commonly measured by the Tower of Hanoi (TOH). The TOH is an appropriate domain for planning programs as the end goal is achieved by decomposition into sub-goals (Shallice, 1982). The current study used an on-line TOH task based on the TOH-R (Tower of Hanoi-revised) developed by Welsh and Huizinga (2001). The TOH-R was designed to increase the reliability of the task and delivers problems with a graded increment of number of moves, indicating the minimum number of moves to solve the problem to the participant. The redesigned task had a higher internal consistency (Cronbach’s α = .77) and more accurately reflected the executive function of mental planning.

Twelve TOH problems were used in this study, which increased in number of moves required to reach the goal state (2–7 moves). Time spent planning (time from the appearance of the disks to the first move made) and the number of errors or excess moves made was recorded.

**Analysis**

There were two main stages to the data analysis. In stage one, stepwise regressions of variables on intention were calculated. Predictors included the three TPB variables, and as research has suggested that past behaviour can influence future behaviour through intentions (Brickell, Chatzisarantis, & Pretty, 2006), past behaviour was also examined as a predictor of intentions. In stage two, the impact of variables on behaviour were calculated in a hierarchical regression. All variables were mean centred and intention and PBC were entered to represent the original TPB model. The additional variables of past behaviour and executive function were entered to assess if either explained any additive variance or moderated the association between intention and behavioural performance. Past behaviour was entered in the first step so that it could seen which factors explicitly predicted behaviour once this variable was controlled.

**Results**

**Description of the sample**

A total of 96 participants completed the study. The majority of respondents were female (69%) and of Caucasian-Australian ethnicity (61%). Almost half of the participants ate breakfast everyday over the 1-week experimental period (46.9%) and only one person (1%) did not eat breakfast at all. Of the 51 participants in the sample that did not eat breakfast everyday, 88% reported their main reasons for not eating breakfast were ‘not having enough time’ or ‘waking up too late’.

Table 1 presents the Pearson product correlation matrix between all study variables including TPB variables, past behaviour and executive function measures.
### Table 1. Pearson’s product correlation matrix of TPB variables

<table>
<thead>
<tr>
<th></th>
<th>ATT</th>
<th>SN</th>
<th>PBC</th>
<th>INT</th>
<th>P_BEH</th>
<th>BEH</th>
<th>RT</th>
<th>PI</th>
<th>PT</th>
<th>TE</th>
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<tbody>
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<td>ATT</td>
<td>-</td>
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<td>.491**</td>
<td>.500**</td>
<td>.501**</td>
<td>.566**</td>
<td>- .003</td>
<td>.067</td>
<td>.105</td>
<td>.086</td>
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<tr>
<td>SN</td>
<td>-</td>
<td>-</td>
<td>.335**</td>
<td>.152</td>
<td>.170</td>
<td>.194</td>
<td>- .198</td>
<td>.156</td>
<td>.043</td>
<td>- .056</td>
</tr>
<tr>
<td>PBC</td>
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<td>-</td>
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<td>.692**</td>
<td>.659**</td>
<td>.628**</td>
<td>- .101</td>
<td>.115</td>
<td>- .066</td>
<td>.003</td>
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<td>INT</td>
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<td>-</td>
<td>-</td>
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<td>.845**</td>
<td>.797**</td>
<td>- .030</td>
<td>.055</td>
<td>- .006</td>
<td>.075</td>
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<tr>
<td>P_BEH</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.862**</td>
<td>- .031</td>
<td>.035</td>
<td>- .006</td>
<td>.054</td>
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<tr>
<td>BEH</td>
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<td>.041</td>
<td>.123</td>
<td>.062</td>
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<tr>
<td>RT</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>- .939**</td>
<td>- .181</td>
<td>.213*</td>
<td></td>
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<tr>
<td>PI</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.186</td>
<td>- .204*</td>
<td></td>
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<tr>
<td>PT</td>
<td>-</td>
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<td>-</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
<td>- .240*</td>
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<td>TE</td>
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</tbody>
</table>

Note. ATT, attitude; SN, subjective norm; PBC, perceived behavioural control; INT, intentions to eat breakfast; P_BEH, past behaviour; BEH, behaviour or days of breakfast consumption; RT, Reaction time on Go-NoGo (GNG); PI, performance index on GNG; PT, planning time on TOH; TE, no. of errors on TOH; *p < .05 (two tailed); **p < .01 (two tailed).
Predicting intention

Attitude, subjective norm and PBC were entered simultaneously into a multiple regression analysis to evaluate their unique contribution to predicting intention. The overall model was significant \( (R^2 = .531; F_{3,94} = 34.316, p < .001) \). All three variables together accounted for 53.1% of the variance in intentions. However, only attitudes and PBC were significant predictors of intention, with PBC weighted most heavily. Subjective norm was not significant (Table 2). Past behaviour significantly increased the percentage of variance explained in intentions by 23.2% and was the strongest predictor of intentions over any TPB variable.

Table 2. Hierarchical regression analysis: Variables predicting intention (unstandardized and standardized coefficients)

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>( \beta )</th>
<th>R</th>
<th>( R^2 )</th>
<th>F</th>
</tr>
</thead>
<tbody>
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<tr>
<td>ATT</td>
<td>.496</td>
<td>.238**</td>
<td></td>
<td>.531</td>
<td>34.316**</td>
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<tr>
<td>SN</td>
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<td>-.134</td>
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<tr>
<td>PBC</td>
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<td>.623**</td>
<td>.729</td>
<td>.531</td>
<td>34.316**</td>
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<tr>
<td>Step 2:</td>
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<tr>
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<td>138</td>
<td>.066</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SN</td>
<td>-.120</td>
<td>-.065</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>PBC</td>
<td>.370</td>
<td>.241**</td>
<td>.873</td>
<td>.763</td>
<td>72.254**</td>
</tr>
<tr>
<td>Past behaviour</td>
<td>.763</td>
<td>.671**</td>
<td>.873</td>
<td>.763</td>
<td>72.254**</td>
</tr>
</tbody>
</table>

Note. \( N = 96 \); dependent variable = intention; *\( p < .05 \) (two tailed); **\( p < .01 \) (two tailed).

Predicting behaviour

Past behaviour had the highest correlation with behaviour at .862 over any other TPB variable. To control for the effects of past behaviour, it was entered in the first step in the regression analyses. Alone it predicted 74.3% of the variance in behaviour. The remaining TPB variables and executive function measures were then added to a hierarchical regression in sequential steps.

Consistent with the TPB, intention to eat breakfast over a one week period was a significant predictor of actual behaviour \( (B = .225, t = 2.517; p < .05) \). Alone, intention accounted for 63.6% of variance in behaviour. When controlling for past behaviour, intention significantly increased the proportion of variance accounted for in behaviour \( (R^2 \text{ change} = .017; p = .012) \). PBC was not found to be a significant predictor of breakfast consumption (Table 3).

Executive function variables

The same 96 participants completed the GNG task, however only 94 completed the Tower of Hanoi task due to technical difficulties. There were four measures of executive function obtained from the two tasks that were entered as predictors of behaviour including reaction time and performance index from the GNG task, and planning time and number of errors in the TOH task.

To examine the effect of executive function in predicting behaviour, each of the executive function measures were added into a hierarchical regression analyses holding
intention constant, with behaviour as the dependent variable. The hypothesis that executive function may predict unique variance of behaviour was not supported by the GNG results from this study. Reaction times and PI from the GNG task did not predict any significant change in behaviour (Table 3).

From the TOH task, planning time and number of errors were entered into a regression analysis, controlling for intention with behaviour as the dependent variable. Of the measures, planning time significantly predicted unique variance in behaviour ($B = .052, t = 3.274, p < .01$). Executive function measures accounted for an additional 2% of variance in behaviour. This was not a significant change controlling for TPB variables and past behaviour. The model as a whole accounted for 78% of variance in behaviour of breakfast eating ($R^2 = .781, p < .001$).

A series of interaction tests were also carried out as it was considered that executive function may moderate the intention—behaviour relationship in that people with greater executive function may demonstrate a stronger association between intentions and action compared to those with weaker executive function. Analyses revealed a significant interaction between planning time and intention when controlling all other variables ($B = -.017, t = -2.109; p < .05$). To examine the direction of the interaction, simple slopes analyses were carried out in accordance with Aiken and West (1991) by forming high and low planning groups ($\pm 1 SD$). The regression slope was tested for each group separately however alone, neither the high or low planning group significantly predicted behaviour. As can be seen in Figure 1 whilst not significant,

### Table 3. Hierarchical regression analyses predicting behaviour (unstandardized and standardized coefficients)

<table>
<thead>
<tr>
<th></th>
<th>$B$</th>
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<th>$R^2$</th>
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<td>Planning time</td>
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<td>.884</td>
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<td>.012</td>
<td>.043</td>
<td>.884</td>
<td>.781</td>
</tr>
<tr>
<td>Past behaviour X INT</td>
<td>-.013</td>
<td>-.036</td>
<td></td>
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</tr>
<tr>
<td>Planning time X INT</td>
<td>-.017</td>
<td>-.106*</td>
<td></td>
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<tr>
<td>RT X INT</td>
<td>-.001</td>
<td>-.115</td>
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<tr>
<td>PI X INT</td>
<td>.004</td>
<td>.012</td>
<td></td>
<td></td>
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<tr>
<td>Tower errors X INT</td>
<td>.005</td>
<td>.080</td>
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</tbody>
</table>

Note. Dependent= breakfast consumption behaviour; *p < .05 (two tailed); ** p < .01 (two tailed).
planning appears to moderate the intention–behaviour link for individuals with low intention strength. In contrast, individuals with high intention show a strong association with behaviour, regardless of planning ability, and in fact behaviour reduced fractionally for those with high planning. No other significant interactions were found between other executive function measures or between past behaviour and intention (Table 3).

**Discussion**

The present study sought to investigate the social-cognitive determinants of breakfast consumption under the application of the TPB, and to examine the predictive and additive effects of past behaviour and biologically imbued self-regulation. The TPB was found to explain 53.1% of variance in intentions to eat breakfast, comparing favourably with other studies applying the theory (Armitage & Conner, 2001). Attitudes and perceived behavioural control were found to significantly predict intentions, but subjective norm did not. This finding is somewhat consistent with previous research that has found subjective norm to be the weakest variable in the model (Armitage & Conner, 2001; Godin & Kok, 1996). Reviews of the TPB have found social influence on intention to be less important than the other variables. The majority of the participants were over 18 years old and breakfast consumption is often a private behaviour, so social/parental influence may have less impact than behaviours performed in public or in a younger sample. Alternatively, it could be related to the operationalization of the construct (Godin & Kok, 1996). Direct subjective norm is often only measured by a single item and in addition, there are thought to be several other normative components including moral and descriptive norms that are not encompassed by the standard measure (Armitage & Conner, 2001).

The TPB was also found to be highly predictive of behaviour at 1 week follow-up. Intentions accounted for 63.6% of the variance in behaviour of breakfast consumption. PBC did not significantly increase the variance accounted for when combined
with intention. Therefore, it appears that although perceived control is predictive of intentions to eat breakfast, actual behaviour remains mainly influenced by personal motivation.

The addition of past behaviour to the TPB was found to have a robust effect on future behaviour. Past behaviour exceeded the predictive power of the established TPB variables and diminished the effect of intention on behaviour. This is in concord with previous research that has found past behaviour to be the strongest predictor of future behaviour (Ouellette & Wood, 1998) and implies that breakfast consumption may be under habitual control. It is believed that when a particular behaviour is repeated frequently and consistently in a similar situation, it eventually becomes automatic or habitual (Brickell et al., 2006). The behaviour then requires less conscious attention and effort to be executed. Based on the interpretation that frequent repetitions of behaviour lead to development of habit, habit strength is commonly assessed by self-reported frequency of past behaviour (Brickell et al., 2006; Ouellette & Wood, 1998). Eating breakfast is often termed a healthy 'habit' and for many people it becomes part of a daily routine. Habits are likely to be cued by recurring features of the environment or stable contexts (Ouellette & Wood, 1998). In the case of breakfast consumption, there may be a variety of internal and external stable cues associated, such as hunger, waking up, morning time, or brushing teeth.

Some investigators have suggested that past behaviour be added to the TPB. However, Azjen and Fishbein (2005) argues that past behaviour does not have the same status as other predictors. Frequency of past behaviour cannot explain performance of later action. For example, to say that an individual eats breakfast because they have eaten breakfast in the past, begs the question as to why that person has previously behaved that way (Ajzen & Fishbein, 2005). In addition, frequently performing a behaviour does not necessarily result in habit (Verplanken, 2006) and low frequency of performance may also be an indication of strong habit (Ajzen & Fishbein, 2005). For instance, frequently skipping breakfast may also indicate a strong habitual pattern.

Although the results indicated the strongest model of behaviour included past behaviour, it appears that past behaviour may be better viewed as a control variable when investigating health behaviours, rather than one that determines behaviour. In addition, as frequency of behaviour does not necessarily equate to habit (Verplanken, 2006), future research into more valid measures of habit is needed to determine if breakfast consumption is a habitual behaviour.

This study has demonstrated that the TPB is a useful framework for predicting behaviour. However, the imperfect correlation between intention and behaviour, although high for this type of study (Armitage & Conner, 2001), instantiates the common observation that people sometimes fail to act on their intentions (Sniehotta et al., 2005). Self-regulation theories propose self-regulatory post-intentional processes are more proximal to actual behaviour, challenging the assumption held by dominant theories of health behaviour that intention is sufficient to explain behaviour (Hall et al., 2008; Sniehotta, Nagy, Scholz, & Schwarzer, 2006).

The additional variable of self-regulation was investigated and the results provided partial support for the role of executive function in predicting unique variance in behaviour. This study is the first to examine the Tower of Hanoi paradigm in its relation to predicting health behaviour. Length of preplanning time in the TOH was found to be a significant predictor of behaviour. The effect however was small in contrast to the variance explained by the TPB constructs and past behaviour implying that in general, executive function is not a strong predictor of this specific behaviour. The study also
used a similar GNG paradigm to Hall et al. (2008) but in contrast, did not find that reaction time explained additional variance of this behaviour. As mentioned, the high positive correlations between intention, past behaviour and behaviour, implicates that eating (or skipping) breakfast may be a stable habit. Behaviours under habitual control have been shown to require less effort and conscious attention, and thus it is less likely that active self-regulation or inhibitory control would be necessary for performance.

However, the results support Hall and colleagues’ (2006) proposal that it is possible for specific facets of executive function to be differentially predictive of health-protective versus health-risk behaviours. Under closer examination the measures used by Hall et al., (2006; 2008) — the Stroop and GNG tasks, assess the same facet commonly termed response inhibition. In addition to response inhibition, the present study examined the facets of planning and problem solving which are evidently involved in many aspects of behaviour. Planning can be considered as conceptually similar to ‘implementation intentions’ which are defined as a self-regulatory strategy that prepares a person to respond to certain situations by specifying where, when and how to perform a particular behaviour (Gollwitzer, 1999). Empirical studies on implementation intentions have found them to be particularly advantageous in increasing the likelihood of performing health-promoting behaviours. A study investigating weight loss in overweight women (Luszczynska, Sobczyk, & Abraham, 2007) found that the addition of an implementation intention intervention doubled the impact of the Weight Watchers program on weight reduction over 2 months. It is thought that if a certain behaviour is planned to be performed in specified conditions (e.g. ‘I will eat breakfast first thing in the morning, in the kitchen’) and is consciously prepared (e.g. ‘bought food items’, ‘set alarm clock’), when conditions are encountered the cues stimulate automatic activation of the behaviour (Gollwitzer, 1999). Hence the beneficial effects of planning can be facilitated through mimicking or replacing habitual tendencies (Gollwitzer, 1999).

As well as investigating the predictive effects of executive function, the present study also considered the moderating role of executive function on the intention—behaviour link. A small but significant interactive effect was found for planning time, in that planning moderated the association between intention and behaviour. This association can be explained by the fact that planning appeared to have no impact on behaviour of those that already had high intentions. The majority of those with high intentions ate breakfast everyday during the period of measurement suggesting a habitual behaviour as discussed above and less need for self-regulation. However for participants with low intention strength, planning does seem to moderate the intention—behaviour relationship and is a topic for further research.

This finding is in contrast to Hall et al. (2008) research that found behavioural intention was a more powerful predictor of behaviour for individuals with stronger executive function than those with weak executive function. It is possible that those with high ability to plan and low intention were more successful in their breakfast eating because this process of self-regulation may increase behaviour in a similar way to implementation intentions. Perhaps a combination of filling in a questionnaire regarding breakfast eating and knowing that breakfast consumption was going to be measured resulted in the formation of spontaneous implementation intentions. According to Sheeran, Milne, Gollwitzer and Webb (2005), implementation intentions lead to the achievement of goals because the person is ‘perceptually ready to encounter the situational cues specific to the ‘if’ component of the plan’ (p. 285). Therefore, those who can plan will be more successful in evoking the behavioural component without necessarily being consciously aware.
Therefore, the present research infers that planning may be necessary for consistent performance of health-protective behaviours and acts of commission such as consistently eating breakfast. In comparison, response inhibition was not shown to be predictive of breakfast consumption, but previous research has shown that it may be necessary for acts of omission or inhibiting inappropriate actions (Hall et al., 2006). These may be more relevant for health-risk behaviour, for example resisting the urge to light up a cigarette (Hall et al., 2006).

There are several limitations to the present study. A limitation common to studies on behaviour is reliance on self-report measure. More objective measures of behaviour would reinforce the current findings, such as observation of eating behaviour or validation by significant others. However meta-analyses have demonstrated the TPB can predict objectively measured behaviour almost as well as self-reported data (Armitage & Conner, 2001). The time frame of one week between intention and behaviour may not show the long-term efficacy of the TPB or the role of self-regulation in the maintenance of behaviour. Future studies with longer follow-ups would be desirable. Nevertheless the present research has advantage over many studies on eating behaviours, as only few have employed prospective designs (Godin & Kok, 1996). Finally, the use of an undergraduate university sample raises questions concerning the extent to which findings may be generalised. In contrast to past studies (e.g. Belloc & Breslow, 1972; Williams, 2005) the percentage of breakfast skippers was low in this sample, but breakfast eating patterns are not consistent across studies, nor is the definition of what breakfast 'skipping' is (Williams, 2005).

The TPB not only provides a framework for explaining behaviour but also has implications in designing interventions for behaviour change. The current research has empirically identified factors on which intervention efforts should focus to increase the frequency of breakfast consumption. The findings suggest that PBC and attitudes should be targeted to increase intentions to eat breakfast. Such intentions were found to be predictive of actual breakfast consumption over a prospective time period. To change attitudes, Fishbein & Azjen (1975) recommend persuasive communication targeting beliefs about the salient outcomes of behaviour. Methods in which to enhance perceived control could be achieved by making the behaviour more accessible and easier to perform, for example providing children with free breakfasts at school.

The role of past behaviour in breakfast consumption implies that interventions need to target development of eating breakfast as a habit. Habits are thought to form early in life and are likely to continue into adulthood (Stang, Taft Bayerl, Flatt, & Association Positions Committee, 2006). Thus interventions should target children, and educate parents to be good role models and create an environment where positive health behaviours are regularly executed.

Finally, understanding the biological capacity for self-regulation gives an alternative strategy for individual-level intervention and health promotion (Hall et al., 2006). If individuals could be assessed on their levels of executive function, those found with low capacity to self-regulate can be monitored more carefully as they may have greater difficulty in initiating and maintaining health-promoting behaviour. Behavioural interventions to improve executive function and enhance capacity to regulate behaviour may be beneficial for these individuals (Hall et al., 2006). It has been shown that self-regulatory ability can improve over time with repeated exercises of self-control (Muraven, Baumeister, & Tice, 1999). In addition interventions aimed at those with low intentions should consider the moderating role of planning ability. The environment in Western society is typically structured to make unhealthy food choices easy, so active
self-regulation is needed to avoid unhealthy foods. Restructuring the environment to reduce self-regulatory efforts may also influence the success of health promotion campaigns (Hall et al., 2006).

The results of this study provide support for the TPB as a framework to predict the health behaviour of breakfast consumption. Investigation of the additional role of executive function revealed that capacity to plan contributed positively, although modestly, to performing health-protective behaviours. This gives preliminary evidence that specific facets of executive function may be differentially predictive of different health behaviours. Compared to intention or past behaviour, executive function was not a strong predictor of behaviour, which may be due to less need for self-regulatory demand in breakfast eating habits. Given that breakfast has been associated with obesity, chronic disease and mortality, the decline of breakfast consumption is a significant public health problem. Thus, the overall study was successful in elucidating factors determining individual behaviour and has important implications for creating interventions to foster health behaviour change.

References


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