

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

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2 Three Healthy-Eating Behaviours

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8

10 A motivational model integrating self-determination theory, the theory of planned
11 behaviour, and the health action process approach was tested in three samples in three
12 behavioural contexts: fruit and vegetable, breakfast, and snack consumption. Perceived
13 support for autonomous (self-determined) forms of motivation from parents and autonomous
14 motivation from self-determination theory were hypothesised to predict intention and
15 behaviour indirectly via the mediation of attitude and perceived behavioural control from the
16 theory of planned behaviour. It was also expected that planning strategies would mediate the
17 effect of intention on behaviour. Relations in the proposed models were expected to be
18 similar across the behaviours. A two-wave prospective design was adopted. Three samples of
19 high-school students (total N = 1041; 59.60% female; *M* age = 17.13 years \pm 1.57) completed
20 measures of perceived autonomy support, autonomous motivation, theory of planned
21 behaviour constructs, planning strategies and behaviour for each of the three behavioural
22 contexts. Three months later, 816 participants (62,24% female; *M* age: 17.13 years, *SD* =
23 1.58) of the initial sample self-reported their behaviour referred to the previous three months.
24 Structural equation models provided support for the key hypothesised effects of the proposed
25 model for the three health-related behaviours. Two direct effects were significantly different
26 across the three behaviours: the effect of perceived autonomy support on perceived
27 behavioural control and the effect of attitude on intention. In addition, planning strategies
28 mediated the effect of intention on behaviour in fruit and vegetable sample only. Findings
29 extend knowledge of the processes by which psychological antecedents from the theories
30 affect energy-balance related behaviours.

31 *Keywords:* Self-determination theory; Theory of planned behaviour; fruit and vegetable;
32 breakfast; snack consumption; Planning; Theoretical integration

33 Eating fruit and vegetables, eating breakfast, and avoiding snacks have been identified
34 as three important behaviours to target in order to promote health and reduce chronic illness
35 risk (World Health Organization & UN Food and Agriculture Organization, 2003; Van Duyn
36 & Pivonka, 2000). The consumption of fruit and vegetables has been associated with a
37 variety of physical benefits including the prevention of obesity, cardiovascular disease, and
38 cancer (Van Duyn & Pivonka, 2000). In addition, evidence from the seminal ‘Alameda 7’
39 study identified eating breakfast and avoiding snacking as two of seven key healthy habits
40 that contributed to good long term health and reduced premature mortality (Belloc &
41 Breslow, 1972). As such, it is important for researchers to investigate the psychological
42 factors that affect these health-related behaviours in order to promote health. These factors
43 may have a role in the development of campaigns, recommendations, and interventions that
44 may promote good health and minimise chronic disease risk.

45 Research into the antecedent factors and processes that underpin people’s motivation to
46 engage in health-related behaviour has been conducted from a number of different theoretical
47 perspectives (Hagger & Chatzisarantis, 2009). Prominent among these theories are the theory
48 of planned behaviour, self-determination theory, and the health action process approach
49 (HAPA). Each has been applied to predict and understand health-related behaviour and
50 provide a basis for intervention. In the present study, we aim to integrate these approaches to
51 provide a comprehensive, multi-theory model that explains the special psychological factors
52 and apply the model to predict variance in three key dietary-related behaviours (eating fruit
53 and vegetables, eating breakfast, and reducing snacking), regular participation in which has
54 been shown to be associated with reduce risk of chronic illness. In the next sections we
55 outline the tenets of the three models and provide a basis for their integration consistent with
56 previous work on theoretical integration (Hagger & Chatzisarantis, 2009).

57 One of the most prominent social psychological theories applied to health behaviour is
58 the theory of planned behaviour (Ajzen, 1991), a specific version of the more generalised
59 integrated behavioural model or reasoned action approach (Fishbein & Ajzen, 2010; Head &
60 Noar, 2014; Montaña & Kasprzyk, 2008). According to theory of planned behaviour (Ajzen,
61 1991) the most proximal and salient predictor of behaviour is behavioural intention, which is
62 a function of three belief-based social cognitive constructs: attitudes - the extent to which
63 individuals have a favourable or unfavourable evaluation of the behaviour; subjective norms -
64 the social pressure individuals perceive with regard to whether or not they are expected to act
65 that behaviour; and perceived behavioural control - the beliefs people hold about resources
66 they have to enact the behaviour and their capacity to overcome barriers. This approach has
67 demonstrated to be effective in predicting health-related behaviour in a large number of
68 contexts (Armitage & Conner, 2001) including the consumption of fruit and vegetables
69 (Kothe, Mullan & Butow, 2012; Allom & Mullan, 2012), breakfast consumption (Wong &
70 Mullan, 2009; Mullan, Wong & Kothe, 2013) and avoiding snacking (Branscum & Sharma,
71 2011).

72 While the theory of planned behaviour adopts a social cognitive, information
73 processing approach to understanding health behaviour, a different approach from a
74 conceptual and epistemological perspective, is offered by self-determination theory (Deci &
75 Ryan, 1985). The theory takes a needs-based organismic perspective which focuses on the
76 quality of the motivation of an individual toward behaving in a given context and the
77 environmental variables that predict motivation in that context. A prominent feature of the
78 theory is the distinction between self-determined and controlled forms of motivation.
79 Individuals with self-determined or autonomous motives experience a sense of personal
80 choice and autonomy in the implementation of certain behaviours, whereas individuals with a
81 non-self-determined or *controlled* motives feel pressured and coerced into implementing their

82 behaviour from external forces, perceived or real. Autonomous motivation has a positive
83 effect on the implementation of, and persistence with, behaviour in various health-related
84 behaviours such as physical activity, smoking cessation, control of diabetes, and dental care
85 (Halvari, Halvari, Bjornebekk & Deci, 2012; Silva et al., 2010; Williams et al., 2011).
86 Consistent with the tenets of self-determination theory, motivation can be encouraged
87 through autonomy-supportive behaviours offered by significant figures in the social context
88 in which the individual is engaged. In addition, perceptions that significant others engage in
89 autonomy-supportive behaviours, such as providing choice and giving a reason or rationale
90 for the implementation of a behaviour, accepting the perspective of the individual and
91 providing feedback on skills, has been shown to promote autonomous motivation
92 (Chatzisarantis, Hagger & Smith, 2007). In turn, autonomous motivation has been shown to
93 predict intentions and actual behavioural engagement such that the effect of perceived
94 autonomy support on action is mediated by autonomous motivation (Deci & Ryan, 2000).

95 Health Action Process Approach (HAPA) is a recently-developed social-cognitive
96 model of health behaviour which adopts a dual-phase approach to understanding and
97 predicting behaviour. The model contends that the performance of health behaviour involves
98 two key phases: a motivational phase and a volitional phase (Schwarzer, 2008). The
99 motivational phase charts how individuals form intentions whether or not to adopt a
100 behaviour. The volitional phase outlines how intentions are translated into actual behaviour
101 and behavioural maintenance through planning, maintenance self-efficacy, and recovery self-
102 efficacy (Schwarzer et al., 2003). However, the most commonly used version of the HAPA
103 views the stages as a continuum where planning mediates the intention-behaviour relation
104 (Schwarzer, 2008). This means that individuals with high intentions are more likely to engage
105 in action planning, and those who plan are consequently more likely to perform their
106 behaviour (Sutton, 2008). The HAPA has been applied to a number of healthy eating

107 behaviours including fruit and vegetable consumption (Luszczynska, Tryburcy, & Schwarzer,
108 2007), adopting or maintaining an healthy diet (Schwarzer & Renner, 2000), eating breakfast
109 (Mullan, Wong, Kothe, & Maccann, 2013), the restriction of unhealthy food (van Osch et al.,
110 2009), and weight loss through diet and exercise (Hattar, Hagger & Pal, 2015).

111 **Integrating the theories**

112 Recent research has integrated self-determination theory and the theory of planned
113 behaviour because the processes they explain can be complementary (Hagger &
114 Chatzisarantis, 2012, 2014). A growing body of research has indicated that motivational
115 variables from self-determination theory can exert effects on social cognitive variables from
116 the theory of planned behaviour (Hagger, Barkoukis, Chatzisarantis, Wang & Baranowski,
117 2005; Hagger & Chatzisarantis, 2009, 2014). The integration is based on the link between
118 self-determined motivation and the beliefs that underpins the proximal antecedents of
119 behavioural intentions: attitudes, subjective norms and perceived behavioural control. The
120 theory of planned behaviour, like other social cognitive theories, suggests that individuals'
121 belief-based constructs such as attitudes arise from an evaluation of the propensity of the
122 behaviour to yield certain outcomes and the evaluation of those outcomes. That is, the
123 development arises from an evaluation of the behaviour, situation, and context in which the
124 behaviour will be conducted, i.e. a bottom-up process. Such evaluative, conditional, future
125 statements are also informed from learned experiences with the behaviour and like
126 behaviours, i.e. top-down. However, the top-down influences on beliefs can be derived from
127 other motivational orientations that drive behaviour. In the original conceptualization of self-
128 determination theory, such a process was implied by Deci and Ryan (1985): "Cognitive
129 theories [such as the theory of planned behaviour] begin their analysis with... a motive [such
130 as intentions], which is a cognitive representation of some future desired state. What is
131 missing, of course, is the consideration of the conditions of the organism that makes these

132 future states desired” (p. 228). In other words, individuals will align their social cognitive
133 beliefs like attitudes with their autonomous motives because those beliefs are perceived will
134 lead to future engagement in behaviour to achieve intrinsically- or autonomously-valued
135 outcomes. Hagger and Chatzisarantis (2015) have argued that individuals align their attitudes
136 and perceptions of control, and intentions, with their needs-based motives as a goal-directed
137 strategy to engage in future needs-satisfying behaviour. Similarly, individuals may align their
138 beliefs with controlling motives but such beliefs may not lead to behavioural persistence
139 given that controlled motives focus on extrinsic outcomes which, if removed, may signal an
140 individual to believe that there is no value in pursuing the behaviour.

141 An interesting addendum to this theorizing is the role that subjective norms play in
142 mediating the effects of beliefs from self-determination theory on behaviour. Typically,
143 subjective norms tend to reflect social pressure to engage in behaviour, a fact that has been
144 recognised in previous research (Chatzisarantis & Biddle, 1998; Sheeran, Norman, & Orbell,
145 1998), and there is evidence that controlled forms of motivation are more likely associated
146 with subjective norms (e.g., Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003).
147 Nevertheless, there is also evidence that autonomous motivation positively predicts
148 subjective norms (Hagger & Chatzisarantis, 2009, 2015) and that the effects vary across
149 samples and contexts (e.g., Hagger, Chatzisarantis, Barkoukis, Wang, Baranowski, 2005).
150 This issue presents somewhat of a conundrum for the integrated model – how can subjective
151 norms be related to autonomous forms of motivation in one context, and controlled forms in
152 another? The answer lies in the extent to which the individual has internalised the desires and
153 expectations of significant others. Internalizing the endorsement of significant others and
154 performing behaviours consistent with those endorsements means that individuals believe
155 those significant others to act in their best interest and support their true sense self. They will
156 therefore feel autonomous when they act even though they are doing it at the behest of others.

157 Actions and behaviours that are not endorsed by significant others are likely to be externally
158 reference, perceived as controlled, and are likely to lead to beliefs that one engages in the
159 behaviour for external reasons i.e. to comply with those others. In the current study we
160 predicted that subjective norms would not be predicted by autonomous motivation (Hagger et
161 al., 2003), or would have a negative effect (Barkoukis, Hgger, Lambropoulos, &
162 Torbatzoudis, 2010), consistent with the conceptualization of the integrated model. However,
163 it is clear that in contexts where others' beliefs are internalised by the individual, an
164 alternative hypothesis is that there will be an effect of autonomous motivation on subjective
165 norms (Hagger & Chatzisarantis, 2009). The effect indicates that individuals may form
166 beliefs about future behaviour because it services their needs-based motive to engage in the
167 behaviour consistent with the desires of the internalised significant others.

168 Consistent with the proposed integration, research has shown that individuals have
169 close correspondence between their beliefs and motives (McLachlan & Hagger, 2010) and
170 also can and do make the distinction between self-determined and controlled beliefs
171 (McLachlan & Hagger, 2011). For example, some beliefs about outcomes can be interpreted
172 as self-determined (outcomes that people chose to seek) or controlled (outcomes that people
173 feel compelled to engage in). Considering health-related behaviours, for some people eating a
174 healthy diet can be self-determined because they value being healthy and it is representative
175 of their true self. Others people may be motivated to eat a healthy diet to lose weight or to be
176 more attractive for others, i.e. for controlled reasons (McLachlan & Hagger, 2011).
177 Therefore, self-determined motives are hypothesised to be a distal predictor as an antecedent
178 of attitudes and PBC. Attitudes and PBC are, in turn, proximal predictors of the formation of
179 intentions to engage in future health-related behaviour in accordance with the theory of
180 planned behaviour. Therefore a motivational sequence is proposed such that the effects of
181 perceived autonomy support on attitude, subjective norm, and PBC are mediated by the

182 motivational constructs from self-determination theory, and that the three theory of planned
183 behaviour variables mediate the effect of the motivational variables from self-determination
184 theory on intention and health behaviour (Hagger, Chatzisarantis & Harris, 2006a,b). The
185 tenets of this integrated model have been examined for a number of health-related behaviours
186 such as myopia prevention (Chan, Hagger & Fung, 2012), injury prevention (Chan & Hagger,
187 2011), binge drinking reduction (Hagger et al., 2012), physical activity (Chatzisarantis,
188 Hagger & Smith, 2007), healthy eating (Hagger, Chatzisarantis, & Harris, 2006a,b), dental
189 treatment (Halvari, Halvari, Bjornebekk & Deci, 2010), and sleep hygiene (Kor & Mullan,
190 2011). A meta-analysis (Hagger & Chatzisarantis, 2009) also confirmed the predictive
191 validity of the integrated model across a number of studies in health-related behavioural
192 contexts.

193 A large body of research in numerous behavioural domains has demonstrated that
194 furnishing intentions with action plan is effective in promoting better behavioural enactment
195 (Schwarzer, 2008; Hagger & Luszczynska, 2014). Following this evidence, we propose a
196 volitional “phase” to our model, with action planning forming an important mediator of
197 intention-behaviour relationship to account for the insufficiency of intentions. Within the
198 integrated model, the introduction of planning as a mediator of the relation between intention
199 and behaviour is well specified in approaches that specify dual-phases of action such as the
200 HAPA. Furthermore, the integrated model has been further augmented with action plans as a
201 key mediator of the intention-behaviour relationship (Hagger & Chatzisarantis, 2014). This
202 means that the volitional phase has been incorporated into the integrated model to account for
203 the process by which intentions are converted into action.

204 Few studies have adopted integrated models of social cognition and motivation to
205 predict healthy eating. One of the studies using undergraduate students examined dieting
206 behaviour (e.g., watching one’s diet without necessarily being on a dietary program; Hagger

207 et al., 2006a,b). The study confirmed the predictive validity of the model in healthy eating
208 behaviours. Neither study however considered the impact of the integrated model on health-
209 related food choices in adolescents. Moreover, neither study considered the impact of the
210 model on three aspects of healthy eating behaviour separately and then compared the strength
211 of the effects across behaviours. Finally, the study did not account for volitional processes by
212 incorporating planning as a mediator of the intention-behaviour relationship. Our study is the
213 first investigation that integrates the theory of planned behaviour, self-determination theory
214 and HAPA into a unified model to explain three healthy eating behaviours in adolescents.

215 **The present study**

216 Based on the theory of planned behaviour, self-determination theory, and previous
217 research on the integration of the two theories (Chan & Hagger, 2012a, b, c; Hagger &
218 Chatzisarantis, 2009), we propose a motivational sequence in which perceived autonomy
219 support is envisaged as a predictor of autonomous motivation; autonomous motives predict
220 attitudes and perceived behavioural control, but the effect on subjective norms is not
221 significant or negative (Hagger et al., 2006a,b); the effect of perceived autonomy support on
222 the constructs of theory of planned behaviour is mediated by autonomous motives; attitudes,
223 subjective norms and perceived behavioural control predict intention; the effects of
224 autonomous motives on intention are mediated by attitudes and perceived behavioural control
225 (Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003), but not by subjective norms;
226 intention is a predictor of behaviour, although a direct effect of perceived behavioural control
227 is included in accordance with Ajzen (1991). It is important to note that for fruit and
228 vegetable and breakfast samples, intention is hypothesised to be a positive predictor of
229 behaviour, whereas in snacking sample it is expected to be a negative predictor since the
230 intention measure used is worded as avoiding this behaviour while the behavioural measure
231 asks how much snacking the participant has done. Furthermore, in accordance with the

232 HAPA model (Schwarzer, 2008) it is also hypothesised that the relationship between
233 intention and behaviour will be mediated by planning. The proposed model is depicted in
234 Figure 1.

235 **Method**

236 **Participants and Procedures**

237 The sample comprised 1041 high schools students (59.60% female; M age = 17.13
238 years, $SD = 1.57$; age range 14 to 22 years) from three high schools in Rome, Italy. A two-
239 wave prospective survey design was employed. Participants were assigned randomly to the
240 fruit and vegetable consumption, eating breakfast, and avoiding snack behavioural group.
241 Each target behaviour was defined for the participants in a standardised set of instructions. In
242 the first wave of data collection, questionnaires measuring perceived autonomy support,
243 motivation, attitudes, subjective norms, perceived behavioural control, intention, planning,
244 and behaviour. In the second wave of data collection, conducted three months later, self-
245 reported measures of the behaviour were administered. Participants were required to
246 complete self-reported measures of the behaviour to which they were assigned for the
247 previous three months. Questionnaires were completed anonymously to preserve
248 confidentiality and data collected in the first wave were matched with the ones in the second
249 wave by using a personalised code. Attrition rate across the two times of data collection due
250 to absences or inability to match the data was 21.61%, leaving a total of 816 participants
251 (62.24% female; M age: 17.13 years, $SD = 1.58$).

252 **Measures**

253 Behaviour-specific versions of each measure were developed for the fruit and vegetable
254 consumption, eating breakfast, and restricting the consumption of snack behaviours in the

255 present study. We developed measures of constructs from the component theories of the
256 adopted integrated model based on previous research (Ajzen, 2003; Ryan & Connell, 1989)¹.

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

267 **Autonomous motivation.** Autonomous motivation was measured at the first wave of
268 data collection using an adapted version of Ryan and Connell (1989) Perceived Locus of
269 Causality. Three behaviour-specific versions of the scale were developed and each was
270 initially presented with a common stem (Fruit and vegetable consumption: "Why do I eat at
271 least 5 portions of fruit and vegetables everyday?"; Eating breakfast: "Why do I eat breakfast
272 everyday?"; Avoiding snacking: "Why do I try to restrict my consumption of snack?").

¹While 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.

273 Respondents were then asked to rate several reasons pertaining to four regulation styles:
274 intrinsic motivation (e.g., "...because I find it enjoyable"), identified regulation (e.g.,
275 "...because I know the benefits of [health behaviour]"), introjected regulation (e.g.,
276 "...because I feel guilty if I don't"), external regulation (e.g., "...because it's what I'm
277 supposed to do). For each of the three scales, there were four items for each regulation style
278 with responses given on seven-point Likert-type scales ranging from *not true at all* (1) to
279 *very true* (7).

280 Measures of theory of planned behaviour constructs were developed in accordance with
281 standard instructions (Ajzen, 1991) and based on measures used in previous studies (Mullan,
282 Wong and Kothe, 2013; Wong and Mullan, 2009).

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

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

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

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

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

315 **Self-reported behaviour.** Self-reported fruit and vegetable consumption, eating
316 breakfast and snacking behaviour was measured at the first wave and at the second wave of
317 data collection, three months after the first wave. We used adapted versions of measures
318 developed to estimate behavioural frequency in a previous study (Mullan, Wong & Kothe,
319 2013). Participants rated their three-months behavioural frequency on three separate scales,
320 each comprising four items (e.g., Fruit and vegetable consumption: “In the course of the last

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

331 **Translation.** All questionnaires were translated from English to Italian, the first
332 language of the participants. The translation was conducted by two English-Italian bilinguals
333 using standardised back translation procedures (Hambleton and Patsula, 1998).

334 **Data analysis**

335 Analyses were conducted separately for each sample. First, in order to maximise the
336 parsimony of the models tested in this study, we collapsed the four constructs from the PLOC
337 into a single index of autonomous motivation, called Relative Autonomy Index (RAI,
338 Vallerand & Ratelle, 2002). According to a standardised procedure suggested by Grolnick
339 and Ryan (1987), weights were assigned to each of the items according to their relative
340 position on the continuum. Therefore items from the intrinsic motivation scale were assigned
341 a weight of +2, identified regulation items a weight of +1, introjected regulation items a
342 weight of -1 and external regulation items a weight of -2 for each behaviour. All the resulting
343 weighted item scores were then multiplied to produce a composite parcelled item score for
344 the indication of a latent RAI factor. As there were four items for each scale, four parcelled
345 RAI items were produced using this system. Therefore each parcelled item reflected a

346 participant's degree of relative autonomy with high scores representing higher levels of
347 autonomy. These parcels were used as indicators of a single latent RAI factor according to
348 the procedure used in previous studies (Hagger, Chatzisarantis, & Harris 2006a,b).

349 Data were initially analysed by confirmatory factor analysis (CFA) with latent variables to
350 test for the construct and discriminant validity of the study measures for each sample. Then,
351 the hypothesised relations among the perceived autonomy support, RAI, attitude, subjective
352 norms, perceived behavioural control, intention and planning constructs measured at Time 1
353 and behaviour measured at Time 2 were tested in a Structural Equation Model (SEM) (Figure
354 1). Data were screened for multivariate normality. Specifically, we calculated Mardia's Index
355 for the data in each sample, and compared it with the critical value. Mardia's Index was
356 slightly above critical value for the data in two of the samples (788.40 and 862.40,
357 respectively, for the fruit and vegetable and breakfast samples, against a critical value of
358 783), indicating multivariate non-normal distributions. For snacking sample, multivariate
359 normality was supported (Mardia's Index= 750.99 against the critical value of 783).

360 Considering these results, our models were estimated using a robust maximum likelihood
361 estimation method with the Mplus Program, which has been shown to provide stable
362 estimates under conditions of multivariate non-normality (Muthén and Muthén, 2010).

363 Goodness-of-fit of the proposed models with the data was evaluated using Goodness of fit
364 multiple recommended indexes: the Comparative Fit Index (CFI), the Root Mean Square
365 Error of Approximation (RMSEA), the Standardised Root Mean Squared Residuals (SRMR)
366 and the Chi square/df ratio. Cut-off values of 0.90 or above for the CFI indicated acceptable
367 models, although values greater than 0.95 were preferable (Hu & Bentler, 1999). Values of
368 0.08 or less for the RMSEA and the SRMR were deemed satisfactory for well-fitting models
369 (Hu & Bentler, 1999). The chi square/df ratio should be below two (Tabachnick and Fidell,

370 2007). However, Kline (1998) suggested that a chi square/df ratio of 3 or less is a reasonably
371 good indicator of model fit.

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

379 **Results**

380 **Descriptive statistics**

381 Eight-hundred and sixteen participants completed the questionnaire at Time 1 and Time
382 2 (62.24% female; M age = 17.13 years, SD = 1.58, age range 14 to 22 years). The sample
383 comprised 258 participants in the fruit and vegetable sample (63.95% female; M age = 16.92,
384 SD = 1.57), 287 participants in the breakfast sample (58.47% female; M age = 17.21, SD =
385 1.61), and 271 participants in the avoiding snack sample (64.66% female; M age = 17.21, SD
386 = 1.55). Univariate analyses of variance on age, gender distribution, and all the key measured
387 variables showed no significant differences between participants filled out both Time 1 and
388 Time 2 assessments and those that dropped out after Time 1. Participants of the final sample
389 responded to all questions and, thus, there was no missing data on the measured variables of
390 the study.

391 Zero-order correlations between age and behaviour were not statistically significant in
392 all the three contexts. Univariate analyses of variance of the effect of gender distribution on
393 behaviour showed a statistically significant gender effect in the fruit and vegetable sample,
394 ($F_{(1,256)} = 4.53$, $p < .05$, $d = 0.27$) with females more likely to consume fruit and vegetables (M

395 = 3.10, $SD = x.xx$) than males ($M = 2.65$, $SD = x.xx$), although the effect size was small. No
396 significant gender differences were found on the behavioural outcome in the breakfast and
397 snack consumption samples.

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

400 **Fit of the Models**

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

407 **Testing model relationships**

408 Standardised path coefficients for the free parameters in the path analyses for each
409 sample are depicted in Figures 2, 3, and 4, respectively. Standardised path coefficients for
410 mediated effects for each sample are given in Table 3.

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

414 **Hypothesis 2.** In accordance with our hypothesis, there was a significant direct effect
415 of autonomous motivation on attitudes and perceived behavioural control in all samples.
416 Also, as expected, the effect of autonomous motivation on subjective norms was not
417 statistically significant for the fruit and vegetable sample, and statistically significant and

418 negative in breakfast and avoiding snacking sample. This means we could reject the
419 alternative hypothesis of a statistically significant, positive effect.

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

436 **Hypothesis 4.** In the fruit and vegetable sample, only perceived behavioural control
437 significantly and directly predicted behavioural intention; the effects of attitude and
438 subjective norms on intention were not statistically significant, so this hypothesis was
439 rejected. In the breakfast sample, perceived behavioural control and subjective norms
440 significantly predicted behavioural intention while the effect of attitude was not statistically
441 significant so again, this hypothesis was rejected. In the snacking sample, all the three TPB

442 constructs (i.e., attitude, subjective norms, and perceived behavioural control) significantly
443 predicted intention, so only in this sample was the hypothesis supported.

444 **Hypothesis 5.** We also hypothesised that the effect of autonomous motives on intention
445 would be mediated by attitudes and perceived behavioural control but not by subjective
446 norms. In the fruit and vegetable and in the breakfast samples, the specific indirect effect
447 between autonomous motives and intention by perceived behavioural control was statistically
448 significant, that confirmed that the relationship between autonomous motives and intention
449 was mediated by perceived behavioural control. In addition, in these two samples, the
450 specific indirect effect of autonomous motivation on intention by subjective norms was not
451 statistically significant, as hypothesised. However, the specific indirect effect of autonomous
452 motivation on intention mediated by attitude was not statistically significant, so our
453 hypothesis was not supported in these samples. In the snacking sample, the specific indirect
454 effect between autonomous motives and intention mediated by subjective norms was
455 statistically significant meaning that the relationship between autonomous motives and
456 intention was mediated by subjective norms, contrary to our hypothesis. Furthermore, the
457 specific indirect effect of autonomous motivation on intention by attitude and perceived
458 behavioural control was not statistically significant, so in this sample this hypothesis was not
459 supported.

460 **Hypotheses 6 and 7.** Behavioural intention significantly predicted behaviour in all
461 samples so hypothesis 6 was confirmed in all samples. In the fruit and vegetable sample
462 intention was hypothesised to be a positive predictor of behaviour whereas the relationship
463 between intention and behaviour was proposed to be negative. Furthermore, as hypothesised,
464 perceived behavioural control was statistically significant direct predictor of behaviour in all
465 samples, so hypothesis 7 was supported in all samples.

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

471 **Testing model relationships and controlling for past behaviour**

472 Goodness of fit indexes for the CFA and the SEM for the models in which we
473 controlled for past behaviour measured at Time 1 are in square parentheses in Table 2.
474 Overall, in all samples, the fit of the models were almost identical to that exhibited by the
475 models without controlling for past behaviour. SEM standardised path coefficients for each
476 sample controlling for Time 1 behaviour, are depicted in parentheses in Figure 2, 3, and 4,
477 respectively². As reported in these figures, the pattern of relationships was largely identical to
478 the models without past behaviour albeit with a slight reduction in the magnitude in the
479 majority of the path coefficients. In some cases, controlling for Time 1 behaviour resulted in
480 substantial changes in the magnitude of some paths. For example, in the fruit and vegetable
481 sample, the effects of perceived autonomy support on autonomous motivation and on
482 perceived behavioural control were attenuated such that they were no longer statistically
483 significant. In contrast, the effect of attitude on intention, became statistically significant. In
484 the breakfast sample, the effect of autonomous motivation on subjective norm, the effect of
485 perceived behavioural control and of intention on behaviour were all extinguished with the
486 inclusion of Time 1 behaviour. Finally, in the snacking sample, the effect of perceived

² Mediation effects for the models in which we controlled for behavior 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.

487 behavioural control on intention was not statistically significant once Time 1 behaviour was
488 included.

489 **Strength effect comparison**

490 Finally, in order to evaluate the differences in effects strength between the three aspects
491 of healthy eating behaviour, we compared each path in the model across the three behaviours
492 using 95% confidence intervals of the path coefficient. Table of effects strength comparison
493 is available from the first author on request (Appendix B). We found a stronger effect of
494 autonomous motivation on attitude for fruit and vegetable and breakfast behaviours,
495 compared to avoiding snacking behaviour. Also, we found a stronger effect of perceived
496 behavioural control on intention for fruit and vegetable and breakfast consumption samples,
497 compared to avoiding snacking.

498 **Discussion**

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

506 Findings from well-fitting models indicated overall good fit of data with the
507 hypothesised integrated model in the three behavioural contexts. Specifically, perceived
508 autonomy support was a significant predictor of autonomous motivation and attitude,
509 autonomous motivation was a significant predictor of attitudes and perceived behavioural
510 control, and perceived behavioural control was a significant predictor of intention and
511 behaviour in all the three behavioural contexts. Moreover, intention was a significant

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

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

537 personal choice and agency in the implementation of behaviour and they will feel that their
538 actions represent their true sense of self (Deci & Ryan, 2000).

539 There were also a number of consistent patterns of effects that were in accordance with
540 the theory of planned behaviour (Ajzen, 1991). Specifically there were statistically significant
541 effects of perceived behavioural control on intention, and on behaviour directly. This effect is
542 consistent with previous studies that have shown PBC to have a strong, significant and
543 consistent effect on both outcome behaviours in health-related contexts (Armitage & Conner,
544 2001; Hagger et al., 2002).

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

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

558 Another purpose of the present study was to investigate the role of planning in the
559 intention behaviour gap. Even though intention was found to predict planning in all samples,
560 the bootstrapped indirect effect of intention on behaviour was statistically significant only for

561 the fruit and vegetable sample and not for the breakfast and snacking samples. The mediation
562 hypothesis was, therefore, only confirmed in the fruit and vegetable sample. It is recognised
563 that intentions to change a person's habitual lifestyle are seldom successful (Sutton, 1998),
564 and have modest predictive power (Johnston, Johnston, Pollard, Kinmonth, & Mant, 2004).
565 The present study therefore contributed to this issue (i.e., intention-behaviour gap) by
566 including a measure of planning. Previous research showed that planning is a possible
567 mediator of the effect of intentions on behaviour (Scholz, Schuz, Ziegelmann, Lippke &
568 Schwarzer, 2008). Unexpectedly, this mediation effect was supported in the fruit and
569 vegetable sample only. An explanation for this finding may be the fact that planning is
570 grounded on personal knowledge and experience (Hagger & Luszczynska, 2014; Sniehotta et
571 al., 2005; Sniehotta, Scholz, Schwarzer, 2006). Planning might not be a good predictor of
572 behaviour when individuals have no experience with the behaviour. Also, people might not
573 be very good at planning unless they are given explicit directions on how, where and when to
574 enact the behaviour, so perhaps they can't be expected to form appropriate, effective plans
575 (Sniehotta et al., 2005). This result is also consistent with previous studies which have shown
576 that planning is not useful when trying to maintain behaviour that is already being performed
577 regularly rather than initiate one, as breakfast behaviour, for instance (Mullan, Wong, Kothe
578 & Maccann, 2013).

579 Finally, we controlled for past behaviour measured at Time 1 by including it as a
580 predictor of all variables in the model. We found that the patterns of relationships were
581 consistent with those estimated without controlling for past behaviour, although we found a
582 slight attenuation of these relationships in most cases consistent with previous research.
583 However, for a few effects, the attenuation was substantial. For example, in the breakfast
584 sample, the effect of perceived behavioural control and intention on behaviour was no longer
585 statistically significant. Modelling past behaviour tends to reflect habitual actions or decisions

586 that have been made consistently in the past, indicating, unsurprisingly, that breakfast is very
587 much a behaviour that has strong consistency over time (e.g., Mullan, Wong, Kothe &
588 Maccann, 2013). Overall, results are in line with previous research indicating that the
589 inclusion of past behaviour reduces the effects in a model because it represents the extent to
590 which individuals have made particular decisions in the past (Ouellette & Wood, 1998;
591 Sutton, 1994; Ajzen, 2002). Testing the current models with and without the inclusion of past
592 behaviour is informative as it illustrates the extent to which the current analyses are affected
593 by habitual or previous decision making. It also demonstrates the efficacy of the current
594 approach in accounting for variance in future behaviour once the effects of past behaviour
595 have been controlled. As a consequence, we consider the models that control for past
596 behaviour as providing the most definitive estimates of model effects.

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

606 It would be remiss of us not to identify the limitations of the present study and
607 recommendations for future research. Our data are limited because participants are high-
608 school students so the results might not be generalizable to the population. Furthermore, our
609 design did not permit the testing of possible reciprocal relations among constructs, which has
610 been shown to assist in identifying causal direction of effects in social cognitive and

611 motivational models (e.g., Hagger, Chatzisarantis, Biddle & Orbell, 2001; Lindwall,
612 Larsmann, & Hagger, 2011; Liska, Felson, Chamlin, & Baccaglini, 1984). In addition, while
613 we recognise the importance of parents as a highly salient referent in the lives of the
614 participants in the current study and that's the reason why we focused on this referent in our
615 measure, it is also important to acknowledge that there are other salient referents for this age
616 group (e.g., friends, peers, teachers, siblings) that should have been taken into account.
617 Despite these limitations, present results support the important relations embedded in a
618 theoretically integrated model of theory of planned behaviour, self-determination theory and
619 the HAPA.

620 **Conclusion**

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

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