

1 Title: Self-control mediates the relationship between time perspective and BMI.

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3
4 Abstract

5 Trait future time perspective measures the extent to which behaviour is dominated by a
6 striving for future goals and rewards. Trait present time perspective measures orientation
7 towards immediate pleasure. Previous research has explored the relationship between
8 future and present time perspective and BMI with mixed findings. In addition, the
9 psychological mechanism underlying this relationship is unclear. Self-control is a likely
10 candidate, as it has been related to both BMI and time perspective, but the relationship
11 between all of these concepts has not been examined in a single study. Therefore, the aim
12 of this study was to examine if trait self-control mediates the relationship between time
13 perspective (future and present) and BMI. Self-report time perspective (ZTPI), self-control
14 (SCS) and height/weight data were collected using an online survey from a mixed student
15 and community sample ($N=218$) with wide ranging age (mean 29, SD 11, range 18-73 years)
16 and BMI (mean 24, SD 4, range 15-43). The results of a structural equation model including
17 both facets of time perspective suggested that the traits are related yet distinct measures
18 that independently predict BMI through changes in self-control. Bootstrap mediation
19 analysis showed that self-control mediated the relationship between both future time
20 perspective (95% CI, $-.10$ to $-.02$) and present time perspective (95% CI, $.03$ to $.17$), and BMI
21 in opposite directions. Participants with higher future time perspective scores (higher
22 present time perspective scores) had higher (lower) self-control, which predicted lower
23 (higher) BMI. These results are consistent with previous research suggesting an important
24 role for time perspective in health outcomes. Self-control likely mediates the relationship
25 between temporal perspectives and BMI, suggesting that time perspective may be a target
26 for individualised interventions.

27 Key words: Time perspective; Self-control; BMI

29 Introduction

30 Trait time perspective has been shown to predict a number of self-report health behaviours,
31 including alcohol use (Keough, Zimbardo, & Boyd, 1999), smoking (Adams & Nettle, 2009),
32 and fatty food consumption (Hall, Fong, & Cheng, 2012). However, there is a relative paucity
33 of research investigating the relationship between time perspective and obesity (Hall, Fong,
34 & Sansone, 2015). The purpose of the current study is to investigate the extent to which
35 time perspective predicts overweight and obesity, and to explore self-control as a potential
36 mediating mechanism. Establishing the nature of any relationships between time
37 perspective and obesity may be useful for informing individualised weight loss
38 interventions.

39 Studies that have measured trait time perspective in relation to general health behaviours
40 have often made use of two separate sub-scales that capture both future and present time
41 orientation (Keough et al., 1999; Henson, Carey, Carey, & Maisto, 2006; Daugherty & Brase,
42 2010; Joireman, Shaffer, Balliet, & Strathman, 2012; Guthrie, Lessl, Ochi, & Ward, 2013;
43 Belsky, Epel, & Tomiyama, 2014; Dassen, Houben, & Jansen, 2015). Future time perspective
44 is the tendency to consider the reward of attaining future goals when making decisions in
45 the present moment (for example, goals for weight loss or abstinence when confronted with
46 a tempting food or an alcoholic beverage). Present time perspective is the tendency to make
47 decisions based on immediate rewards in the present moment (for example, goals for
48 present enjoyment when confronted with a tasty food or alcoholic beverage). Although
49 these may appear conceptually to be opposite ends of the same continuum, evidence
50 suggests that they are related, yet distinct traits independently predicting different
51 outcomes (Joireman et al., 2012). For example, studies have shown present time
52 perspective to be a stronger predictor of alcohol intake and future time perspective to be a
53 stronger predictor of smoking (Henson et al., 2006; Daugherty and Brace, 2010).

54 Although behavioural measures of time preference, such as the delay discounting task, have
55 often been applied in obesity research, with outcomes suggesting a tendency to discount
56 the future is higher in overweight/obese populations (for example, Weller, Cook, Avsar, &
57 Cox, 2008; Jarmolowicz, Cherry, Reed, Bruce, Crespi, Lusk, et al., 2014; Price, Higgs, Maw,
58 & Lee, 2016), self-report measures of time perspective have not been applied to this

59 population as readily. Self-report time-perspective does not correlate robustly with delay
60 discounting outcomes (Teuscher & Mitchell, 2011), and these measures do not predict
61 health behaviours in the same way (Daugherty & Brase, 2010), suggesting that self-report
62 time perspective is independent from delay discounting tendencies and thus merits further
63 investigation. Self-report measures of time perspective that have been related to eating
64 behaviour and obesity include Zimbardos' Time Perspective Inventory (ZTPI; Keough,
65 Zimbardo & Boyd, 1999), the Consideration of Future Consequences Scale (CFCS; Strathman,
66 Gleicher, Boninger, & Edwards, 1994) and the Time Perspective Questionnaire (TPQ; Fong
67 and Hall, 2003). Each of these includes a future time perspective scale, but only the ZTPI and
68 CFCS also have an additional present (or immediate) time perspective scale.

69 A number of studies have found higher scores on various future time perspective scales to
70 predict a lower BMI (Adams & White, 2009; Adams & Nettle, 2009; Belsky et al., 2014; Hall,
71 Fong, & Sansone, 2015), with the exception of Guthrie et al. (2013) who failed to find
72 differences in future time perspective between lean and obese participants in their sample.
73 Present time perspective has been studied less frequently in relation to BMI, with
74 inconsistent findings (Belsky et al., 2014; Guthrie et al., 2013). Interestingly, Hall et al. (2015)
75 found that the relationship between future time perspective and BMI was mediated by
76 health behaviours. Hall et al. (2012) used a diet specific version of the TPQ (TPQ-D) in a
77 sample newly diagnosed with Type 2 diabetes and found that TPQ-D predicted self-reported
78 fatty food consumption at six months follow-up. However, BMI was not assessed and so the
79 downstream effects of fat consumption on weight change is not known. In addition, the
80 study did not include separate scales for future and present time perspective so the relative
81 influence of these traits on eating behaviour was not investigated.

82 Joireman et al. (2012) used the future and immediate sub-scales of the CFCS and using
83 factor analysis showed that the two sub-scales were distinct and that they differentially
84 predicted healthy eating intentions. Whereas CFCS future scores predicted healthier eating
85 attitudes and intentions, scores on the CFCS immediate scale did not predict eating
86 attitudes or intentions. The authors concluded that future and present time perspective
87 predict different self-regulatory techniques that vary in their impact on eating behaviour
88 intentions. Dassen et al. (2015) used both a general and food-specific version of the CFCS
89 future and immediate scales, and found that only CFCS-food scores predicted self-report

90 healthy eating and the general CFCS did not. In summary, the relationship between future
91 time perspective and BMI has been demonstrated, but there is less research examining the
92 relationship between present time perspective and BMI which merits further investigation.

93 Trait time perspective may influence other mediating mechanisms that in turn impact on
94 BMI (e.g. Hall et al., 2012; Hall et al., 2015). We argue here that self-control may be a
95 general behaviour that mediates the relationship between time perspective and BMI.
96 Engaging in future goal oriented thoughts when in a tempting situation (e.g. attending a
97 tasty buffet lunch, choosing whether to watch television or exercise during leisure time)
98 may increase behaviours consistent with future goals and intentions (health and weight
99 maintenance). Engaging in thoughts about immediate pleasures however may increase
100 behaviours inconsistent with future health goals. In this sense, tendencies to either over-
101 ride or engage in behavioural responses that are incongruent with long-term goals can be
102 viewed as self-control. Construal level theory (CLT; Trope & Liberman, 2003) maintains that
103 a future time perspective allows for a psychological 'distancing' from a tempting situation
104 that affords higher level thought processes and greater self-control. Research has shown
105 that priming a higher level construal, enhances self-control in general (Peters & Buchel,
106 2010; Fujita, Trope, Liberman, & Levin-Sagin, 2006) and reduces consumption of high energy
107 dense snack food (Daniel, Stanton, & Epstein, 2014; Price, Higgs, & Lee, 2016). Therefore, a
108 trait tendency to maintain temporal distance from a situation may predict a trait tendency
109 to exert more self-control. Future time perspective has been positively correlated with
110 scores on the Self Control Scale (SCS; Tangney, Baumeister & Boone, 2004) (Barber, Munz,
111 Bagsby, & Grawitch, 2009; Milfont & Schwarzenhal, 2014) and Hall et al. (2012) found that
112 scores on the TPQ-Diet (future) predicted perceived self-control over dietary intake.
113 Therefore, evidence is supportive of a link between future time perspective and self-control.
114 In turn, there is evidence that self-control is highly predictive of overeating, overweight and
115 obesity (e.g. Vainik, Dagher, Dube, & Fellows, 2013; Appelhans, French, Pagoto, &
116 Sherwood, 2016; Higgs, 2015; Rollins, Dearing, & Epstein, 2010; Carr, Daniel, Lin, & Epstein,
117 2011).

118 Self-control in general has been reported to predict BMI and related behaviours (healthy
119 eating, physical activity), as well as to time perspective and is supported as a potential
120 mediating mechanism between time perspective and BMI. However, no study to date has

121 examined the relationship between both present and future time perspective, general self-
 122 control and obesity. Therefore, the aim of the current study was to examine the mediating
 123 role of trait self-control in the relationship between both future and present time
 124 perspective and BMI, within a single structural equation model.

125 Method

126 *Participants*

127 Participants were recruited from the student populations at Swansea University, and the
 128 University of Birmingham, as well as from the wider community ($N=218$). The demographic
 129 and questionnaire items were presented to participants online using Survey Monkey (Palo
 130 Alto, California, USA), alongside a battery of other personality questionnaires (see below),
 131 the results of which are reported elsewhere (see Price, Higgs, & Lee, 2015). Ethical approval
 132 for the study was granted by the Swansea University Department of Psychology Research
 133 Ethics Committee. See Table 1 for sample characteristics.

134 Table 1: Sample characteristics and reliability estimates

Measure	N/Mean (SD); Range	Cronbach Alpha
Age (years)	29 (11); 18-73	
Sex	Male: Female 38:180	
BMI	24 (4); 15-43	
Population	Student:Community129:88*	
ZTPI future	44 (8); 20-61	.79
ZTPI present	20 (5); 9-40	.76
Self-Control Scale	40 (9); 18-65)	.83

135 BMI (Body Mass Index); ZTPI (Zimbardo Time Perspective Inventory). *Data missing for N=1

136 *Measures*

137 The following questionnaires were used in the current study. Means, standard deviations
 138 and internal reliability estimates for the sample are in Table 1.

139 *Zimbardo Time Perspective Inventory (ZTPI; Keough, Zimbardo & Boyd, 1999)*

140 Data was collected using the future and present sub-scales of the ZTPI, as described by
141 Keough, Zimbardo, and Boyd (1999). The future sub-scale contains 13 items measured on a
142 5-point scale ranging from 1 (very untrue of me) to 5 (very true of me). Example items
143 include 'I believe that a person's day should be planned ahead each morning' and 'When I
144 want to achieve something, I set goals and consider specific means of reaching those goals'.
145 The internal reliability in the current sample was good (.79). The present sub-scale contains
146 9 items also measured on a 5 point scale (as above). Example items include 'I try to live one
147 day at a time' and 'I believe getting together with friends to party is one of life's important
148 pleasures'. The internal reliability in the current sample was good (.76).

149 *Self-Control Scale – Brief (SCS; Tangney, Baumeister & Boone, 2004)*

150 Self-control was measured using the brief self-control scale, which has 13 items assessing
151 behaviour on a scale ranging from 1 (not at all like me) to 5 (very much like me). Example
152 items include 'I am good at resisting temptation' and 'I have a hard time breaking bad habits
153 (reverse scored)'. Internal reliability in the current sample was good (.83).

154 *Demographic information*

155 Participants self-reported their height and weight. Body Mass Index (BMI) was calculated
156 using the standard formula kg/m^2 . Although self-reporting BMI tends to result in under
157 estimating weight and overestimating height, it is highly correlated with actual BMI across
158 age groups (Vainik, Neseliler, Konstabel, Fellows, & Dagher, 2015; Pursey, Burrows,
159 Stanwell, & Collins, 2014; Ng, Korda, Clements, Latz, Bauman, Lu, et al., 2011). Participants
160 also completed several demographic questions asking about age (years), occupation
161 (student or otherwise), and sex (male or female).

162 *Other Questionnaires*

163 As the measures used in the current study were delivered alongside a battery of other
164 questionnaires, these are listed here: The Power of Food Scale (PFS: Short version: Lowe,
165 Butryn, Didie, Annunziato, Thomas, Crerand et al., 2009); The Emotional Eating Scale (EES;
166 Arnow, Kenardy, & Agras, 1995); The Three Factor Eating questionnaire (TFEQ short version;
167 Karlsson, Persson, Sjostrom, & Sullivan, 2000); The Dutch Eating Behaviour Questionnaire
168 (DEBQ; Van Strien, Frijter, Bergers, & Defares, 1986); The Barrett Impulsiveness Scale (BIS

169 11; Patton, Stanford, & Barrett, 1995); The Yale Food Addiction Scale (YFAS; Gearhardt,
170 Corbin, & Brownell, 2009).

171 *Data Analysis*

172 All of the variables in the model were entered into a correlation matrix along with potential
173 covariates, age and sex. Any significant covariates were controlled for in the subsequent
174 structural equation model (SEM). To address the hypothesis that future and present time
175 perspective independently predict BMI, through the mediating influence of self-control, a
176 SEM was tested using IBM SPSS AMOS 22.0 software. This type of analysis was selected over
177 two separate regression-based mediation models as it allows for direct and indirect
178 pathways from two independent (exogenous) variables (ZTPI future and present) to be
179 tested within a single model. This controls for any potential overlap between the two
180 independent variables and indicates the independent influences from each. It also allows for
181 measurement error for all dependent (endogenous) variables (in this case, self-control and
182 BMI), making outcomes more reliable. Bootstrap sampling was performed to indicate the
183 significance of the indirect pathway. The model was set to 1,000 bootstrap samples, with a
184 95% confidence interval. The fit of the overall model was judged using the Chi-square test,
185 Root Mean Square Error of Approximation (RMSEA), and the Normal Fit Index (NFI).

186 Results

187 *Correlations*

188 Preliminary correlations are reported in Table 2. The ZTPI future sub-scale was positively
189 correlated with self-control and the present sub-scale was negatively correlated with self-
190 control. Neither sub-scale of the ZTPI was correlated with BMI. Self-control was negatively
191 related to BMI. This is supportive of an indirect (but not a direct), pathway between time
192 perspective and BMI. Age positively correlated with BMI, self-control and ZTPI future and so
193 was controlled for in the subsequent SEM model.

194

195

196 Table 2: Pearson’s correlations (two-tailed) between ZTPI future, ZTPI present, self-control,
 197 BMI, age and sex.

	1	2	3	4	5
1. ZTPI future					
2. ZTPI present	-.32**				
3. Self-control	.44**	-.45**			
4. BMI	.07	-.02	-.15*		
5. Age	.24**	-.06	.17*	.35**	
6. Sex	.07	-.02	-.10	-.10	-.05

198 *p<.05 **p<.01. Sex coded 1=male 2=female.

199 *Structural Equation Model*

200 The model proposed in Figure 1 was a good fit to the data. Chi-square = .66 (df=1, p=.42),
 201 RMSEA= .00 and NFI= .99. A good fit is indicated by a non-significant chi-square (i.e. the
 202 actual data does not differ significantly from the model), a small RMSEA (<.08), and a large
 203 NFI (>.9). For the indirect pathway between ZTPI future and BMI, through self-control, the
 204 lower level (LL) and upper level (UL) bootstrap confidence intervals (CI) did not pass through
 205 zero (LLCI = -.10; ULCI = -.02), indicating that the indirect pathway is significant. For the
 206 indirect pathway between ZTPI present and BMI, through self-control, confidence intervals
 207 did not pass through zero (LLCI=.03; ULCI = .17), indicating that this indirect pathway was
 208 also significant. See Figure 1 for the significant pathways in the final model.

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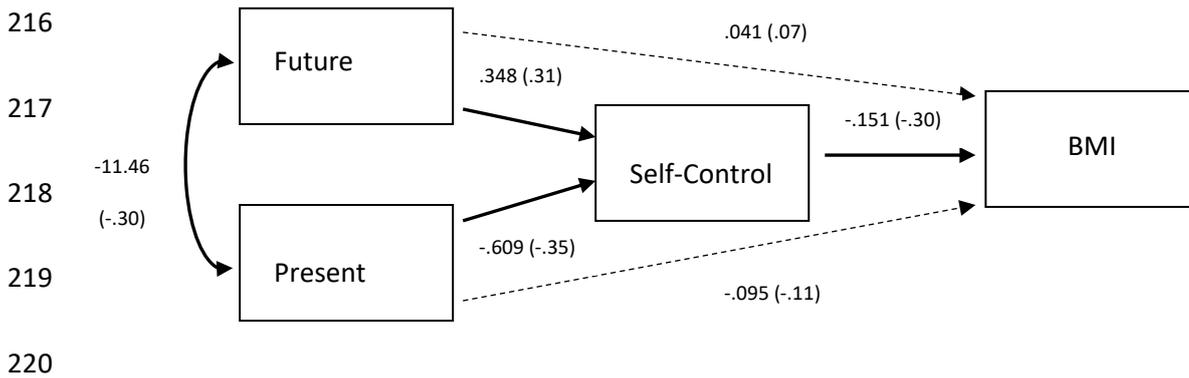
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221 Figure 1: Final model (controlling for age). Solid arrows indicate significant pathways
 222 ($p < .0001$), dotted arrows indicate non-significant pathways ($p > .12$). Unstandardized
 223 regression weights are included (standardised in parentheses).

224 Squared multiple correlations indicated that ZTPI future and present explained 30.0% of the
 225 variance in self-control, with the contribution of all predictors (including age) explaining
 226 18.8% of the variance in BMI.

227 Discussion

228 The aim of the current study was to examine the mediating role of trait self-control in the
 229 relationship between both future and present time perspective and BMI, within a single
 230 structural equation model. The model provided a good fit to data. Future and present time
 231 perspective were supported as related, yet distinct personality traits that indirectly
 232 predicted BMI through changes in self-control. Greater future time perspective predicted
 233 higher self-control and a lower BMI. Conversely, greater present time perspective predicted
 234 lower self-control and a higher BMI.

235 The current findings support previous research that future and present time perspective are
 236 distinct constructs that independently contribute to health outcomes (Henson et al., 2006;
 237 Daugherty & Brase, 2010; Joireman et al., 2012; Dassen et al., 2016). Our results also
 238 support previous findings that future time perspective is positively related to self-control
 239 (Barber et al., 2009; Hall et al., 2012; Milfont & Schwarzenhal, 2014). In addition, we
 240 provide evidence that present time perspective negatively predicts self-control.

241 A relationship between various self-control measures and obesity outcomes has been
 242 reported previously. Specifically, self-report self-control has been shown to predict both

243 healthy eating patterns (Vainik et al., 2015) and BMI (Jungen & Kampen, 2010). We provide
244 support for these findings using the self-control scale, but acknowledge that the relationship
245 between self-control and BMI is modest ($r = -.15$). The extent to which the self-control and
246 time perspective measures used in our study overlap with the variance in BMI accounted for
247 by other related processes remains to be tested (e.g. Uncontrolled Eating, Vainik et al.,
248 2015; Food Reward Responsivity, Price et al., 2015) and suggests the need for a full model to
249 be tested that includes such measures. Future time perspective has been reported to
250 predict BMI in some studies (Adams & White, 2009; Adams & Nettle, 2009), but not in
251 others (Guthrie et al., 2013). Present time perspective has been reported to be significantly
252 lower in a group of lean calorie restrictors compared to overweight/obese controls (Belsky
253 et al., 2014), but Guthrie et al. (2013) failed to find any differences between weight groups
254 in their community sample. We hypothesised that the pathway between time perspective
255 and BMI may be indirect, exerting influence through changes in general self-control, and
256 this was supported in our current findings. We found no direct relationship between time
257 perspective and BMI, suggesting that an indirect pathway better describes the relationship.

258 Construal level theory (Trope & Liberman, 2003) maintains that a future directed construal
259 allows for a psychological distancing from a tempting situation, and enhances consideration
260 of future goals and values (e.g. weight loss goals). This in turn enhances self-control.
261 Conversely, a present minded construal facilitates attention to the details of the immediate
262 moment which, in a tempting situation (e.g. when offered a tasty chocolate bar), reduces
263 self-control (Fujita et al, 2006). Here we find support for a relationship between trait
264 temporal perspective and self-control that is in-line with temporal construal theory. Further,
265 we report an association with BMI. Hall et al. (2015) reported that future time perspective
266 predicted BMI through the mediating influence of health behaviours. It is logical then to
267 suggest that trait self-control enhances the use of these health behaviours (healthy eating,
268 physical activity), which in turn directly impact BMI. It would be useful for future research to
269 include measures of weight-related health behaviours and investigate the full serial pathway
270 between time perspective and BMI, via self-control and health behaviours within one study.

271 Another avenue for future research would be to investigate the present model further using
272 behaviour specific measures of time preference and self-control. For example, Dassen et al.
273 (2015) reported that only food specific measures of time perspective predicted healthy

274 eating intentions, and not general time perspective. Therefore, the use of behaviour specific
275 measures may show even stronger effects. In addition, an experimental approach
276 measuring food intake and food preference as outcome variables would inform us of the
277 predictive validity of this model for actual eating behaviour.

278 It is not possible to draw conclusions about the direction of the relationship between time
279 perspective and BMI due to the cross-sectional design of the design of the study. Previous
280 research and theory would support that suggestion that a present time perspective may
281 undermine self-control of eating leading to a greater probability of weight gain, but it is
282 plausible that an increase in BMI causes individuals to consider their increased health risk
283 and adopt a more present minded perspective. Future studies should use prospective
284 designs to investigate the long-term effects of trait time perspective on self-control, eating
285 behaviour and obesity to establish the causal factors. The study was also based on an
286 opportunity sample, and although this allowed for a wider sample than the standard
287 undergraduate, female populations, the number of males, and non-students was not large
288 enough to test the model on these groups separately. Therefore, future research should
289 look to replicate these findings in specific populations (e.g. males versus females) to see if
290 the model fits in the same way. Prospective studies of weight change over time and success
291 with interventions would also be highly desirable. The limitations of structural equation
292 modelling (SEM) using questionnaire data in general should also be noted. SEM assumes
293 that data is at an interval level, whereas questionnaire data is strictly speaking, ordinal by
294 nature. Although SEM can model error arising from both interval and ordinal data, ordinal
295 data is limited in range and therefore truncated. This can produce attenuation of the
296 coefficients in the correlation matrix used by SEM. If ordinal data is used, then it should at
297 least come from questionnaires using likert scales with five categories or more and be
298 normally distributed, both of which are present in this study. A second issue surrounding the
299 use of SEM is the assumption of linearity. It is unlikely that all of the relationships within the
300 model are linear and this can be a potential source of error, with underestimation of
301 explained variance. Lastly, as we took a strictly confirmatory approach to our SEM, the
302 model has not been tested against any other models and can only strictly be considered as a
303 'not-disconfirmed' model at this stage. It would therefore be useful for future research to

304 compare the model presented here to one that includes other measured behaviours, such
305 as dietary control or exercise, as previously suggested.

306 In conclusion, future and present time perspective are related, yet distinct, traits that
307 predict BMI through directional changes in self-control. Overweight/obese individuals, high
308 in present time perspective or low in future time perspective represent vulnerable sub-
309 groups for whom self-control interventions may be particularly effective.

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