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Price, Menna; Higgs, Suzanne; Lee, Michelle

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

Menna Price[a*], Suzanne Higgs[b], Michelle Lee[a]

[a] Department of Psychology, College of Human and Health Sciences, Swansea University, Singleton Park, Swansea, UK.

[b] School of Psychology, University of Birmingham, Edgbaston, Birmingham, UK.

*Correspondence: Menna Price: email: m.j.price@swansea.ac.uk; Department of Psychology, College of Human and Health Sciences, Swansea University, Singleton Park, Swansea, UK (Tel: (44) 1792 295279).

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Abstract

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

Key words: Time perspective; Self-control; BMI

Introduction

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

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

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

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

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

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

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

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

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

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

Method

Participants

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

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

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

Measures

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

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

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

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

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

Demographic information

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

Other Questionnaires

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

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

Data Analysis

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

Results

Correlations

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

Table 2: Pearson's correlations (two-tailed) between ZTPI future, ZTPI present, self-control, 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

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

Structural Equation Model

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

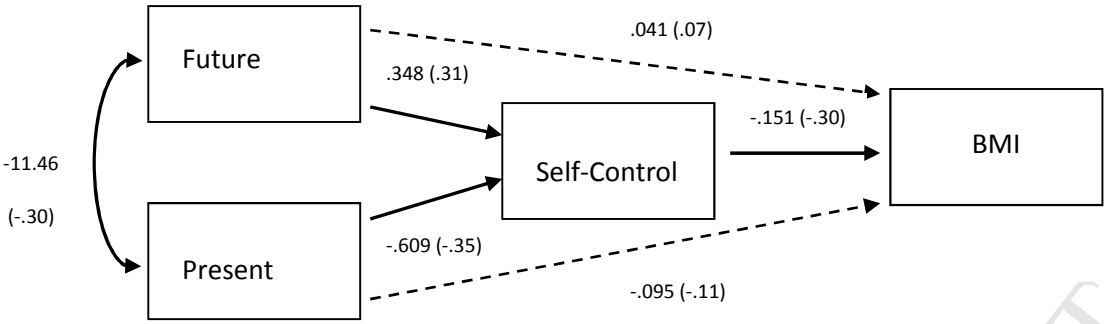

Figure 1: Final model (controlling for age). Solid arrows indicate significant pathways (p<.0001), dotted arrows indicate non-significant pathways (p>.12). Unstandardized regression weights are included (standardised in parentheses).

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

Discussion

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

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

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

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

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

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

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

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

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

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

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