



# From perceived autonomy support to intentional behaviour: Testing an integrated model in three healthy-eating behaviours



Laura Girelli <sup>a, \*</sup>, Martin Hagger <sup>b</sup>, Luca Mallia <sup>a, c</sup>, Fabio Lucidi <sup>a</sup>

<sup>a</sup> Department of Psychology of Development and Socialization Processes – Sapienza, University of Rome, Italy

<sup>b</sup> Health Psychology and Behavioural Medicine Research Group, School of Psychology and Speech Pathology, Curtin University, Australia

<sup>c</sup> Department of Movement, Human and Health Sciences, University of Rome, "Foro Italico", Italy

## ARTICLE INFO

### Article history:

Received 24 April 2015

Received in revised form

22 September 2015

Accepted 24 September 2015

Available online 28 September 2015

### Keywords:

Self-determination theory

Theory of planned behaviour

Fruit and vegetable

Breakfast

Snack consumption

Planning

Theoretical integration

## ABSTRACT

A motivational model integrating self-determination theory, the theory of planned behaviour, and the health action process approach was tested in three samples in three behavioural contexts: fruit and vegetable, breakfast, and snack consumption. Perceived support for autonomous (self-determined) forms of motivation from parents and autonomous motivation from self-determination theory were hypothesised to predict intention and behaviour indirectly via the mediation of attitude and perceived behavioural control from the theory of planned behaviour. It was also expected that planning strategies would mediate the effect of intention on behaviour. Relations in the proposed models were expected to be similar across the behaviours. A two-wave prospective design was adopted. Three samples of high-school students (total  $N = 1041$ ; 59.60% female;  $M$  age = 17.13 years  $\pm$  1.57) completed measures of perceived autonomy support, autonomous motivation, theory of planned behaviour constructs, planning strategies and behaviour for each of the three behavioural contexts. Three months later, 816 participants (62.24% female;  $M$  age: 17.13 years,  $SD = 1.58$ ) of the initial sample self-reported their behaviour referred to the previous three months. Structural equation models provided support for the key hypothesised effects of the proposed model for the three health-related behaviours. Two direct effects were significantly different across the three behaviours: the effect of perceived autonomy support on perceived behavioural control and the effect of attitude on intention. In addition, planning strategies mediated the effect of intention on behaviour in fruit and vegetable sample only. Findings extend knowledge of the processes by which psychological antecedents from the theories affect energy-balance related behaviours.

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Eating fruit and vegetables, eating breakfast, and avoiding snacks have been identified as three important behaviours to target in order to promote health and reduce chronic illness risk (Van Duyn & Pivonka, 2000; World Health Organization & UN Food and Agriculture Organization, 2003). The consumption of fruit and vegetables has been associated with a variety of physical benefits including the prevention of obesity, cardiovascular disease, and cancer (Van Duyn & Pivonka, 2000). In addition, evidence from the seminal 'Alameda 7' study identified eating breakfast and avoiding snacking as two of seven key healthy habits that contributed to good long term health and reduced premature

mortality (Belloc & Breslow, 1972). As such, it is important for researchers to investigate the psychological factors that affect these health-related behaviours in order to promote health. These factors may have a role in the development of campaigns, recommendations, and interventions that may promote good health and minimise chronic disease risk.

Research into the antecedent factors and processes that underpin people's motivation to engage in health-related behaviour has been conducted from a number of different theoretical perspectives (Hagger & Chatzisarantis, 2009). Prominent among these theories are the theory of planned behaviour, self-determination theory, and the health action process approach (HAPA). Each has been applied to predict and understand health-related behaviour and provide a basis for intervention. In the present study, we aim to integrate these approaches to provide a comprehensive, multi-theory model that explains the special psychological factors and apply the model

\* Corresponding author. Department of Psychology of Development and Socialization Processes – Sapienza, University of Rome, Via dei Marsi, 78-00185 Roma, Italy.

E-mail address: [laura.girelli@uniroma1.it](mailto:laura.girelli@uniroma1.it) (L. Girelli).

to predict variance in three key dietary-related behaviours (eating fruit and vegetables, eating breakfast, and reducing snacking), regular participation in which has been shown to be associated with reduce risk of chronic illness. In the next sections we outline the tenets of the three models and provide a basis for their integration consistent with previous work on theoretical integration (Hagger & Chatzisarantis, 2009).

One of the most prominent social psychological theories applied to health behaviour is the theory of planned behaviour (Ajzen, 1991), a specific version of the more generalised integrated behavioural model or reasoned action approach (Fishbein & Ajzen, 2010; Head & Noar, 2014; Montano & Kasprzyk, 2008). According to theory of planned behaviour (Ajzen, 1991) the most proximal and salient predictor of behaviour is behavioural intention, which is a function of three belief-based social cognitive constructs: attitudes – the extent to which individuals have a favourable or unfavourable evaluation of the behaviour; subjective norms – the social pressure individuals perceive with regard to whether or not they are expected to act that behaviour; and perceived behavioural control – the beliefs people hold about resources they have to enact the behaviour and their capacity to overcome barriers. This approach has demonstrated to be effective in predicting health-related behaviour in a large number of contexts (Armitage & Conner, 2001) including the consumption of fruit and vegetables (Allom & Mullan, 2012; Kothe, Mullan, & Butow, 2012), breakfast consumption (Mullan, Wong, & Kothe, 2013a; Wong & Mullan, 2009) and avoiding snacking (Branscum & Sharma, 2011).

While the theory of planned behaviour adopts a social cognitive, information processing approach to understanding health behaviour, a different approach from a conceptual and epistemological perspective, is offered by self-determination theory (Deci & Ryan, 1985). The theory takes a needs-based organismic perspective which focuses on the quality of the motivation of an individual toward behaving in a given context and the environmental variables that predict motivation in that context. A prominent feature of the theory is the distinction between self-determined and controlled forms of motivation. Individuals with self-determined or autonomous motives experience a sense of personal choice and autonomy in the implementation of certain behaviours, whereas individuals with a non-self-determined or *controlled* motives feel pressured and coerced into implementing their behaviour from external forces, perceived or real. Autonomous motivation has a positive effect on the implementation of, and persistence with, behaviour in various health-related behaviours such as physical activity, smoking cessation, control of diabetes, and dental care (Halvari, Halvari, Bjornebekk, & Deci, 2012; Silva et al., 2010; Williams et al., 2011). Consistent with the tenets of self-determination theory, motivation can be encouraged through autonomy-supportive behaviours offered by significant figures in the social context in which the individual is engaged. In addition, perceptions that significant others engage in autonomy-supportive behaviours, such as providing choice and giving a reason or rationale for the implementation of a behaviour, accepting the perspective of the individual and providing feedback on skills, has been shown to promote autonomous motivation (Chatzisarantis, Hagger, & Smith, 2007). In turn, autonomous motivation has been shown to predict intentions and actual behavioural engagement such that the effect of perceived autonomy support on action is mediated by autonomous motivation (Deci & Ryan, 2000; Hagger & Chatzisarantis, 2008).

Health Action Process Approach (HAPA) is a recently-developed social-cognitive model of health behaviour which adopts a dual-phase approach to understanding and predicting behaviour. The model contends that the performance of health behaviour involves two key phases: a motivational phase and a volitional phase (Schwarzer, 2008). The motivational phase charts how individuals

form intentions whether or not to adopt a behaviour. The volitional phase outlines how intentions are translated into actual behaviour and behavioural maintenance through planning, maintenance self-efficacy, and recovery self-efficacy (Schwarzer et al., 2003). However, the most commonly used version of the HAPA views the stages as a continuum where planning mediates the intention–behaviour relation (Schwarzer, 2008). This means that individuals with high intentions are more likely to engage in action planning, and those who plan are consequently more likely to perform their behaviour (Sutton, 2008). The HAPA has been applied to a number of healthy eating behaviours including fruit and vegetable consumption (Luszczynska, Tryburcy, & Schwarzer, 2007), adopting or maintaining a healthy diet (Schwarzer & Renner, 2000), eating breakfast (Mullan, Wong, Kothe, & Maccann, 2013b), the restriction of unhealthy food (van Osch et al., 2009), and weight loss through diet and exercise (Hattar, Hagger, & Pal, 2015).

## 1. Integrating the theories

Recent research has integrated self-determination theory and the theory of planned behaviour because the processes they explain can be complementary (Hagger & Chatzisarantis, 2012, 2014). A growing body of research has indicated that motivational variables from self-determination theory can exert effects on social cognitive variables from the theory of planned behaviour (Hagger, Barkoukis, Chatzisarantis, Wang & Baranowski, 2005; Hagger & Chatzisarantis, 2009; Hagger & Chatzisarantis, 2014). The integration is based on the link between self-determined motivation and the beliefs that underpins the proximal antecedents of behavioural intentions: attitudes, subjective norms and perceived behavioural control. The theory of planned behaviour, like other social cognitive theories, suggests that individuals' belief-based constructs such as attitudes arise from an evaluation of the propensity of the behaviour to yield certain outcomes and the evaluation of those outcomes. That is, the development arises from an evaluation of the behaviour, situation, and context in which the behaviour will be conducted, i.e. a bottom-up process. Such evaluative, conditional, future statements are also informed from learned experiences with the behaviour and like behaviours, i.e. top-down. However, the top-down influences on beliefs can be derived from other motivational orientations that drive behaviour. In the original conceptualization of self-determination theory, such a process was implied by Deci and Ryan (1985): "Cognitive theories [such as the theory of planned behaviour] begin their analysis with ... a motive [such as intentions], which is a cognitive representation of some future desired state. What is missing, of course, is the consideration of the conditions of the organism that makes these future states desired" (p. 228). In other words, individuals will align their social cognitive beliefs like attitudes with their autonomous motives because those beliefs are perceived will lead to future engagement in behaviour to achieve intrinsically- or autonomously-valued outcomes. Hagger and Chatzisarantis (2015) have argued that individuals align their attitudes and perceptions of control, and intentions, with their needs-based motives as a goal-directed strategy to engage in future needs-satisfying behaviour. Similarly, individuals may align their beliefs with controlling motives but such beliefs may not lead to behavioural persistence given that controlled motives focus on extrinsic outcomes which, if removed, may signal an individual to believe that there is no value in pursuing the behaviour.

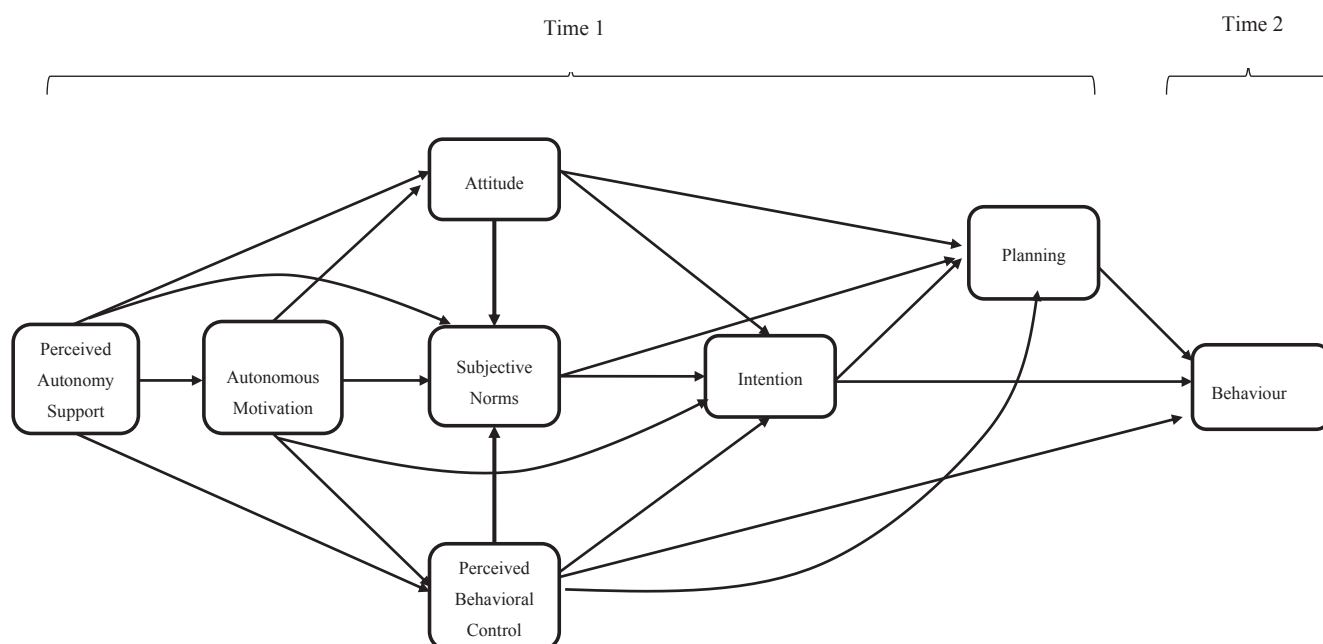
An interesting addendum to this theorizing is the role that subjective norms play in mediating the effects of beliefs from self-determination theory on behaviour. Typically, subjective norms tend to reflect social pressure to engage in behaviour, a fact that has been recognised in previous research (Chatzisarantis & Biddle, 1998; Sheeran, Norman, & Orbell, 1999), and there is evidence

that controlled forms of motivation are more likely associated with subjective norms (e.g., [Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003](#)). Nevertheless, there is also evidence that autonomous motivation positively predicts subjective norms ([Hagger & Chatzisarantis, 2009, 2015](#)) and that the effects vary across samples and contexts (e.g., [Hagger, Barkoukis, Chatzisarantis, Wang, & Baranowski, 2005](#)). This issue presents somewhat of a conundrum for the integrated model – how can subjective norms be related to autonomous forms of motivation in one context, and controlled forms in another? The answer lies in the extent to which the individual has internalised the desires and expectations of significant others. Internalizing the endorsement of significant others and performing behaviours consistent with those endorsements means that individuals believe those significant others to act in their best interest and support their true sense self. They will therefore feel autonomous when they act even though they are doing it at the behest of others. Actions and behaviours that are not endorsed by significant others are likely to be externally reference, perceived as controlled, and are likely to lead to beliefs that one engages in the behaviour for external reasons i.e. to comply with those others. In the current study we predicted that subjective norms would not be predicted by autonomous motivation ([Hagger et al., 2003](#)), or would have a negative effect ([Barkoukis, Hagger, Lambropoulos, & Torbatzoudis, 2010](#)), consistent with the conceptualization of the integrated model. However, it is clear that in contexts where others' beliefs are internalised by the individual, an alternative hypothesis is that there will be an effect of autonomous motivation on subjective norms ([Hagger & Chatzisarantis, 2009](#)). The effect indicates that individuals may form beliefs about future behaviour because it services their needs-based motive to engage in the behaviour consistent with the desires of the internalised significant others.

Consistent with the proposed integration, research has shown that individuals have close correspondence between their beliefs and motives ([McLachlan & Hagger, 2010](#)) and also can and do make the distinction between self-determined and controlled beliefs ([McLachlan & Hagger, 2011](#)). For example, some beliefs about outcomes can be interpreted as self-determined (outcomes that people chose to seek) or controlled (outcomes that people feel

compelled to engage in). Considering health-related behaviours, for some people eating a healthy diet can be self-determined because they value being healthy and it is representative of their true self. Others people may be motivated to eat a healthy diet to lose weight or to be more attractive for others, i.e. for controlled reasons ([McLachlan & Hagger, 2011](#)). Therefore, self-determined motives are hypothesised to be a distal predictor as an antecedent of attitudes and PBC. Attitudes and PBC are, in turn, proximal predictors of the formation of intentions to engage in future health-related behaviour in accordance with the theory of planned behaviour. Therefore a motivational sequence is proposed such that the effects of perceived autonomy support on attitude, subjective norm, and PBC are mediated by the motivational constructs from self-determination theory, and that the three theory of planned behaviour variables mediate the effect of the motivational variables from self-determination theory on intention and health behaviour ([Hagger, Chatzisarantis, & Harris, 2006a; Hagger, Chatzisarantis, & Harris, 2006b](#)). The tenets of this integrated model have been examined for a number of health-related behaviours such as myopia prevention ([Chan, Hagger, & Fung, 2012](#)), injury prevention ([Chan & Hagger, 2011](#)), binge drinking reduction ([Hagger et al., 2012](#)), physical activity ([Chatzisarantis et al., 2007](#)), healthy eating ([Hagger et al., 2006a,b](#)), dental treatment ([Halvari, Halvari, Bjornebekk, & Deci, 2010](#)), and sleep hygiene ([Kor & Mullan, 2011](#)). A meta-analysis ([Hagger & Chatzisarantis, 2009](#)) also confirmed the predictive validity of the integrated model across a number of studies in health-related behavioural contexts.

A large body of research in numerous behavioural domains has demonstrated that furnishing intentions with action plan is effective in promoting better behavioural enactment ([Hagger & Luszczynska, 2014; Schwarzer, 2008](#)). Following this evidence, we propose a volitional “phase” to our model, with action planning forming an important mediator of intention–behaviour relationship to account for the insufficiency of intentions. Within the integrated model, the introduction of planning as a mediator of the relation between intention and behaviour is well specified in approaches that specify dual-phases of action such as the HAPA. Furthermore, the integrated model has been further augmented with action plans as a key



**Fig. 1.** Hypothesized integrated model from perceived autonomy support to intentional behaviour in the three samples.

mediator of the intention–behaviour relationship (Hagger & Chatzisarantis, 2014). This means that the volitional phase has been incorporated into the integrated model to account for the process by which intentions are converted into action.

Few studies have adopted integrated models of social cognition and motivation to predict healthy eating. One of the studies using undergraduate students examined dieting behaviour (e.g., watching one's diet without necessarily being on a dietary program; Hagger et al., 2006a,b). The study confirmed the predictive validity of the model in healthy eating behaviours. Neither study however considered the impact of the integrated model on health-related food choices in adolescents. Moreover, neither study considered the impact of the model on three aspects of healthy eating behaviour separately and then compared the strength of the effects across behaviours. Finally, the study did not account for volitional processes by incorporating planning as a mediator of the intention–behaviour relationship. Our study is the first investigation that integrates the theory of planned behaviour, self-determination theory and HAPA into a unified model to explain three healthy eating behaviours in adolescents.

## 2. The present study

Based on the theory of planned behaviour, self-determination theory, and previous research on the integration of the two theories (Chan & Hagger, 2012a, Chan & Hagger, 2012b, Chan & Hagger, 2012c; Hagger & Chatzisarantis, 2009), we propose a motivational sequence in which perceived autonomy support is envisaged as a predictor of autonomous motivation; autonomous motives predict attitudes and perceived behavioural control, but the effect on subjective norms is not significant or negative (Hagger et al., 2006a,b); the effect of perceived autonomy support on the constructs of theory of planned behaviour is mediated by autonomous motives; attitudes, subjective norms and perceived behavioural control predict intention; the effects of autonomous motives on intention are mediated by attitudes and perceived behavioural control (Hagger et al., 2003), but not by subjective norms; intention is a predictor of behaviour, although a direct effect of perceived behavioural control is included in accordance with Ajzen (1991). It is important to note that for fruit and vegetable and breakfast samples, intention is hypothesised to be a positive predictor of behaviour, whereas in snacking sample it is expected to be a negative predictor since the intention measure used is worded as avoiding this behaviour while the behavioural measure asks how much snacking the participant has done. Furthermore, in accordance with the HAPA model (Schwarzer, 2008) it is also hypothesised that the relationship between intention and behaviour will be mediated by planning. The proposed model is depicted in Fig. 1.

## 3. Method

### 3.1. Participants and procedures

The sample comprised 1041 high schools students (59.60% female;  $M$  age = 17.13 years,  $SD$  = 1.57; age range 14–22 years) from three high schools in Rome, Italy. A two-wave prospective survey design was employed. Participants were assigned randomly to the fruit and vegetable consumption, eating breakfast, and avoiding snack behavioural group. Each target behaviour was defined for the participants in a standardised set of instructions. In the first wave of data collection, questionnaires measuring perceived autonomy support, motivation, attitudes, subjective norms, perceived behavioural control, intention, planning, and behaviour. In the second wave of data collection, conducted three months later, self-reported measures of the behaviour were administered.

Participants were required to complete self-reported measures of the behaviour to which they were assigned for the previous three months. Questionnaires were completed anonymously to preserve confidentiality and data collected in the first wave were matched with the ones in the second wave by using a personalised code. Attrition rate across the two times of data collection due to absences or inability to match the data was 21.61%, leaving a total of 816 participants (62.24% female;  $M$  age: 17.13 years,  $SD$  = 1.58).

### 3.2. Measures

Behaviour-specific versions of each measure were developed for the fruit and vegetable consumption, eating breakfast, and restricting the consumption of snack behaviours in the present study. We developed measures of constructs from the component theories of the adopted integrated model based on previous research (Ajzen, 2003; Ryan & Connell, 1989).<sup>1</sup>

#### 3.2.1. Perceived autonomy support

Three modified versions of the Perceived Autonomy Support Scale for Exercise Setting (Hagger et al., 2007), one for each behaviour, were used to assess perceived autonomy support from participants' parents in the first wave of data collection (Fruit and vegetable consumption: "I feel that my parents provide me with the opportunity to eat a least 5 portions of fruit and vegetables everyday over the next 3 months"; Eating breakfast: "I feel that my parents provide me with the opportunity to eat breakfast everyday over the next 3 months"; Avoiding snacking: "I feel that my parents provide me with the opportunity to restrict the consumption of snack over the next 3 months"). Each scale comprises 11 items with responses made on seven-point Likert-type scales from *not true at all* (1) to *very true* (7).

#### 3.2.2. Autonomous motivation

Autonomous motivation was measured in the first wave of data collection using an adapted version of Ryan and Connell (1989) Perceived Locus of Causality. Three behaviour-specific versions of the scale were developed and each was initially presented with a common stem (Fruit and vegetable consumption: "Why do I eat at least 5 portions of fruit and vegetables everyday?"; Eating breakfast: "Why do I eat breakfast everyday?"; Avoiding snacking: "Why do I try to restrict my consumption of snack?"). Respondents were then asked to rate several reasons pertaining to four regulation styles: intrinsic motivation (e.g., "... because I find it enjoyable"), identified regulation (e.g., "... because I know the benefits of [health behaviour]"), introjected regulation (e.g., "... because I feel guilty if I don't"), external regulation (e.g., "... because it's what I'm supposed to do). For each of the three scales, there were four items

<sup>1</sup> While there is a level of congruency and in the measures of constructs from the theory of planned behaviour and the self-determination theory, the measures differ in their orientation and content consistent with their underpinning theories. Measures of self-determination theory constructs are context-tied reasons for engaging in a given behaviour (e.g., "I eat at least 5 portions of fruit and vegetable everyday because I enjoy it"). In contrast, theory of planned behaviour constructs such as intentions, attitudes, subjective norms, and perceived behavioural control are measured with respect to expectations regarding engaging in a given behaviour in the future (e.g., "I think eating 5 portions of fruit and vegetable everyday for the next three months, is good/bad"). These examples demonstrate the distinction between orientation and belief (or expectation) in the conceptualization of the measures. We also note the overlap in the meaning of the measures reflects the theoretical congruence of the constructs and are purpose-built measures developed independently to tap these constructs. However, like all studies adopting psychometric inventories to tap psychological constructs, the potential for additional variance to be introduced in the data due to the use of common methods should be recognised and acknowledged of a caveat.



for each regulation style with responses given on seven-point Likert-type scales ranging from *not true at all* (1) to *very true* (7).

Measures of theory of planned behaviour constructs were developed in accordance with standard instructions (Ajzen, 1991) and based on measures used in previous studies (Mullan et al., 2013a; Wong & Mullan, 2009).

### 3.2.3. Attitudes

Attitudes were measured in the first wave of data collection. Three measures of attitude were developed with six items for each measure, with responses provided on seven-point semantic differential scales with the bipolar adjectives: 'bad–good', 'harmful–beneficial', 'unenjoyable–enjoyable', 'useful–useless', 'foolish–wise', and 'unpleasant–pleasant', in response to a common stem for each scale: "I think eating 5 portions of fruit and vegetables everyday/eating breakfast everyday/restricting the consumption of snack for the next three months, is ...".

### 3.2.4. Subjective norms

Subjective norms were assessed in the first wave of data collection with three different scales, one for each behaviour (e.g. "My parents would want me to eat 5 portions of fruit and vegetables everyday/eat breakfast everyday/to restrict the consumption of snack over the next three months"). There were three items for each scale, with responses given on a seven-point Likert-type scales ranging from *strongly disagree* (1) to *strongly agree* (7) endpoints.

### 3.2.5. Perceived behavioural control

Perceived behavioural control was measured in the first wave of data collection on three different scales, one for each behaviour with each comprising three items (e.g. "I'm confident I can eat at least 5 portions of fruit and vegetables everyday/breakfast everyday/restrict the consumption of snack everyday over the next three months"). Responses were made on seven-point Likert-type scales ranging from *strongly disagree* (1) to *strongly agree* (7).

### 3.2.6. Intention

Behavioural intention was assessed at the first wave of data collection using three different scales, one for each behaviour. Each scale comprised four items ("I intend to eat at least 5 portions of fruit and vegetables everyday/to eat breakfast everyday/to restrict the consumption of snack everyday over the next three months") with responses made on seven-point Likert-type scales ranging from *strongly disagree* (1) to *strongly agree* (7).

### 3.2.7. Planning

Measures of planning were developed using the Action Planning and Coping planning Scales (Sniehotka, Scholz, & Schwarzer, 2005) adapted for adolescents. Planning was assessed in the first wave of data collection using three different scales, one for each behaviour. Each scale comprised seven items, four for action planning (e.g., "I've already planned how I will organise to eat fruit and vegetable") and three for coping planning (e.g., "I'm going to make a detailed plan about how to eat fruit and vegetables if I don't have time") with responses made on seven-point Likert-type scales ranging from *not true at all* (1) to *very true* (7).

### 3.2.8. Self-reported behaviour

Self-reported fruit and vegetable consumption, eating breakfast and snacking behaviour was measured in the first wave and at the second wave of data collection, three months after the first wave. We used adapted versions of measures developed to estimate behavioural frequency in a previous study (Mullan et al., 2013a). Participants rated their three-months behavioural frequency on three separate scales, each comprising four items (e.g., Fruit and

vegetable consumption: "In the course of the last three months, how many times per week on average did you eat 5 portions of fruit and vegetable?"; Eating breakfast: "In the course of the last three months, how many times per week on average did you eat breakfast?"; Snacking: "In the course of the last three months, how many times per week on average did you eat snack?") using a seven-point Likert scales with scale endpoints of *once a week or less* (1) to *everyday* (7). It is important to note that the behavioural measures of fruit and vegetables and breakfast consumption are expected to be correlated positively with intention measures for these behaviours. This is because the intention measures are worded in terms of engaging in these behaviours. In contrast, the correlation between intention and behaviour for the snacking measure is expected to be negative because the intention measure is worded in terms of avoiding this behaviour.

### 3.2.9. Translation

All questionnaires were translated from English to Italian, the first language of the participants. The translation was conducted by two English–Italian bilinguals using standardised back translation procedures (Hambleton & Patsula, 1998).

### 3.3. Data analysis

Analyses were conducted separately for each sample. First, in order to maximise the parsimony of the models tested in this study, we collapsed the four constructs from the PLOC into a single index of autonomous motivation, called Relative Autonomy Index (RAI, Vallerand & Ratelle, 2002). According to a standardised procedure suggested by Grolnick and Ryan (1987), weights were assigned to each of the items according to their relative position on the continuum. Therefore items from the intrinsic motivation scale were assigned a weight of +2, identified regulation items a weight of +1, introjected regulation items a weight of –1 and external regulation items a weight of –2 for each behaviour. All the resulting weighted item scores were then multiplied to produce a composite parcelled item score for the indication of a latent RAI factor. As there were four items for each scale, four parcelled RAI items were produced using this system. Therefore each parcelled item reflected a participant's degree of relative autonomy with high scores representing higher levels of autonomy. These parcels were used as indicators of a single latent RAI factor according to the procedure used in previous studies (Hagger et al., 2006a,b).

Data were initially analysed by confirmatory factor analysis (CFA) with latent variables to test for the construct and discriminant validity of the study measures for each sample. Then, the hypothesised relations among the perceived autonomy support, RAI, attitude, subjective norms, perceived behavioural control, intention and planning constructs measured at Time 1 and behaviour measured at Time 2 were tested in a Structural Equation Model (SEM) (Fig. 1). Data were screened for multivariate normality. Specifically, we calculated Mardia's Index for the data in each sample, and compared it with the critical value. Mardia's Index was slightly above critical value for the data in two of the samples (788.40 and 862.40, respectively, for the fruit and vegetable and breakfast samples, against a critical value of 783), indicating multivariate non-normal distributions. For snacking sample, multivariate normality was supported (Mardia's Index = 750.99 against the critical value of 783). Considering these results, our models were estimated using a robust maximum likelihood estimation method with the Mplus Program, which has been shown to provide stable estimates under conditions of multivariate non-normality (Muthén and Muthén, 1998–2012). Goodness-of-fit of the proposed models with the data was evaluated using Goodness of fit multiple recommended indexes: the Comparative Fit Index

(CFI), the Root Mean Square Error of Approximation (RMSEA), the Standardised Root Mean Squared Residuals (SRMR) and the Chi square/df ratio. Cut-off values of .90 or above for the CFI indicated acceptable models, although values greater than .95 were preferable (Hu & Bentler, 1999). Values of .08 or less for the RMSEA and the SRMR were deemed satisfactory for well-fitting models (Hu & Bentler, 1999). The chi square/df ratio should be below two (Tabachnick & Fidell, 2007). However, Kline (1998) suggested that a chi square/df ratio of 3 or less is a reasonably good indicator of model fit.

Furthermore, in order to control for past behaviour, we conducted a further analysis of the data that included behaviour measured at Time 1 as a control variable which predicted all other variables in the model (Hagger, Sultan, Hardcastle, & Chatzisarantis, 2015). Finally, following Preacher and Hayes' (2008) procedure, hypothesised mediation effects were tested for each sample by calculating indirect effects and 95% confidence intervals using a bootstrapped resampling method with 5000 resamples. Mediation was confirmed by the presence of a statistically significant bootstrapped indirect effect.

## 4. Results

### 4.1. Descriptive statistics

Eight-hundred and sixteen participants completed the questionnaire at Time 1 and Time 2 (62.24% female;  $M$  age = 17.13 years,  $SD$  = 1.58, age range 14–22 years). The sample comprised 258 participants in the fruit and vegetable sample (63.95% female;  $M$  age = 16.92,  $SD$  = 1.57), 287 participants in the breakfast sample (58.47% female;  $M$  age = 17.21,  $SD$  = 1.61), and 271 participants in the avoiding snack sample (64.66% female;  $M$  age = 17.21,  $SD$  = 1.55). Univariate analyses of variance on age, gender distribution, and all the key measured variables showed no significant differences between participants filled out both Time 1 and Time 2 assessments and those that dropped out after Time 1. Participants of the final sample responded to all questions and, thus, there was no missing data on the measured variables of the study.

Zero-order correlations between age and behaviour were not statistically significant in all the three contexts. Univariate analyses of variance of the effect of gender distribution on behaviour showed a statistically significant gender effect in the fruit and vegetable sample, ( $F_{(1,256)} = 4.53$ ,  $p = .03$ ,  $d = .27$ ) with females more likely to consume fruit and vegetables ( $M = 3.10$ ,  $SD = 1.68$ ) than males ( $M = 2.65$ ,  $SD = 1.43$ ), although the effect size was small. No significant gender differences were found on the behavioural outcome in the breakfast and snack consumption samples.

Descriptive statistics, Cronbach's alpha reliability estimates, and zero-order intercorrelations among all the key variables of the study are reported in Table 1.

### 4.2. Fit of the models

Goodness of fit indexes for the CFA and the SEM for the three samples are given in Table 2. The fit of the models for the CFA and the SEM met the multiple criteria for adequate model fit for each sample. Overall, both for CFA and SEM models, factor loadings of each latent variable were statistically significant ( $p < .001$ ) and above .32, that is the minimum value that has been cited as the minimum acceptable criterion for a factor loading (Tabachnick & Fidell, 2007).

### 4.3. Testing model relationships

Standardised path coefficients for the free parameters in the

path analyses for each sample are depicted in Figs. 2–4, respectively. Standardised path coefficients for mediated effects for each sample are given in Table 3.

**Hypothesis 1.** For the fruit and vegetable, breakfast and avoiding snacking sample, perceived autonomy support from parents was statistically significant predictor of autonomous motivation as hypothesised.

**Hypothesis 2.** In accordance with our hypothesis, there was a significant direct effect of autonomous motivation on attitudes and perceived behavioural control in all samples. Also, as expected, the effect of autonomous motivation on subjective norms was not statistically significant for the fruit and vegetable sample, and statistically significant and negative in breakfast and avoiding snacking sample. This means we could reject the alternative hypothesis of a statistically significant, positive effect.

**Hypothesis 3.** We also hypothesised that the effect of perceived autonomy support on attitude, subjective norms, and perceived behavioural control would be mediated by autonomous motives. In the fruit and vegetable and breakfast samples, there were statistically significant indirect effects of perceived autonomy support on attitude and perceived behavioural control consistent with our hypothesis that autonomous motives mediated the relationship between perceived autonomy support and attitude, and between perceived autonomy support and perceived behavioural control. However, the indirect effect of perceived autonomy support on subjective norms was not statistically significant, so, in these two samples, only the hypotheses relating to attitudes and perceived behavioural control could be supported. In contrast, we found statistically significant indirect effects of perceived autonomy support on attitude, subjective norms, and perceived behavioural control in the snacking sample. These findings indicate that autonomous motives mediated the relationship between perceived autonomy support and attitudes, subjective norms, and perceived behavioural control. Findings are consistent with our hypothesis that there would be indirect effects of perceived autonomy support on the psychological antecedents of intention mediated by autonomous motivation.

**Hypothesis 4.** In the fruit and vegetable sample, only perceived behavioural control significantly and directly predicted behavioural intention; the effects of attitude and subjective norms on intention were not statistically significant, so this hypothesis was rejected. In the breakfast sample, perceived behavioural control and subjective norms significantly predicted behavioural intention while the effect of attitude was not statistically significant so again, this hypothesis was rejected. In the snacking sample, all the three TPB constructs (i.e., attitude, subjective norms, and perceived behavioural control) significantly predicted intention, so only in this sample was the hypothesis supported.

**Hypothesis 5.** We also hypothesised that the effect of autonomous motives on intention would be mediated by attitudes and perceived behavioural control but not by subjective norms. In the fruit and vegetable and in the breakfast samples, the specific indirect effect between autonomous motives and intention by perceived behavioural control was statistically significant, that confirmed that the relationship between autonomous motives and intention was mediated by perceived behavioural control. In addition, in these two samples, the specific indirect effect of autonomous motivation on intention by subjective norms was not statistically significant, as hypothesised. However, the specific indirect effect of autonomous motivation on intention mediated by attitude was not statistically significant, so our hypothesis was not supported in these samples. In the snacking sample, the specific

**Table 1**  
Descriptive statistics, reliability coefficients, and zero-order correlations of the key variables of the study measured at Time 1, and the behaviour measured at Time 2.

	Mean (SD)	Cronbach's alpha	Correlations							
			1	2	3	4	5	6	7	8
1) Perceived autonomy support										
Fruit and vegetable	5.01 (.99)	.81	—							
Breakfast	5.57 (1.19)	.89	—							
Snacking	5.17 (1.17)	.86	—							
2) Autonomous motivation (RAI)										
Fruit and vegetable	.92 (1.24)	.70	.23	—						
Breakfast	1.64 (1.26)	.67	.32	—						
Snacking	1.06 (.98)	.50	.15	—						
3) Attitudes										
Fruit and vegetable	5.33 (1.06)	.80	.32	.44	—					
Breakfast	5.78 (1.49)	.87	.44	.49	—					
Snacking	5.24 (1.10)	.78	.45	.27	—					
4) Subjective norms										
Fruit and vegetable	5.44 (1.20)	.74	.45	.09	.36	—				
Breakfast	5.80 (1.38)	.82	.61	.14	.27	—				
Snacking	4.94 (1.54)	.83	.55	-.08	.37	—				
5) Perceived Behavioural control										
Fruit and vegetable	5.36 (1.24)	.60	.27	.51	.49	.29	—			
Breakfast	6.02 (1.22)	.66	.45	.42	.46	.21	—			
Snacking	5.60 (1.05)	.55	.16	.40	.32	.09	—			
6) Intention										
Fruit and vegetable	4.25 (1.68)	.92	.41	.44	.53	.36	.61	—		
Breakfast	5.40 (1.83)	.94	.53	.48	.53	.35	.64	—		
Snacking	4.98 (1.71)	.93	.53	.21	.48	.53	.33	—		
7) Planning										
Fruit and vegetable	3.05 (1.47)	.86	.30	.09	.19	.13	.22	.41	—	
Breakfast	3.53 (1.65)	.87	.45	.23	.30	.28	.31	.50	—	
Snacking	3.71 (1.61)	.90	.36	.07	.27	.29	.12	.50	—	
8) Behaviour (Time 1)										
Fruit and vegetable	2.94 (1.67)	.93	.38	.41	.35	.21	.45	.54	.25	—
Breakfast	5.40 (2.03)	.96	.41	.44	.44	.17	.61	.71	.39	—
Snacking	3.01 (1.58)	.93	-.14	-.16	-.18	-.11	-.30	-.26	-.08	—
9) Behaviour (Time 2)										
Fruit and vegetable	2.94 (1.61)	.93	.29	.44	.21	.09	.42	.36	.27	.53
Breakfast	5.37 (2.04)	.97	.39	-.14	.40	.16	.57	.67	.38	.83
Snacking	2.97 (1.49)	.92	-.21	.21	-.20	-.04	-.29	-.32	-.10	.54

Note. All the correlations are statistically significant for  $p$ -level < .05, with the exception of the underlined values.

indirect effect between autonomous motives and intention mediated by subjective norms was statistically significant meaning that the relationship between autonomous motives and intention was mediated by subjective norms, contrary to our hypothesis. Furthermore, the specific indirect effect of autonomous motivation on intention by attitude and perceived behavioural control was not statistically significant, so in this sample this hypothesis was not supported.

**Hypotheses 6 and 7.** Behavioural intention significantly predicted behaviour in all samples so hypothesis 6 was confirmed in all samples. In the fruit and vegetable sample intention was hypothesised to be a positive predictor of behaviour whereas the relationship between intention and behaviour was proposed to be negative. Furthermore, as hypothesised, perceived behavioural

control was statistically significant direct predictor of behaviour in all samples, so hypothesis 7 was supported in all samples.

**Hypothesis 8.** Finally, we hypothesised that the relationship between intention and behaviour would be mediated by planning. In the fruit and vegetable sample, the statistically significant indirect effect of intention on behaviour, confirms the hypothesis that planning mediated the relationship between intention and behaviour. In contrast, this hypothesis was not supported in the breakfast or snacking samples.

#### 4.4. Testing model relationships and controlling for past behaviour

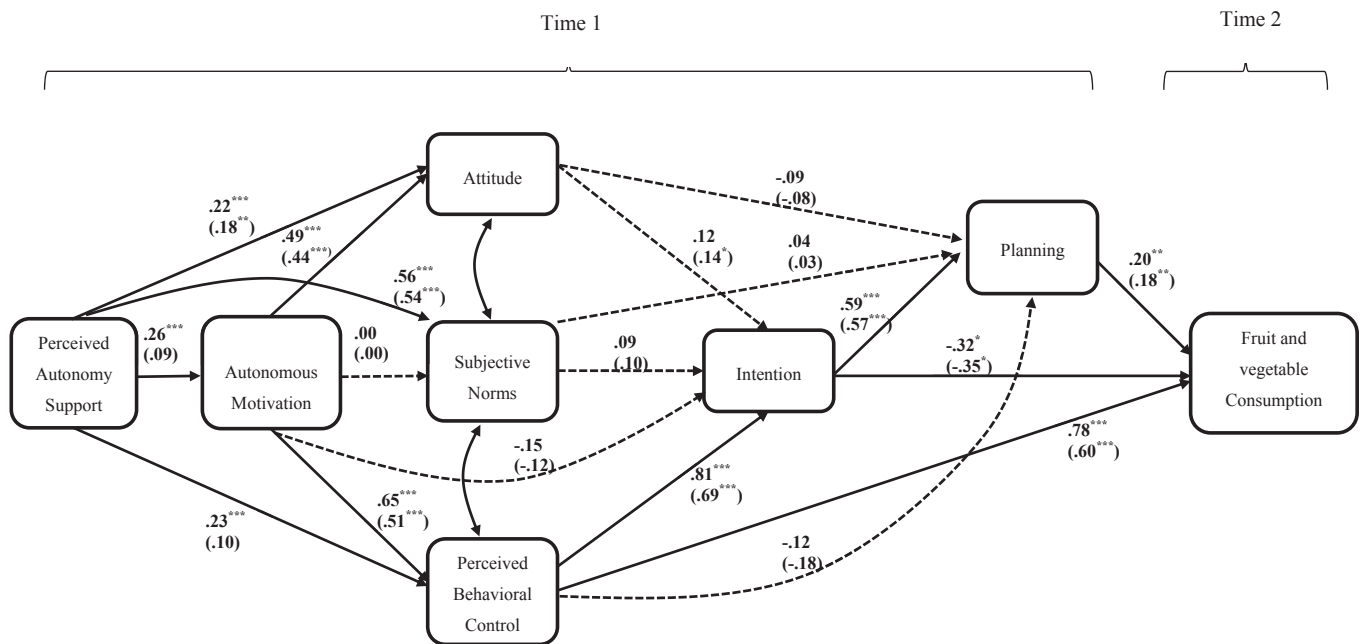
Goodness of fit indexes for the CFA and the SEM for the models in which we controlled for past behaviour measured at Time 1 are in square parentheses in Table 2. Overall, in all samples, the fit of the models were almost identical to that exhibited by the models without controlling for past behaviour. SEM standardised path coefficients for each sample controlling for Time 1 behaviour, are depicted in parentheses in Figs. 2–4, respectively.<sup>2</sup> As reported in these figures, the pattern of relationships was largely identical to

**Table 2**  
Goodness of fit indexes of confirmatory factor analysis and structural equation modelling of the integrated model for each sample.

	Fruit and vegetable		Breakfast		Snacking	
	CFA	SEM	CFA	SEM	CFA	SEM
CFI	.956	.952 [.946]	.949	.946 [.949]	.951	.948 [.951]
RMSEA	.047	.049 [.050]	.060	.061 [.059]	.049	.050 [.047]
SRMR	.050	.057 [.056]	.046	.050 [.047]	.054	.058 [.056]
Chi-square/df	1.73	1.79 [1.84]	2.30	2.30 [2.25]	1.82	1.85 [1.74]

Note. SEM goodness-of-fit indexes controlling for past behaviour measured at Time 1 are in square parentheses.

<sup>2</sup> Mediation effects for the models in which we controlled for behaviour measured at Time 1 were also estimated and are available from the first author on request (Appendix A). Differently from direct effects, the indirect effects changed randomly without a regular pattern.



Note. Standardized path coefficients for the structural equation model estimated controlling for behaviour measured at Time 1 are reported in parentheses. The effects of past behaviour measured at Time 1 on each variable in the model figure were omitted for clarity. These paths were freely estimated in the SEM analysis but not depicted in diagram: past behaviour → perceived autonomy support ( $\beta = .40, p < .001$ ); past behaviour → autonomous motivation ( $\beta = .42, p < .001$ ); past behaviour → attitude ( $\beta = .12, p = .08$ ); past behaviour → subjective norm ( $\beta = .04, p = .57$ ); past behaviour → perceived behavioural control ( $\beta = .35, p < .001$ ); past behaviour → intention ( $\beta = .11, p = .11$ ); past behaviour → planning ( $\beta = .08, p = .31$ ); past behaviour → behaviour at Time 2 ( $\beta = .32, p < .001$ ). Dashed lines indicate paths that were not statistically significant ( $p > .05$ ) in the SEM analysis without controlling for past behaviour.

\*\*\*  $p < .001$ ; \*\*  $p < .01$ ; \*  $p < .05$ .

Fig. 2. The results of the SEM analysis for the fruit and vegetable sample.

the models without past behaviour albeit with a slight reduction in the magnitude in the majority of the path coefficients. In some cases, controlling for Time 1 behaviour resulted in substantial changes in the magnitude of some paths. For example, in the fruit and vegetable sample, the effects of perceived autonomy support on autonomous motivation and on perceived behavioural control were attenuated such that they were no longer statistically significant. In contrast, the effect of attitude on intention, became statistically significant. In the breakfast sample, the effect of autonomous motivation on subjective norm, the effect of perceived behavioural control and of intention on behaviour were all extinguished with the inclusion of Time 1 behaviour. Finally, in the snacking sample, the effect of perceived behavioural control on intention was not statistically significant once Time 1 behaviour was included.

#### 4.5. Strength effect comparison

Finally, in order to evaluate the differences in effects strength between the three aspects of healthy eating behaviour, we compared each path in the model across the three behaviours using 95% confidence intervals of the path coefficient. Table of effects strength comparison is available from the first author on request

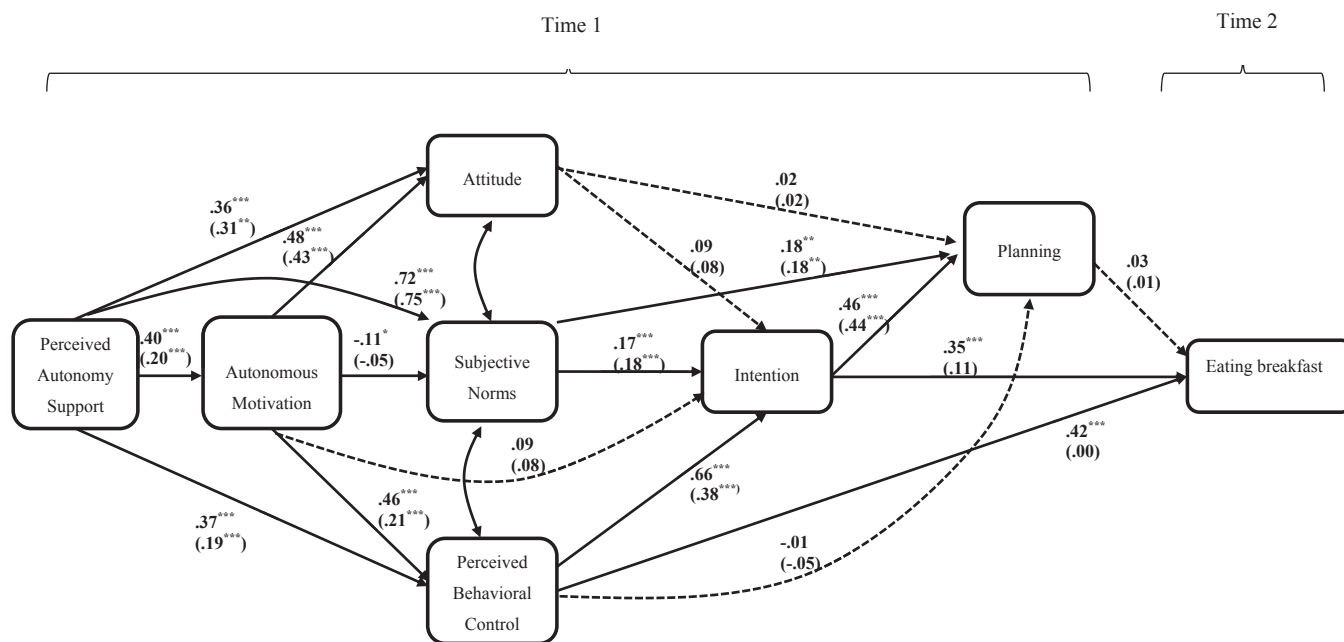
(Appendix B). We found a stronger effect of autonomous motivation on attitude for fruit and vegetable and breakfast behaviours, compared to avoiding snacking behaviour. Also, we found a stronger effect of perceived behavioural control on intention for fruit and vegetable and breakfast consumption samples, compared to avoiding snacking.

## 5. Discussion

The purpose of the present study was to test an integrated health behaviour model informed by hypotheses from the theory of planned behaviour, self-determination theory, and the HAPA to investigate the social psychological predictors of motivation and behaviour, and associated processes in three healthy eating behaviours: fruit and vegetable consumption, eating breakfast, and restricting snack consumption. Another aim of the study was to test whether the relationship between intention and behaviour was mediated by planning in the three behavioural contexts.

Findings from well-fitting models indicated overall good fit of data with the hypothesised integrated model in the three behavioural contexts. Specifically, perceived autonomy support was a significant predictor of autonomous motivation and attitude, autonomous motivation was a significant predictor of attitudes and





*Note.* Standardized path coefficients for the structural equation model estimated controlling for behaviour measured at Time 1 are reported in parentheses. The effects of past behaviour measured at Time 1 on each variable in the model figure were omitted for clarity. These paths were freely estimated in the SEM analysis but not depicted in diagram: past behaviour → perceived autonomy support ( $\beta = .45, p < .001$ ); past behaviour → autonomous motivation ( $\beta = .42, p < .001$ ); past behaviour → attitude ( $\beta = .15, p < .05$ ); past behaviour → subjective norm ( $\beta = -.12, p < .05$ ); past behaviour → perceived behavioural control ( $\beta = .58, p < .001$ ); past behaviour → intention ( $\beta = .33, p < .001$ ); past behaviour → planning ( $\beta = .06, p = .50$ ); past behaviour → behaviour at Time 2 ( $\beta = .76, p < .001$ ). Dashed lines indicate paths that were not statistically significant ( $p > .05$ ) in the SEM analysis without controlling for past behaviour.

\*\*\*  $p < .001$ ; \*\*  $p < .01$ ; \*  $p < .05$ .

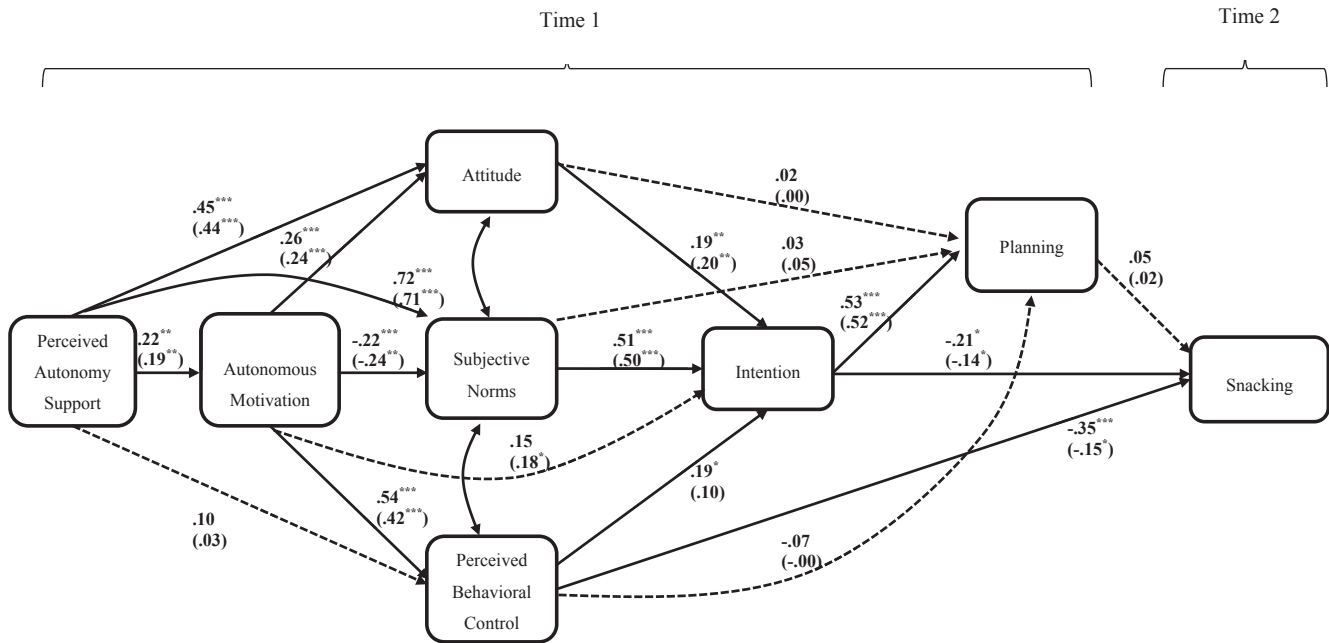
**Fig. 3.** The results of the SEM analysis for the breakfast sample.

perceived behavioural control, and perceived behavioural control was a significant predictor of intention and behaviour in all the three behavioural contexts. Moreover, intention was a significant predictor of behaviour and planning in all the three samples. There were also some important mediation effects in all three behavioural contexts. In fact, the effect of perceived autonomy support on attitude and on perceived behavioural control was mediated by autonomous motivation in all the three samples. This suggests that individuals' perceptions that significant others create an environment that supports autonomous motivation for a given health behaviour are associated with their attitudes and control beliefs with respect enacting that behaviour. This is consistent with previous research that has shown significant relations between the immediate antecedents of behavioural intentions from the theory of planned behaviour, namely attitudes and PBC, and autonomous forms of motivation from self-determination theory (Hagger & Chatzisarantis, 2009, 2015). Such research indicates that individuals are likely to form future beliefs about resources they have to enact that behaviours and a more favourable evaluation of that behaviour if their motives are self-determined. A likely mechanism for this is that people with autonomous motives are more likely to pursue personally-relevant outcomes and feel competent in doing

so.

Furthermore, it is important to note that there were a number of consistent patterns of effects that were in accordance with the expected patterns from the self-determination theory (Deci & Ryan, 2000). Specifically, it seems that, in the three behavioural contexts, autonomy-supportive behaviours offered by significant others in the social context in which the individual is engaged, promotes autonomous forms of motivation in individuals. This is consistent with previous research that has shown significant relations between perceived autonomy support and autonomous motivation (Chatzisarantis et al., 2007). Such research indicates that when individuals were provided with choice, given a reason for the implementation of a behaviour, or when significant others provide them with feedback on skills, they are more likely to be motivated to enact that behaviour. A likely mechanism for this is that when individuals feel their autonomy is supported, they will experience a sense of personal choice and agency in the implementation of behaviour and they will feel that their actions represent their true sense of self (Deci & Ryan, 2000).

There were also a number of consistent patterns of effects that were in accordance with the theory of planned behaviour (Ajzen, 1991). Specifically there were statistically significant effects of



Note. Standardized path coefficients for the structural equation model estimated controlling for behaviour measured at Time 1 are reported in parentheses. The effects of past behaviour measured at Time 1 on each variable in the model figure were omitted for clarity. These paths were freely estimated in the SEM analysis but not depicted in diagram: past behaviour → perceived autonomy support ( $\beta = -.15, p < .01$ ); past behaviour → autonomous motivation ( $\beta = -.16, p < .01$ ); past behaviour → attitude ( $\beta = -.09, p = .09$ ); past behaviour → subjective norm ( $\beta = -.06, p = .23$ ); past behaviour → perceived behavioural control ( $\beta = -.40, p < .001$ ); past behaviour → intention ( $\beta = -.08, p = .11$ ); past behaviour → planning ( $\beta = .06, p = .28$ ); past behaviour → behaviour at Time 2 ( $\beta = .46, p < .001$ ). Dashed lines indicate paths that were not statistically significant ( $p > .05$ ) in the SEM analysis without controlling for past behaviour.

\*\*\*  $p < .001$ ; \*\*  $p < .01$ ; \*  $p < .05$ .

Fig. 4. The results of the SEM analysis for the snacking sample.

perceived behavioural control on intention, and on behaviour directly. This effect is consistent with previous studies that have shown PBC to have a strong, significant and consistent effect on both outcome behaviours in health-related contexts (Armitage & Conner, 2001; Hagger, Chatzisarantis, & Biddle, 2002).

Last, it is important to note that there were relations in the present models that were specific to each behavioural context. In particular, the direct effect of perceived autonomy support on perceived behavioural control was significant in the models for the fruit and vegetable and breakfast behaviours but not for snacking behaviour. Moreover, the effect of attitude on intention was significant only in the model for snacking behaviour and not for the models for the fruit and vegetable and breakfast behaviours.

There were also incongruent patterns of effects of the proximal antecedents of behaviour on actual behaviour. For the fruit and vegetable sample, the link between intention and behaviour was negative. This negative path can be interpreted as a statistical artifact and probably indicates a suppressor effect (Cohen & Cohen, 1983), since the two variables have a significant and positive zero-order bivariate correlation (see Table 1). In other words, the regression weight of intention on behaviour becomes negative in virtue of its high correlation with the other predictors included in the model.

Another purpose of the present study was to investigate the role of planning in the intention behaviour gap. Even though intention was found to predict planning in all samples, the bootstrapped indirect effect of intention on behaviour was statistically significant only for the fruit and vegetable sample and not for the breakfast and snacking samples. The mediation hypothesis was, therefore, only confirmed in the fruit and vegetable sample. It is recognised that intentions to change a person's habitual lifestyle are seldom successful (Sutton, 1998), and have modest predictive power (Johnston, Johnston, Pollard, Kinmonth, & Mant, 2004). The present study therefore contributed to this issue (i.e., intention–behaviour gap) by including a measure of planning. Previous research showed that planning is a possible mediator of the effect of intentions on behaviour (Scholz, Schüz, Ziegelmann, Lippke, & Schwarzer, 2008). Unexpectedly, this mediation effect was supported in the fruit and vegetable sample only. An explanation for this finding may be the fact that planning is grounded on personal knowledge and experience (Hagger & Luszczynska, 2014; Sniehotta et al., 2005; Sniehotta, Scholz, & Schwarzer, 2006). Planning might not be a good predictor of behaviour when individuals have no experience with the behaviour. Also, people might not be very good at planning unless they are given explicit directions on how, where and when to enact the behaviour, so perhaps they can't be expected to form

**Table 3**  
Standardized path coefficients for mediated effects for the structural equation models for each behaviour (fruit and vegetable consumption, eating breakfast, snacking).

Paths	Behaviour	Mediator	Direct effect		Indirect effect		Total effect		Mediation
			Std. Estimation	95% C.I. Low/High	Std. Estimation	95% C.I. Low/High	Std. Estimation	95% C.I. Low/High	
Perceived Autonomy Support → Attitudes	Fruit and vegetable	Relative autonomy index	.22 <sup>a</sup>	.09/.35	.13 <sup>a</sup>	.06/.21	.35 <sup>a</sup>	.20/.53	Yes
			.35 <sup>a</sup>	.22/.48	.19 <sup>a</sup>	.12/.26	.55 <sup>a</sup>	.44/.66	Yes
			.45 <sup>a</sup>	.34/.56	.06 <sup>c</sup>	.01/.11	.51 <sup>a</sup>	.40/.62	Yes
Perceived Autonomy Support → Subjective norm	Fruit and vegetable	Relative autonomy index	.56 <sup>a</sup>	.41/.70	.00	−.04/.05	.56 <sup>a</sup>	.44/.68	No
			.71 <sup>a</sup>	.59/.83	−.04	−.10/.01	.67 <sup>a</sup>	.56/.77	No
			.72 <sup>a</sup>	.61/.82	−.05 <sup>c</sup>	−.10/.00	.67 <sup>a</sup>	.57/.76	Yes
Perceived Autonomy Support → Perceived behavioural control	Fruit and vegetable	Relative autonomy index	.23 <sup>a</sup>	.10/.37	.17 <sup>a</sup>	.08/.25	.40 <sup>a</sup>	.25/.55	Yes
			.37 <sup>a</sup>	.25/.49	.19 <sup>a</sup>	.12/.25	.56 <sup>a</sup>	.45/.66	Yes
			.11	−.05/.26	.12 <sup>c</sup>	.02/.21	.23 <sup>b</sup>	.08/.37	Yes
Relative autonomy index → Intention	Fruit and vegetable	Attitudes	−.14	−.54/.26	.06	−.06/.18	.44 <sup>a</sup>	.34/.54	No
			.09	−.08/.25	.04	−.03/.11	.41 <sup>a</sup>	.31/.51	No
			.15	−.07/.37	.05	−.01/.11	.19 <sup>a</sup>	.07/.30	No
Relative autonomy index → Intention	Fruit and vegetable	Subjective norm	−.14	−.54/.26	.00	−.02/.02	.44 <sup>a</sup>	.34/.54	No
			.09	−.08/.25	−.02	−.04/.00	.41 <sup>a</sup>	.31/.51	No
			.15	−.07/.37	−.12 <sup>b</sup>	−.20/−.03	.19 <sup>a</sup>	.07/.30	Yes
Relative autonomy index → Intention	Fruit and vegetable	Perceived behavioural control	−.14	−.54/.26	.52 <sup>c</sup>	.07/.98	.44 <sup>a</sup>	.34/.54	Yes
			.09	−.08/.25	.30 <sup>a</sup>	.17/.44	.41 <sup>a</sup>	.31/.51	Yes
			.15	−.07/.37	.10	−.06/.27	.19 <sup>a</sup>	.07/.30	No
Attitudes → Planning	Fruit and vegetable	Intention	−.09	−.27/.08	.07	−.22/.37	−.02	−.33/.29	No
			.02	−.12/.17	.04	−.03/.11	.06	−.10/.22	No
			.03	−.15/.21	.10 <sup>c</sup>	.01/.20	.13	−.06/.32	Yes
Subjective norm → Planning	Fruit and vegetable	Intention	.04	−.12/.20	.06	−.17/.29	.09	−.17/.36	No
			.18 <sup>b</sup>	.05/.31	.08 <sup>c</sup>	.02/.14	.26 <sup>a</sup>	.13/.39	Yes
			.04	−.13/.20	.27 <sup>a</sup>	.15/.39	.31 <sup>a</sup>	.16/.45	Yes
Perceived Behavioural control → Planning	Fruit and vegetable	Intention	−.12	−.49/.24	.47	−.35/1.31	.35	−.36/1.07	No
			−.01	−.24/.21	.30 <sup>a</sup>	.14/.47	.29 <sup>a</sup>	.12/.46	Yes
			−.07	−.26/.10	.10	−.05/.26	.03	−.21/.26	No
Intention → Behaviour	Fruit and vegetable	Planning	−.30	−.69/.09	.07 <sup>c</sup>	.01/.14	−.22	−.60/.15	Yes
			.35 <sup>c</sup>	.08/.62	.02	−.03/.07	.37 <sup>b</sup>	.11/.63	No
			−.21 <sup>b</sup>	−.38/−.05	.04	−.05/.12	−.18 <sup>b</sup>	−.31/−.05	No

<sup>a</sup>  $p < .001$ .

<sup>b</sup>  $p < .01$ .

<sup>c</sup>  $p < .05$ .

appropriate, effective plans (Sniehotta et al., 2005). This result is also consistent with previous studies which have shown that planning is not useful when trying to maintain behaviour that is already being performed regularly rather than initiate one, as breakfast behaviour, for instance (Mullan et al., 2013b).

Finally, we controlled for past behaviour measured at Time 1 by including it as a predictor of all variables in the model. We found that the patterns of relationships were consistent with those estimated without controlling for past behaviour, although we found a slight attenuation of these relationships in most cases consistent with previous research. However, for a few effects, the attenuation was substantial. For example, in the breakfast sample, the effect of perceived behavioural control and intention on behaviour was no longer statistically significant. Modelling past behaviour tends to reflect habitual actions or decisions that have been made consistently in the past, indicating, unsurprisingly, that breakfast is very much a behaviour that has strong consistency over time (e.g., Mullan et al., 2013b). Overall, results are in line with previous research indicating that the inclusion of past behaviour reduces the effects in a model because it represents the extent to which individuals have made particular decisions in the past (Ajzen, 2002; Ouellette & Wood, 1998; Sutton, 1994; ). Testing the current

models with and without the inclusion of past behaviour is informative as it illustrates the extent to which the current analyses are affected by habitual or previous decision making. It also demonstrates the efficacy of the current approach in accounting for variance in future behaviour once the effects of past behaviour have been controlled. As a consequence, we consider the models that control for past behaviour as providing the most definitive estimates of model effects.

The original contribution of this study is threefold. First, it corroborates prior research that has supported the complementarity of the theory of planned behaviour and self-determination theory (e.g., Hagger et al., 2006a,b). The important relations between theory of planned behaviour and self-determination theory constructs were supported (e.g., between autonomous motivation and attitudes and perceived behavioural control for all the three samples). Second, the most important contribution of this study is the fact that it is the first of its kind to consider three different aspects of healthy eating behaviours. Third, the present study is the first to adopt the theoretically integrated model to predict healthy eating behaviour with the inclusion of planning measures.

It would be remiss of us not to identify the limitations of the present study and recommendations for future research. Our data

are limited because participants are high-school students so the results might not be generalizable to the population. Furthermore, our design did not permit the testing of possible reciprocal relations among constructs, which has been shown to assist in identifying causal direction of effects in social cognitive and motivational models (e.g., Hagger, Chatzisarantis, Biddle, & Orbell, 2001; Lindwall, Larsson, & Hagger, 2011; Liska, Felson, Chamlin, & Baccaglioni, 1984). In addition, while we recognise the importance of parents as a highly salient referent in the lives of the participants in the current study and that's the reason why we focused on this referent in our measure, it is also important to acknowledge that there are other salient referents for this age group (e.g., friends, peers, teachers, siblings) that should have been taken into account. Despite these limitations, present results support the important relations embedded in a theoretically integrated model of theory of planned behaviour, self-determination theory and the HAPA.

## 6. Conclusion

The theory-based integrated model tested in the current study is useful as it provides a framework to understand the antecedents of the social cognitive variables of intention, attitude and perceived behavioural control within the theory of planned behaviour. The present study showed supported hypotheses relating to these proposed effects. Future research should test the model in different target populations, adopt a cross-lagged panel design to account for reciprocal relations among constructs, and consider other salient referents for this age group (e.g., friends, peers, teachers, siblings) as source of subjective norms or autonomy support.

## Appendix A. Supplementary data

Supplementary data related to this article can be found online at <http://dx.doi.org/10.1016/j.appet.2015.09.027>.

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