



## Time perspective, personality and smoking, body mass, and physical activity: An empirical study

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**Objectives.** Time perspective describes how individuals conceptualize and value future events, and may be related to health behaviours. Research to date has focused on addictive behaviours, used a variety of different measures of time perspective, and not explored the role of personality. This work aimed to: explore the relationships between: five previously used measures of time perspective; time perspective and the broad domains of the five-factor model of personality; and time perspective and smoking, body mass, and physical activity after controlling for socio-demographics and personality.

**Design.** Cross-sectional self-report data were collected using a web based survey.

**Methods.** Participants ( $N = 423$ ) were recruited via local community internet message boards in US urban areas. The survey collected information on: delay discount rate, the Consideration of Future Consequences Scale (CFCS), the future scale of the Zimbardo Time Perspective Inventory (ZTPI), subjective probability of living to age 75, and time period for financial planning, the five-factor personality inventory, smoking, body mass index (BMI), and physical activity.

**Results.** After controlling for socio-demographics, most markers of time perspective were significantly correlated with each other, but the strength of correlations was rarely strong. Conscientiousness, Neuroticism, Agreeableness, and Openness were associated with some markers of time perspective. After controlling for socio-demographic and personality domains, only CFCS score was associated with smoking status and BMI.

**Conclusions.** There is some overlap between previously used markers of time perspective and the five-factor personality domains but this is neither strong nor consistent. Smoking and BMI, but not physical activity, are associated with CFCS, but not other measures of time perspective.

Individuals may vary in how they orientate themselves towards, think about and value the future. A number of related terms in the economic (e.g. time preference) and

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psychological (e.g. consideration of future consequences (Strathman, Gleicher, Boninger, & Edwards, 1994), delay of gratification (Cuskelly, Einam, & Jobling, 2001), and impulsivity (Allen, Moeller, Rhoades, & Cherek, 1998)) literature make reference to the importance of future outcomes in present-day decisions. We use the term 'time perspective' to refer to this phenomenon.

Many health promoting messages appeal to a desire to make the future better – or at least more healthy – encouraging us to adopt healthy behaviours now in order to safeguard our health in the future (Orbell & Hagger, 2006; Rakowski, 1986). Similarly, many health related behaviours involve a trade off between immediate pleasure and potential future health benefits (Finke, 2000; Fuchs, 1980; Piko, Luszczynska, Gibbons, & Tekozel, 2005). Thus, a rational decision to take part in healthy behaviours – for the purpose of health benefit – requires that value is placed on potential health benefit at some point in the future. Hence, it is highly plausible that time perspective plays a role in the rational decision to take part in healthy behaviours for health gain. However, as many health behaviours may not be engaged in for rational reasons or for the purpose of health benefit (e.g. some individuals use smoking as a weight control strategy (Camp, Klesges, & Relyea, 1993)), variations in time perspective will never explain all variations in health behaviours.

Existing theoretical models of health behaviour support the notion that thinking about and valuing the future is an important determinant of health-promoting behaviours. For example, the health belief model proposes that the perceived benefits of a behaviour to an individual is one important determinant of whether or not they will engage in that behaviour (Becker, 1974). As the health benefits of health behaviours are generally delayed in time, many perceived benefits of these behaviours are also likely to be delayed. If the future is not valued, a health benefit in the future will not be valued.

Being able to consider oneself in future possible situations also facilitates prospective memory (remembering to do something in the future) and the formation of implementation intentions (specific plans stating 'if x occurs, I will do y' (Webb & Sheeran, 2004); Atance & O'Neill, 2001). Implementation intentions are increasingly recognized as the bridge linking behavioural intention and actual behaviour (Gollwitzer & Sheeran, 2006) and their formation is possibly linked to time perspective.

Although there is strong theoretical reason why time perspective may be important in determining many different health behaviours, the majority of the empirical evidence to date has focused on addictive behaviours. Many studies have now reported a cross-sectional relationship between time perspective and use of substances such as heroin, cocaine, and tobacco (Bickel, Odum, & Madden, 1999; Keough, Zimbardo, & Boyd, 1999; Kirby & Petry, 2004; Reynolds, Richards, Horn, & Karraker, 2004).

Much less work has explored the relationship between measures of time perspective and non-addictive health related behaviours. Whilst condom use and other safer sexual practices appear to be associated with more orientation towards the future (Agnew & Loving, 1998; Appleby *et al.*, 2005; Rothspan & Read, 1996), time perspective was not strongly associated with acceptance of an influenza vaccine or adherence with hypertension or cholesterol medication prescriptions (Chapman, Brewer, Coups, Brownlee, & Leventhal, 2001; Chapman & Coups, 1999). Other behaviours such as fruit and vegetable intake and regular physical activity are inconsistently related to measures of time perspective (e.g. Hamilton, Kives, Micevski, & Grace, 2003; Huston & Finke, 2003; Mahon & Yarcheski, 1994; Wardle & Steptoe, 2003).

Time perspective also appears to moderate how individuals respond to health promoting messages with more future orientated individuals being more likely to

respond positively to messages framed in terms of long term benefit than less future orientated individuals (Orbell & Hagger, 2006; Orbell, Perugini, & Rakow, 2004). If time perspective is confirmed as an important determinant of health behaviours, interventions to encourage uptake of healthier behaviours could include attempting to alter individuals' time perspective (Murgraff, McDermoot, White, & Phillips, 1999), or tailoring interventions to individuals' time perspective (Orbell & Hagger, 2006; Orbell *et al.*, 2004).

Whilst we propose here that time perspective predicts health behaviours, it is also possible that the direction of causation flows in the opposite direction with health behaviours instead predicting time perspective. For example, smokers have a shorter life expectancy, and hence less future, than non-smokers (Doll, Peto, Boreham, & Sutherland, 2004). The existing, scant, longitudinal data provides evidence for both possibilities (Henik & Domino, 1975; Reynolds, 2004; Reynolds, Karraker, Horn, & Richards, 2003; Reynolds *et al.*, 2004).

A number of different methods have been previously used to measure time perspective. These include a number of different choice tasks (Chapman *et al.*, 2001; Chesson & Viscusi, 2000; Green, Fry, & Myerson, 1994) and questionnaires asking respondents to rate their agreement with a number of statements (Strathman *et al.*, 1994; Zimbardo & Boyd, 1999). The most widely used measure in published literature is the hypothetical money choice task. This is specifically used to measure the economic concept time preference, operationalized as the delay discount rate (or  $k$ ). Respondents are asked to make a series of choices between a variable amount of money today, or a set amount of money after variable delays. For example:

- (a) Would you prefer to receive £500 today or £1,000 in 5 years from today?
- (b) Would you prefer to receive £750 today or £1,000 in 2 years from today?

Typically, around 50 questions are asked to cover a range of immediate 'prizes' and delays. In this way, the value, in today's money, of the delayed 'prizes' can be modelled using an hyperbolic function in order to determine delay discount rate (Mazur, 1987). Some authors have used similar choice tasks substituting goods (e.g. cigarettes) or health states for money (e.g. Baker, Johnson, & Bickel, 2003; Odum, Madden, & Bickel, 2002).

Other proxies that have been used to measure time perspective include time period for financial planning (Barsky, Juster, Kimball, & Shapiro, 1997; Komlos, Smith, & Bogin, 2004; Picone, Sloan, & Taylor, 2004), and predicted longevity (Nagin & Pogarsky, 2004; Picone *et al.*, 2004; Wardle & Steptoe, 2003).

Whilst some of the questionnaires that ask respondents to rate their agreement with various statements have been subject to ample psychometric testing (D'Alessio, Guarino, Pascalis, & Zimbardo, 2003; Strathman *et al.*, 1994; Zimbardo & Boyd, 1999; Zimbardo, Keough, & Boyd, 1997), and choice tasks appear to produce results in line with a variety of theoretical predictions (Mazur, 1987), it remains unclear how different measures of time perspective relate to each other. Although two studies have investigated the intercorrelations between the same two questionnaire measures of time perspective (Keough *et al.*, 1999; Strathman *et al.*, 1994), we are not aware of any previous work that has explored the intercorrelations between a wider range of measures and proxies of time perspective.

Just as measures of time perspective have not been adequately related to each other, nor have their relationships with broader personality constructs been sufficiently explored. The 'Big Five' personality domains (Neuroticism, Extraversion,

Conscientiousness, Agreeableness, and Openness to experience) represent a consensus framework for personality research (Costa & McCrae, 1992). Since it has been argued that these five constructs are sufficient for capturing the bulk of the variation between individuals in stable personality traits (Digman & Inouye, 1986), it is important for researchers to establish the correlations of more specific explanatory constructs with these broad-scale domains.

There are suggestive similarities between time perspective and the five-factor domain of Conscientiousness. Individuals high in Conscientiousness are described as dutiful, disciplined, and able to control impulses (Hogan & Ones, 1997). Conscientiousness (or synonymous constructs) specifically identifies individuals at risk for addictive behaviours (Slutske, Caspi, Moffitt, & Poulton, 2005; Swendsen, Conway, Rounsaville, & Merikangas, 2002). Moreover, Conscientiousness has been linked with life expectancy (Friedman *et al.*, 1995). Friedman and colleagues (1995) suggest that the mechanism for this association is greater health-promoting behaviour amongst high Conscientiousness individuals. Thus, it is hypothesized that individuals with higher Conscientiousness scores perform more health-promoting behaviours and benefit from this in terms of health and life expectancy.

Previous studies that have related time perspective measures to five-factor domains found a significant positive relationship between Conscientiousness (the only five-factor domain included) and scores on the Consideration of Future Consequences Scale (CFCS; Strathman *et al.*, 1994) and future scale of the Zimbardo Time Perspective Inventory (ZTPI; Keough *et al.*, 1999). A relationship between personality based measures of psychopathy and markers of time perspective has also been documented in student (Miller & Lynam, 2003) and offender populations (Newman, Kosson, & Patterson, 1992).

### **Aims**

This work aimed to: (a) explore the intercorrelation between a number of different markers of time perspective previously used in the literature; (b) explore the intercorrelations between these markers of time perspective and the five-factor personality domains; and (c) explore the relationships between these markers of time perspective and self-reports of smoking, body mass index (BMI), and frequency of physical activity before and after taking the five-factor personality domains into account.

### **Methods**

A web based questionnaire collected information on time perspective, personality, smoking, BMI, frequency of physical activity, and socio-demographics. Internet data collection is widely used in personality psychology, and the results it produces appear valid and comparable to those obtained from paper versions of the same instruments (Gosling, Vazire, Srivastava, & John, 2004).

### **Variables of interest**

#### *Delay discount rate*

Delay discount rate was measured using an hypothetical money choice task that investigated the stated present-day value of \$1,000 delayed over 1 month, 6 months, 1 year, 5 years, and 10 years. For each time delay, respondents were asked, on separate

screens, if they would prefer to receive \$50, \$100, \$200, \$400, \$600, \$800 or \$900 today, or \$1,000 after the delay. The lowest value they identified as being preferable to \$1,000 after the delay was assigned as stated present-day value for that delay. Stated present-day values were then modelled against delay using an hyperbolic decay function to determine the value of  $k$  for each individual:

$$\text{stated present day value} = \frac{1,000}{1 + (k \times d)} \quad (1)$$

where  $k$  = delay discount rate;  $d$  = delay in years (Mazur, 1987). Here higher  $k$ -values indicate a steeper decrease in the value of \$1,000 over time (or decreased value placed on future events).

#### *Consideration of Future Consequences Scale and future scale of the Zimbardo Time Perspective Inventory*

Respondents were asked to indicate for each item in the CFCS (Strathman *et al.*, 1994) and the future scale of the ZTPI (Zimbardo & Boyd, 1999) how true statements were of them. Examples of statements include: 'I take each day as it is rather than try to plan it out' and 'I only act to satisfy immediate concerns, thinking the future will take care of itself'. Responses were on a 5-point Likert-type scale from 'very untrue of me' (scored 1) to 'very true of me' (scored 5). After reverse scoring of appropriate items, scores were summed for analysis. Only those who responded to all items in a scale were included in analyses of that scale. Higher scores indicate greater consideration of future consequences or future time perspective.

#### *Subjective probability of living to age 75*

To determine subjective probability of living to age 75, respondents were asked 'what do you think are the chances you will live to be 75 or more (where 0 means there is not chance you will live to 75 or more, and 100 means you will definitely live to 75 or more)?' (Nagin & Pogarsky, 2004; Picone *et al.*, 2004) with all integer options between 0 and 100 available.

#### *Time period considered for financial planning*

Time period considered for financial planning was investigated using the question 'In planning your, or your family's, saving and spending, which of the following time periods is more important to you and your partner, if you have one?' (Nagin & Pogarsky, 2004; Picone *et al.*, 2004) with the following response options, coded in years as per figures in brackets: day-to-day (0.02 years), the next few weeks (0.12 years), the next few months (0.50 years), the next year (1.00 year), the next few years (3.00 years), the next 5-10 years (7.50 years), longer than 10 years (10.00 years) and my partner and I do not plan our saving and spending (0 years).

There was no item overlap between any of the measures of time perspective used.

#### *Five-factor personality inventory*

Personality was measured using the 50-item five-factor scale from the international personality item pool (Goldberg *et al.*, 2006), which provides scores for each of the broad domains of the five-factor model of personality, namely Extraversion,

Agreeableness, Conscientiousness, Neuroticism, and Openness. This freely available research instrument has been extensively validated against external criteria, and against the reference five-factor instrument, the NEO-PIR (Gow, Whiteman, Pattie, & Deary, 2005).

Respondents are asked how accurate a series of statements were of them with responses on a 5-point Likert-type scale from 'very inaccurate' (scored 1) to 'very accurate' (scored 5). After reverse scoring of appropriate items, scores were summed for analysis. As before, only those who responded to all items in a scale were included in analyses of that scale.

#### *Smoking, BMI, and frequency of physical activity*

Smoking, BMI, and frequency of both moderate and vigorous intensity physical activity were chosen to represent the two largest current life-style related threats to health worldwide – smoking and obesity (World Health Organisation, Beaglehole, Irwin, & Prentice, 2003). Whilst BMI is not a behaviour as such, it is strongly influenced by both dietary and physical activity behaviour (Speiser *et al.*, 2005). As dietary measurement instruments are notoriously burdensome (Bingham, 1991), BMI was focused on rather than diet. This, necessarily, leads to some overlap between BMI and physical activity.

Current smokers were identified as respondents who answered 'yes' to the questions 'have you smoked more than 100 cigarettes in your lifetime?' and 'do you still smoke regularly?'; all others were categorized as not current smokers.

Self-reported height (in feet and inches) and weight (in pounds) without shoes were converted into kilograms and metres respectively and BMI calculated as:

$$\text{BMI} = \frac{w}{h^2} \quad (2)$$

where  $w$  = weight in kilograms;  $h$  = height in metres (WHO Expert Committee on physical status: The use and interpretation of anthropometry, 1995).

Participants were asked two questions in order to determine frequency per week of both moderate and vigorous intensity physical activity: 'over the last 3 months, on average, on how many days per week did you spend at least 30 minutes taking part in sports or activities that are moderately energetic such as, gardening, cleaning the car, walking at a moderate pace, dancing, floor, or stretching exercises?' (moderate intensity activity); and 'over the last 3 months, on average, on how many days per week did you spend at least 20 minutes taking part in sports or activities that are vigorous, such as running or jogging, swimming, cycling, aerobics or gym workout, tennis, or digging with a spade or shovel?' (vigorous intensity activity) (Anonymous, 2000).

#### *Socio-demographics*

Socio-economic position was measured as total household income per adult equivalent, after tax. Total household income, after tax, was reported in \$5,000 bands with the mid-point of income bands used in calculations. Adult equivalents were calculated as:

$$\text{adult equivalents} = 1 + (a - 1) + (0.7 \times c) \quad (3)$$

where  $a$  = number of adults aged 18 or over in household;  $c$  = number of children aged < 18 in household (White *et al.*, 2003).

Respondents were also asked to report their gender and their age in full years.

### **Procedure and data collection**

Respondents were sought via local community internet message boards (Craig's lists - [www.craigslist.org](http://www.craigslist.org)) in 15 major US urban areas: Atlanta, Austin, Chicago, Dallas/Forth Worth, Denver, Houston, Los Angeles, Minneapolis/St Paul, New Jersey, New York, Orange County (California), Philadelphia, Phoenix, San Diego, and San Francisco Bay. Repeat messages were posted on rotating days of the week for 5 weeks. Thus, messages were posted on Monday in week 1 (4 September 2006) and Friday in week 5 (6 October 2006). As these sites are visited by a wide spectrum of the community for various reasons, this strategy should lead to the survey being known to a group of individuals that is highly diverse with respect to age, education, and social position. Respondents were not offered any rewards or incentives to take part.

The questionnaire took around 20–30 minutes to complete. Respondents were free to miss any item and could move back and forward between questionnaire screens. In order to allow participants to withdraw from the study at any time, results were only collected from those who reached the final screen of the questionnaire and clicked on a final 'submit' button. We do not have information on those who started, but did not complete, the questionnaire.

Ethical permission for this study was granted by the departmental ethics committee in the Psychology Department at Newcastle University.

### **Data analysis**

From responses to questions used to calculate the delay discount rate, a coefficient of determination ( $r^2$ ) value was calculated for each respondent that indicated how well their stated present-day values fitted the hyperbolic decay function (Equation 1). The median coefficient of determination for all respondents was used to give an indication of the overall fit of the data to the hyperbolic decay curve in the sample (Mazur, 1987).

The intercorrelations between the markers of time perspective, as well as between them and the personality domains, were investigated using correlation coefficients with pairwise deletion. Partial correlation coefficients were used to allow control for age, gender, and equivalized household income (as a measure of socio-economic position) as previous studies have reported variations in markers of time perspective, smoking, BMI, and frequency of physical activity according to all three of these socio-demographic variables (Fuchs, 1980; Keough *et al.*, 1999; Prenda & Lachman, 2001; Sproston & Primatesta, 2004; Wardle & Steptoe, 2003). As  $k$ -values were highly skewed, logged values were used in these analyses to satisfy the assumption of normality.

The relationships between each of the markers of time perspective and smoking, BMI, and frequency of both moderate and vigorous intensity physical activity, before and after taking the five-factor personality domains into account, was investigated using regression models. Separate models were constructed to investigate the relationship between each marker of time perspective and each health variable - smoking, BMI, and frequency of moderate and vigorous intensity physical activity. In the first instance, only the marker of time perspective was entered. Then age, gender, and equivalized household income (in \$1,000s) were controlled for the same reasons as those described above in relation to partial correlations. Finally, the five-factor personality domains were also controlled for. Logistic regression was used to explore the relationship between markers of time perspective and current smoking status (a dichotomous outcome). Linear regression was used to explore the relationship between markers of time perspective and BMI and frequency of both moderate and vigorous intensity physical

activity (continuous outcomes). To aid interpretation, coefficients and odds ratios are shown per standard deviation change in units of time perspective and five-factor personality domains (but per unit change in age, gender, and equivalized household income in \$1,000s). In linear regression models, log *k* and log BMI values were used to satisfy the assumptions of this technique.

All analyses were conducted in Stata v9.0 (Statacorp, 2003). In order to make best use of the data available, a ‘complete-subject’ approach to analysis was taken (Greenland & Finkle, 1995; Rothman & Greenland, 1998). For each analysis, results are reported for all cases for which data for that analysis were available.

## Results

By 23 October 2006, 10 working days after the last post was made to Craig’s lists, 423 responses had been received. Gender was reported by 418 respondents and 76 (18.2%) were men. Smoking status was reported by 416 respondents and 70 (16.8%) were current smokers. Other variables of interest are summarized in Table 1.

**Table 1.** Summary of continuous variables

Variable	Sample size	Mean	Standard deviation
Age	421	34.7	12.0
Household income per adult equivalent (\$)	361	\$34 973	\$25 228
CFCS	392	42.8	8.5
ZTPI (future scale)	401	48.2	7.1
<i>k</i> -value (per year)	423	1.3	6.7
Time period for financial planning (in years)	411	4.9	4.1
Subjective probability of living to age 75 (%)	407	74.2	27.4
Extraversion	403	32.5	9.0
Agreeableness	392	41.7	5.7
Conscientiousness	398	36.0	6.6
Neuroticism	398	30.9	8.9
Openness	396	40.4	5.4
Body mass index	404	25.7	6.4
Days per week 30 minutes moderate exercise	419	3.2	2.2
Days per week 20 minutes vigorous exercise	419	2.5	2.0

Note. CFCS, Consideration of Future Consequences Scale; ZTPI, Zimbardo Time Perspective Inventory.

Equation 1 accurately described delay discounting data as shown by a high median coefficient of determination (median (interquartile range)  $r^2 = .98 (.97-.98)$ ).

### ***Intercorrelations between markers of time perspective***

Table 2 shows simple and partial correlations, with pairwise deletion, between the five measures of time perspective – controlled for age, gender, and equivalized household income in the case of partial correlations.

In simple correlations, there was evidence of significant intercorrelations between all measures of time perspective, except between probability of living to age 75 and both log *k*-value ( $r = -.04$ ,  $p = .432$ ) and time period for financial planning ( $r = .09$ ,



**Table 2.** Simple and partial correlations (*p*-value) between markers of time perspective and personality domains with pairwise deletion

Variable	1	2	3	4	5	6	7	8	9	10
1. Log <i>k</i> -value	–	-.18 (.002)	-.13 (.019)	-.04 (.436)	-.13 (.004)	-.01 (.902)	-.06 (.290)	.02 (.681)	.09 (.124)	-.05 (.399)
2. CFCS score	-.21 (<.001)	–	.44 (<.001)	.16 (.003)	.32 (<.001)	-.04 (.518)	.21 (<.001)	.23 (<.001)	-.25 (<.001)	.16 (.005)
3. ZTPI score	-.15 (.003)	.45 (<.001)	–	.12 (.034)	.14 (.012)	-.03 (.588)	-.03 (.562)	.56 (<.001)	-.06 (.316)	.05 (.335)
4. Probability of living to age 75	-.04 (.432)	.19 (<.001)	.13 (.008)	–	.07 (.172)	.01 (.961)	.08 (.137)	.09 (.094)	-.22 (<.001)	.02 (.703)
5. Time for financial planning	-.19 (<.001)	.33 (<.001)	.14 (.005)	.09 (.068)	–	-.02 (.652)	.07 (.196)	.06 (.264)	.14 (.011)	.05 (.338)
6. Extraversion	-.02 (.729)	-.01 (.986)	.01 (.877)	.03 (.523)	.01 (.784)	–	.37 (<.001)	.01 (.846)	-.21 (<.001)	.27 (<.001)
7. Agreeableness	-.04 (.486)	.25 (<.001)	.03 (.507)	.10 (.054)	.06 (.278)	.37 (<.001)	–	-.02 (.786)	-.18 (.001)	.23 (<.001)
8. Conscientiousness	.02 (.651)	.25 (<.001)	.57 (<.001)	.15 (.004)	.09 (.063)	.03 (.552)	.02 (.652)	–	-.11 (.041)	.03 (.576)
9. Neuroticism	.08 (.147)	-.26 (<.001)	-.08 (.128)	-.21 (<.001)	-.15 (.003)	-.21 (<.001)	-.15 (.004)	-.15 (.003)	–	-.07 (.208)
10. Openness	-.07 (.201)	.17 (.001)	.06 (.214)	.04 (.406)	.10 (.051)	.28 (<.001)	.19 (<.001)	.07 (.195)	-.11 (.039)	–

Note. Simple correlations below diagonal. Partial correlations (controlled for age, gender, and equivalized household income) above diagonal. CFCS, Consideration of Future Consequences Scale; ZTPI, future scale of the Zimbardo Time Perspective Inventory.

$p = .068$ ). The same pattern of intercorrelations were seen after controlling for age, gender, and equivalized household income.

### ***Intercorrelations between markers of time perspective and five-factor personality domains***

Simple and partial correlations, with pairwise deletions, between the five measures of time perspective and the five-factor personality domains are also shown in Table 2. In simple analyses, score on the CFCFS was significantly associated with four of the personality domains: Agreeableness ( $r = .25, p < .001$ ); Conscientiousness ( $r = .25, p < .001$ ); Neuroticism ( $r = -.26, p < .001$ ); and Openness ( $r = .17, p = .001$ ). Score on the future scale of the ZTPI was also correlated with Conscientiousness ( $r = .57, p < .001$ ), and subjective probability of living to age 75 with both Conscientiousness ( $r = .15, p = .004$ ) and Neuroticism ( $r = -.21, p < .001$ ). Time period for financial planning was also significantly correlated with Neuroticism ( $r = -.15, p = .003$ ). Log  $k$ -value was not significantly correlated with any of the personality domains and Extraversion was not correlated with any of the markers of time perspective. Similar patterns were seen after control for age, gender, and equivalized household income.

### ***Relationships between markers of time perspective and smoking, BMI, and frequency of moderate and vigorous intensity physical activity before and after taking the five-factor personality domains into account***

The logistic regression models exploring the relationships between each of the markers of time perspective and risk of being a current smoker are summarized in Table 3. When only markers of time perspective were included in the models, all markers of time perspective, except log  $k$ -value, were significantly associated with current smoking status. More future orientated time perspective was associated with a decreased risk of being a current smoker. When socio-demographic factors were taken into account, only CFCFS and ZTPI scores, and subjective probability of living to age 75 remained significantly associated with smoking. When five-factor personality domains were also included, the only marker of time perspective that remained associated with smoking status was CFCFS score. Gender was also consistently associated with smoking status with women being less likely to be current smokers than men. Conscientiousness was significantly associated with smoking in three of the models - greater Conscientiousness being associated with decreased risk of being a current smoker.

Summaries of the regression models exploring the relationships between each of the markers of time perspective and BMI are shown in Table 4. In uncontrolled analyses, CFCFS score was the only marker of time perspective significantly associated with BMI. Greater CFCFS score was associated with lower BMI. This association remained significant after control for socio-demographic factors and five-factor personality domains. In addition, age and equivalized household income were consistently associated with BMI in all models. Age was positively associated with BMI whilst equivalized household was negatively associated with BMI.

Table 5 shows summaries of linear regression models exploring the relationships between each marker of time perspective and frequency of moderate intensity physical activity. In uncontrolled analyses, only one marker of time perspective was significantly associated with frequency of moderate intensity physical activity - CFCFS score. CFCFS score was positively associated with frequency of moderate intensity physical activity.

**Table 3.** Logistic regression models of change in odds (95% confidence intervals); (*p*-value) of risk of being a regular smoker per standard deviation change in markers of time perspective; without control, with control for age, gender and equivalized household income, and with additional control for five-factor personality domains

Variable	Log <i>k</i> -value	CFCS score	ZTPI score	Probability of living to age 75	Time for financial planning
Marker of time perspective	0.99 (0.77 to 1.29); (.969)	0.40 (0.30 to 0.52); (<.001)	0.64 (0.50 to 0.84); (.001)	0.72 (0.56 to 0.93); (.010)	0.69 (0.53 to 0.90); (.007)
Marker of time perspective	0.99 (0.75 to 1.32); (.969)	0.42 (0.31 to 0.57); (<.001)	0.72 (0.54 to 0.97); (.030)	0.74 (0.56 to 0.98); (.037)	0.75 (0.55 to 1.01); (.058)
Age	1.02 (0.99 to 1.05); (.115)	1.02 (0.99 to 1.05); (.146)	1.02 (0.99 to 1.04); (.208)	1.02 (0.99 to 1.04); (.194)	1.02 (1.00 to 1.05); (.081)
Gender	0.35 (0.18 to 0.68); (.002)	0.54 (0.24 to 1.19); (.125)	0.37 (0.19 to 0.74); (.005)	0.33 (0.17 to 0.66); (.002)	0.36 (0.18 to 0.71); (.003)
Equivalized income/\$1,000	0.99 (0.98 to 1.00); (.114)	0.99 (0.98 to 1.01); (.279)	0.99 (0.98 to 1.01); (.243)	0.99 (0.98 to 1.00); (.148)	0.99 (0.98 to 1.01); (.299)
Marker of time perspective	0.93 (0.63 to 1.39); (.728)	0.42 (0.28 to 0.62); (<.001)	0.96 (0.64 to 1.46); (.860)	1.09 (0.75 to 1.58); (.658)	0.79 (0.55 to 1.12); (.191)
Age	1.01 (0.99 to 1.05); (.327)	1.01 (0.97 to 1.04); (.665)	1.01 (0.98 to 1.04); (.419)	1.01 (0.98 to 1.05); (.363)	1.02 (0.99 to 1.05); (.307)
Gender	0.22 (0.09 to 0.50); (<.001)	0.29 (0.11 to 0.78); (.014)	0.22 (0.09 to 0.51); (<.001)	0.21 (0.09 to 0.51); (.001)	0.22 (0.09 to 0.51); (<.001)
Equivalized income/\$1,000	0.98 (0.97 to 1.00); (.062)	0.99 (0.97 to 1.01); (.148)	0.98 (0.97 to 1.00); (.089)	0.98 (0.97 to 1.00); (.090)	0.99 (0.97 to 1.00); (.126)
Extraversion	1.26 (0.87 to 1.81); (.218)	1.14 (0.76 to 1.69); (.529)	1.24 (0.86 to 1.77); (.252)	1.29 (0.88 to 1.89); (.187)	1.24 (0.86 to 1.79); (.248)
Agreeableness	0.94 (0.62 to 1.41); (.752)	1.16 (0.73 to 1.84); (.528)	0.93 (0.62 to 1.39); (.731)	0.90 (0.59 to 1.38); (.637)	0.94 (0.63 to 1.41); (.768)
Conscientiousness	0.65 (0.46 to 0.91); (.012)	0.70 (0.47 to 1.03); (.072)	0.66 (0.43 to 1.01); (.055)	0.64 (0.45 to 0.91); (.013)	0.65 (0.46 to 0.92); (.014)
Neuroticism	1.16 (0.83 to 1.63); (.393)	0.94 (0.64 to 1.39); (.760)	1.19 (0.84 to 1.67); (.335)	1.22 (0.85 to 1.74); (.276)	1.11 (0.79 to 1.57); (.539)
Openness	1.13 (0.79 to 1.60); (.503)	1.26 (0.85 to 1.86); (.257)	1.12 (0.79 to 1.60); (.522)	1.26 (0.87 to 1.82); (.229)	1.15 (0.81 to 1.64); (.431)

Note. The table summarizes the results of five separate logistic regression models built sequentially to explore the ability of each of five separate markers of time perspective to predict smoking status without control, with control for age, gender and equivalized household income, and with additional control for five-factor personality domains. Results are per standard deviation change in markers of time perspective and personality domains and per unit change in age, gender, and equivalized household income. CFCS, Consideration of Future Consequences Scale; ZTPI, future scale of the Zimbardo Time Perspective Inventory.

**Table 4.** Linear regression models of change in log body mass index (95% confidence intervals); (*p*-value) per standard deviation change in markers of time perspective; without control, with control for age, gender and equivalized household income, and with additional control for five-factor personality domains

Variable	Log <i>k</i> -value	CFCS score	ZTPI score	Probability of living to age 75	Time for financial planning
Marker of time perspective	0.44 (-0.17 to 1.06); (.159)	-1.16 (-1.81 to -0.51); (.001)	-0.43 (-1.08 to 0.23); (.200)	-0.47 (-1.12 to 0.18); (.159)	-0.61 (-1.24 to 0.03); (.061)
Marker of time perspective	0.48 (-0.09 to 1.06); (.100)	-1.00 (-1.70 to -0.30); (.005)	0.03 (-0.65 to 0.70); (.940)	-0.54 (-1.19 to 0.11); (.104)	-0.58 (-1.23 to 0.08); (.085)
Age	0.17 (0.11 to 0.23); (<.001)	0.17 (0.11 to 0.23); (<.001)	0.16 (0.10 to 0.22); (<.001)	0.18 (0.12 to 0.24); (<.001)	0.18 (0.12 to 0.24); (<.001)
Gender	0.34 (-1.40 to 2.10); (.699)	1.04 (-0.79 to 2.87); (.263)	0.34 (-1.52 to 2.20); (.720)	0.46 (-1.32 to 2.24); (.612)	0.52 (-1.24 to 2.27); (.562)
Equivalized income/\$1,000	-0.04 (-0.07 to -0.02); (.001)	-0.04 (-0.07 to -0.01); (.005)	-0.05 (-0.08 to -0.02); (.001)	-0.05 (-0.07 to -0.02); (.001)	-0.04 (-0.07 to -0.01); (.005)
Marker of time perspective	0.39 (-0.20 to 0.99); (.198)	-0.87 (-1.72 to -0.03); (.044)	0.40 (-0.53 to 1.33); (.397)	-0.50 (-1.24 to 0.25); (.191)	-0.53 (-1.29 to 0.22); (.164)
Age	0.21 (0.14 to 0.28); (<.001)	0.20 (0.13 to 0.27); (<.001)	0.21 (0.14 to 0.28); (<.001)	0.21 (0.14 to 0.28); (<.001)	0.21 (0.14 to 0.28); (<.001)
Gender	0.82 (-1.38 to 3.02); (.465)	1.56 (-0.70 to 3.83); (.174)	0.65 (-1.63 to 2.93); (.575)	0.84 (-1.43 to 3.10); (.467)	0.93 (-1.27 to 3.13); (.404)
Equivalized income/\$1,000	-0.06 (-0.09 to -0.02); (.001)	-0.05 (-0.09 to -0.02); (.001)	-0.06 (-0.09 to -0.02); (.001)	-0.06 (-0.09 to -0.03); (<.001)	-0.05 (-0.08 to -0.02); (.002)
Extraversion	0.06 (-0.75 to 0.87); (.885)	-0.04 (-0.87 to 0.79); (.927)	0.11 (-0.72 to 0.94); (.799)	0.07 (-0.75 to 0.90); (.862)	0.07 (-0.74 to 0.88); (.868)
Agreeableness	-0.29 (-1.17 to 0.59); (.520)	-0.10 (-1.00 to 0.79); (.820)	-0.38 (-1.28 to 0.52); (.408)	-0.31 (-1.19 to 0.58); (.496)	-0.33 (-1.20 to 0.55); (.463)
Conscientiousness	-0.11 (-0.84 to 0.62); (.765)	0.18 (-0.59 to 0.95); (.639)	-0.28 (-1.21 to 0.65); (.549)	-0.03 (-0.76 to 0.70); (.941)	-0.09 (-0.82 to 0.64); (.808)
Neuroticism	0.26 (-0.49 to 1.02); (.490)	0.07 (-0.72 to 0.85); (.868)	0.22 (-0.57 to 1.01); (.581)	0.30 (-0.47 to 1.08); (.443)	0.17 (-0.59 to 0.94); (.655)
Openness	0.23 (-0.54 to 0.99); (.559)	0.47 (-0.32 to 1.25); (.240)	0.25 (-0.56 to 1.05); (.545)	0.30 (-0.47 to 1.08); (.443)	0.27 (-0.49 to 1.04); (.485)

Note. The table summarizes the results of five separate logistic regression models built sequentially to explore the ability of each of five separate markers of time perspective to predict body mass index without control, with control for age, gender and equivalized household income, and with additional control for five-factor personality domains. Results are per standard deviation change in markers of time perspective and personality domains and per unit change in age, gender, and equivalized household income. CFCS, Consideration of Future Consequences Scale; ZTPI, future scale of the Zimbardo Time Perspective Inventory.

**Table 5.** Linear regression models of change in days per week engaging in 30 minutes of moderate exercise (95% confidence intervals); (*p*-value) per standard deviation change in markers of time perspective; without control, with control for age, gender and equivalized household income, and with additional control for five-factor personality domains

Variable	Log <i>k</i> -value	CFCS score	ZTPI score	Probability of living to age 75	Time for financial planning
Marker of time perspective	-0.19 (-0.40 to 0.02); (.081)	0.23 (0.01 to 0.44); (.036)	0.20 (-0.01 to 0.42); (.062)	0.08 (-0.13 to 0.29); (.470)	0.07 (-0.14 to 0.28); (.529)
Marker of time perspective	-0.17 (-0.38 to 0.04); (.103)	0.17 (-0.07 to 0.42); (.161)	0.14 (-0.09 to 0.38); (.225)	0.06 (-0.17 to 0.29); (.594)	-0.002 (-0.24 to 0.23); (.983)
Age	0.01 (-0.01 to 0.03); (.492)	0.01 (-0.02 to 0.03); (.578)	0.01 (-0.02 to 0.03); (.568)	0.01 (-0.02 to 0.03); (.598)	0.01 (-0.02 to 0.03); (.617)
Gender	-0.002 (-0.63 to 0.63); (.996)	0.03 (-0.63 to 0.69); (.933)	-0.10 (-0.75 to 0.55); (.765)	0.03 (-0.61 to 0.67); (.932)	-0.07 (-0.70 to 0.56); (.824)
Equivalized income/\$1,000	0.005 (-0.004 to 0.01); (.342)	0.004 (-0.01 to 0.01); (.426)	0.004 (-0.01 to 0.01); (.409)	0.004 (-0.01 to 0.01); (.368)	0.005 (-0.01 to 0.01); (.345)
Marker of time perspective	-0.19 (-0.39 to 0.02); (.073)	0.19 (-0.10 to 0.48); (.206)	0.17 (-0.14 to 0.48); (.293)	0.07 (-0.19 to 0.32); (.608)	0.004 (-0.25 to 0.26); (.973)
Age	0.002 (-0.02 to 0.03); (.862)	0.01 (-0.02 to 0.03); (.657)	0.002 (-0.02 to 0.03); (.843)	0.002 (-0.02 to 0.03); (.859)	0.003 (-0.02 to 0.03); (.828)
Gender	0.13 (-0.61 to 0.88); (.721)	0.03 (-0.75 to 0.81); (.937)	0.005 (-0.76 to 0.77); (.990)	0.19 (-0.59 to 0.96); (.631)	0.09 (-0.66 to 0.84); (.813)
Equivalized income/\$1,000	-0.0003 (-0.01 to 0.01); (.955)	-0.0002 (-0.01 to 0.01); (.978)	0.001 (-0.01 to 0.01); (.924)	-0.0004 (-0.01 to 0.01); (.938)	0.0002 (-0.01 to 0.01); (.973)
Extraversion	0.25 (-0.03 to 0.52); (.077)	0.22 (-0.06 to 0.51); (.120)	0.23 (-0.04 to 0.51); (.099)	0.25 (-0.03 to 0.52); (.085)	0.24 (-0.04 to 0.51); (.090)
Agreeableness	0.22 (-0.08 to 0.52); (.150)	0.20 (-0.11 to 0.51); (.201)	0.20 (-0.10 to 0.50); (.195)	0.22 (-0.09 to 0.53); (.157)	0.23 (-0.07 to 0.53); (.129)
Conscientiousness	0.28 (0.04 to 0.53); (.024)	0.20 (-0.06 to 0.47); (.133)	0.20 (-0.12 to 0.51); (.216)	0.28 (0.03 to 0.53); (.030)	0.28 (0.03 to 0.53); (.028)
Neuroticism	-0.14 (-0.39 to 0.12); (.298)	-0.10 (-0.37 to 0.17); (.460)	-0.18 (-0.44 to 0.09); (.184)	-0.11 (-0.38 to 0.16); (.420)	-0.12 (-0.38 to 0.15); (.381)
Openness	-0.03 (-0.29 to 0.23); (.824)	-0.07 (-0.34 to 0.20); (.597)	-0.01 (-0.28 to 0.26); (.947)	-0.02 (-0.28 to 0.25); (.893)	-0.03 (-0.29 to 0.23); (.817)

Note. The table summarizes the results of five separate logistic regression models built sequentially to explore the ability of each of five separate markers of time perspective to predict days per week engaging in 30 minutes of moderate exercise without control, with control for age, gender and equivalized household income, and with additional control for five-factor personality domains. Results are per standard deviation change in markers of time perspective and personality domains and per unit change in age, gender, and equivalized household income. CFCS, Consideration of Future Consequences Scale; ZTPI, future scale of the Zimbardo Time Perspective Inventory.

This relationship did not remain significant after control for socio-demographic factors or five-factor personality domains. No other variables were significantly associated with frequency of moderate intensity physical activity.

Linear regression models exploring the relationships between markers of time perspective and frequency of vigorous intensity physical activity are summarized in Table 6. In simple analyses, CFCs and ZTPI scores were significantly associated with frequency of vigorous intensity physical activity – higher scores on both questionnaires were associated with higher frequency of activity. The relationship between CFCs score, but not ZTPI score, and frequency of vigorous intensity physical activity persisted after control for socio-demographics factors. Neither association persisted after inclusion of five-factor personality domains in the models. In fully controlled models, age and Conscientiousness were consistently associated with frequency of vigorous intensity physical activity – age was negatively associated with frequency of activity whilst Conscientiousness was positively associated with frequency of activity.

## **Discussion**

This is the first study to explore the intercorrelations between a number of different markers of time perspective. We found some, but not substantial, overlap between different markers that have previously been used to measure the time perspective concept.

We also explored the relationships between these markers of time perspective and the five-factor personality domains. As predicted, Conscientiousness showed the strongest association with markers of time perspective. There were also scattered significant associations between measures of time perspective (except delay discount rate) Agreeableness, Conscientiousness, Neuroticism, and Openness. Note that we have here used the broad domain level of the five-factor model of personality. The five domains can be decomposed into a larger number of narrower facets. It would be of interest in future to establish which facets were driving the associations between personality scores and measures of time perspective. However, the facets of each domain are moderately to strongly intercorrelated with one another, and thus the overall domain score was felt to be informative for establishing whether there are relationships deserving of further investigation.

In our exploration of the relationships between markers of time perspective and smoking, BMI, and frequency of physical activity, we found that four out of five markers of time perspective were associated with smoking status in simple analyses. However, only CFCs score remained significantly associated with smoking after controlling for socio-demographics and personality domains. Similarly, CFCs score was the only marker of time perspective that remained significantly associated with BMI in fully controlled models. As expected, greater CFCs score were associated with healthier behavioural patterns (decreased risk of smoking and lower BMI). Unexpectedly, no markers of time perspective were associated with frequency of either moderate or vigorous intensity physical activity in fully controlled analyses. However, in unadjusted analyses, statistically significant relationships were in the expected direction with more future orientated time perspective being associated with increased frequency of physical activity.

The data in these analyses are subject to a number of limitations. As with other web surveys of this type, it is highly likely that the respondents were not representative of the population of the US, or even the areas in which we advertised (Coomber, 1997;

**Table 6.** Linear regression models of change in days per week engaging in 20 minutes of vigorous exercise (95% confidence intervals); (*p*-value) per standard deviation change in markers of time perspective; without control, with control for age, gender and equivalized household income, and with additional control for five-factor personality domains

Variable	Log <i>k</i> -value	CFCFS score	ZTPI score	Probability of living to age 75	Time for financial planning
Marker of time perspective	-0.02 (-0.21 to 0.17); (.844)	0.23 (0.03 to 0.43); (.023)	0.25 (0.06 to 0.44); (.011)	0.08 (-0.11 to 0.27); (.432)	0.16 (-0.03 to 0.35); (.097)
Marker of time perspective	-0.01 (-0.19 to 0.18); (.928)	0.23 (0.01 to 0.45); (.040)	0.20 (-0.01 to 0.41); (.061)	0.02 (-0.18 to 0.23); (.827)	0.09 (-0.12 to 0.30); (.391)
Age	-0.02 (-0.04 to 0.002); (.078)	-0.02 (-0.04 to 0.001); (.060)	-0.02 (-0.04 to 0.001); (.059)	-0.02 (-0.04 to 0.002); (.084)	-0.02 (-0.04 to 0.0002); (.052)
Gender	-0.23 (-0.79 to 0.33); (.415)	-0.34 (-0.93 to 0.25); (.255)	-0.20 (-0.78 to 0.38); (.505)	-0.16 (-0.73 to 0.41); (.580)	-0.26 (-0.82 to 0.30); (.354)
Equivalized income/\$1,000	0.01 (-0.002 to 0.02); (.112)	0.01 (-0.002 to 0.02); (.125)	0.01 (-0.003 to 0.02); (.182)	0.01 (-0.002 to 0.01); (.136)	0.01 (-0.003 to 0.01); (.201)
Marker of time perspective	-0.001 (-0.18 to 0.18); (.988)	0.15 (-0.11 to 0.40); (.269)	0.06 (-0.22 to 0.33); (.683)	-0.10 (-0.33 to 0.13); (.387)	0.04 (-0.19 to 0.27); (.745)
Age	-0.02 (-0.05 to -0.01); (.020)	-0.02 (-0.05 to -0.003); (.026)	-0.03 (-0.05 to -0.005); (.017)	-0.02 (-0.04 to -0.003); (.027)	-0.02 (-0.05 to -0.004); (.020)
Gender	-0.44 (-1.11 to 0.22); (.191)	-0.54 (-1.24 to 0.15); (.125)	-0.47 (-1.15 to 0.21); (.175)	-0.36 (-1.05 to 0.32); (.297)	-0.45 (-1.12 to 0.22); (.184)
Equivalized income/\$1,000	0.004 (-0.01 to 0.01); (.362)	0.003 (-0.01 to 0.01); (.525)	0.005 (-0.01 to 0.01); (.362)	0.004 (-0.01 to 0.01); (.440)	0.004 (-0.01 to 0.01); (.414)
Extraversion	0.19 (-0.05 to 0.43); (.125)	0.27 (0.01 to 0.52); (.038)	0.21 (-0.04 to 0.45); (.094)	0.21 (-0.04 to 0.49); (.095)	0.20 (-0.05 to 0.44); (.112)
Agreeableness	0.20 (-0.07 to 0.47); (.141)	0.18 (-0.10 to 0.47); (.201)	0.16 (-0.11 to 0.43); (.239)	0.19 (-0.08 to 0.46); (.166)	0.19 (-0.07 to 0.46); (.154)

**Table 6.** (Continued)

Variable	Log k-value	CFCS score	ZTPI score	Probability of living to age 75	Time for financial planning
Conscientiousness	0.39 (0.17 to 0.61); (<.001)	0.37 (0.13 to 0.60); (.003)	0.41 (0.13 to 0.69); (.004)	0.40 (0.18 to 0.62); (<.001)	0.39 (0.17 to 0.61); (.001)
Neuroticism	-0.09 (-0.32 to 0.14); (.424)	-0.03 (-0.28 to 0.21); (.785)	-0.11 (-0.34 to 0.13); (.372)	-0.11 (-0.35 to 0.13); (.355)	-0.07 (-0.31 to 0.16); (.540)
Openness	0.10 (-0.13 to 0.33); (.382)	0.06 (-0.18 to 0.30); (.646)	0.13 (-0.10 to 0.37); (.270)	0.08 (-0.16 to 0.32); (.504)	0.10 (-0.13 to 0.33); (.411)

Note. The table summarizes the results of five separate logistic regression models built sequentially to explore the ability of each of five separate markers of time perspective to predict days per week engaging in 20 minutes of vigorous exercise without control, with control for age, gender and equivalized household income, and with additional control for five-factor personality domains. Results are per standard deviation change in markers of time perspective and personality domains and per unit change in age, gender and equivalized household income. CFCS, Consideration of Future Consequences Scale; ZTPI, future scale of the Zimbardo Time Perspective Inventory.



Eysenbach & Wyatt, 2002; Rhodes, Bowie, & Hergenrather, 2003; Wyatt, 2000). This is indicated by the strong female bias of respondents, high equalized household income and unusually healthy patterns of smoking, physical activity and BMI – for comparison, US national smoking rates are 21.5%, mean BMI is 28.0, and mean number of days per week on which 10 or more minutes of vigorous activity is taken is 1.2 (National Center for Health Statistics, 2005; Ogden, Fryar, Carroll, & Flegal, 2004; Pleis & Lethbridge-Çejku, 2006). Detailed national data on equalized household income is not available, but other statistics suggest that the cohort had incomes in the higher range (DeNavas-Walt, Proctor, & Smith, 2007). The tendency for responders to life-style questionnaires to be more likely to be female, more affluent and healthier than the population as a whole has been previously reported (Heath *et al.*, 2000). Despite the unusual health, income and gender profile of responders, results on the time perspective measures are similar to those previously reported – mean reported CFCS scores range from 42.5 to 43.3 (Appleby *et al.*, 2005; Strathman *et al.*, 1994); mean reported scores on the future scale of the ZTPI range from 42.8 to 56.4 (Lennings, 1997; Strathman *et al.*, 1994). However, it should be noted that these comparison figures generally come from undergraduate samples which, whilst similarly unrepresentative of the population, may be fairly comparable, in socio-demographic terms, to the sample used here. Future work should focus on exploring the time perspective concept in more representative groups to confirm that the current findings extend to the whole population.

The questionnaire was also quite lengthy and demanding of participants. As we only collected data from those participants who got to the final screen, we do not have information on how many people started but did not finish the survey. It is possible that there was some differential attrition according to socio-demographic factors, which may have contributed to the non-representative sample obtained. For example, the questions in the CFCS and ZTPI refer to things such as ‘work’ that participants who did not engage in paid work and who were unwilling, or unable, to extrapolate to other work, such as household chores, may have found irrelevant. As the CFCS and ZTPI were developed in undergraduate populations (generally well educated and motivated), it is possible that the questionnaires are not easily accessible to the wider population. Further work is needed to confirm the reliability and validity of existing measures of time perspective in population representative samples.

Few participants provided full data on all of the variables included in the analyses reported here. In order to maximize the number of participants included in each analysis, we took a ‘complete subject’ or ‘available case’ approach to analysis where for each analysis all respondents who provided full data for that analysis were included. This leads to variable sample sizes in each model but makes the most efficient use of the data without resorting to complex missing data procedures (Greenland & Finkle, 1995; Rothman & Greenland, 1998). Taking the alternative ‘complete case’ approach, where all analyses are restricted to only those respondents who provided full data on all variables, did not appreciably alter the pattern of results seen (data not shown).

In order to minimize the demands on participants we limited the number of values included in the present-day option in the hypothetical money choice task. In comparison to the seven present-day options we included, other researchers have tended to use between 26 and 29 present-day options (Bickel *et al.*, 1999; Coffey, Gudleski, Saladin, & Brady, 2003; Madden, Bickel, & Jacobs, 1999; Petry, 2001a, 2001b, 2003). This may have limited the accuracy of estimated delay discounting values ( $k$ -values). However, as the data collected showed a very good fit to the predicted hyperbolic curve described in Equation 1, this seems unlikely.

Although this is the first study to explore intercorrelations between a large number of markers of time perspective, two previous studies have explored the correlation between the CFCS and ZTPI. These report correlation coefficients of  $r = .36$  (95% confidence intervals .12-.56) (Strathman *et al.*, 1994) and  $r = .51$  (95% CI .40-.60) (Keough *et al.*, 1999) – comparable (given the overlap of confidence intervals) to the  $r = .45$  (95% CI .37-.53) in this study. Given the limited overlap between existing measures of time perspective found in this study, further work is required to develop an integrated measure of time perspective that reflects the numerous different perspectives covered by the markers used here. This could be supported by factor analysis of the current (or similar) datasets to determine the underlying structure of existing markers.

The finding that Conscientiousness was related to subjective probability of living until 75 (in uncontrolled analyses) is interesting in the light of evidence that life expectancy is greater in individuals with high Conscientiousness scores (Friedman *et al.*, 1995). Our expectation that any relationships between the broad personality domains and time perspective would be strongest for Conscientiousness were largely confirmed, especially for the ZTPI. Whilst the correlation seen in this study between Conscientiousness and the ZTPI was in line with previous results (.57 (95% CI .50-.63) in this study, compared to .59 (95% CI .49-.67) previously (Keough *et al.*, 1999)) that between Conscientiousness and CFCS was somewhat lower than previously reported (.25 (95% CI .15-.34) in this study, compared to .55 (95% CI .45-.64) (Keough *et al.*, 1999) and .49 (95% CI .27-.66) (Strathman *et al.*, 1994)) although there is overlap of confidence intervals with the results of Strathman *et al.* (1994)'s work. However, it is clear that time perspective measures are not reducible to just Conscientiousness, since significant correlations were not universally of large magnitude, not all measures of time perspective correlated significantly with Conscientiousness, and there were correlations between measures of time perspective and other personality domains. Neuroticism was negatively related to CFCS and subjective probability of living to age 75 but positively related to time period for financial planning. Neuroticism is the domain associated with depression, stress, and psychosomatic illness, though it is also linked to poor physical health, probably through the negative effects of long-term stress (Neeleman, Sytema, & Wadsworth, 2002). Thus, its negative relationship to subjective life expectancy is no surprise. The negative affect it causes may also shift focus to immediate relief, explaining the CFCS correlation.

A substantial body of previous work has reported a relationship between measures of time perspective – particularly delay discount rate – and smoking (e.g. Bickel *et al.*, 1999; Keough *et al.*, 1999; Mitchell, 1999; Odum *et al.*, 2002; Ohmura, Takahashi, & Kitamura, 2005; Reynolds *et al.*, 2004). In general, our results confirm these previous findings, although it is unusual that we did not find a relationship between delay discount rate and smoking. Whilst previous investigators have used hypothetical money choice tasks in face-to-face situations, and so been able to confirm respondent understanding, our use of written questions in a web based context means we could not confirm respondents understood the potentially confusing hypothetical money choice questions. Our estimates of delay discount rates may, therefore, be less accurate than previous researchers'. Previous findings of a relationship between smoking status and delay discount rate have also tended to focus on heavy (e.g. 20 or more cigarettes per day) smokers (Baker *et al.*, 2003; Businelle, 1996; Mitchell, 1999; Reynolds *et al.*, 2004). One report found no difference in delay discount rates between light- and non-smokers (Ohmura *et al.*, 2005). As we did not measure average daily cigarette consumption, our results may reflect light smoking amongst those we identified as smokers.

Although some previous authors have reported relationships between markers of time perspective and both body weight and physical activity, the literature is, overall, rather inconsistent (Hamilton *et al.*, 2003; Mahon & Yarcheski, 1994; Mahon, Yarcheski, & Yarcheski, 1997, 2000; Wardle & Steptoe, 2003). If significant relationships between time perspective and both BMI and frequency of physical activity do exist, it seems these are not strong and are highly dependent on the marker of time perspective used (CFCS shows the most consistent relationship).

Other relationships seen in fully controlled models are consistent with previous findings. Women are frequently found to smoke less than men (Sproston & Primatesta, 2004); low Conscientiousness has previously been associated with smoking (Friedman *et al.*, 1995; Slutske *et al.*, 2005); age is consistently associated with both BMI and frequency of physical activity in the literature (Sproston & Primatesta, 2004); and BMI is known to be associated with numerous markers of socio-economic position (Sproston & Primatesta, 2004). The scattered positive associations between physical activity and two of the personality domains are readily interpretable *post hoc*, in that Extraversion is associated with overall energy levels, and preference for novel and thrilling behaviours (Nettle, 2005) and Conscientiousness predicts organization and discipline (e.g. Barrick, Mount, & Strauss, 1993).

### Conclusion

We found some, but not substantial, overlap between the five makers of time perspective used. Further work is required to develop an integrated measure of time perspective that incorporates a variety of perspectives and is accessible to the whole population. In addition, we found that time perspective does not appear reducible to key personality domains. Finally, after taking socio-demographic and personality variables into account, one marker of time perspective (CFCS score) remained associated with smoking and BMI, but not frequency of moderate or vigorous intensity physical activity. In this cohort, associations between time perspective and smoking, BMI, and frequency of physical activity were not consistent and seem highly dependent on the marker of time perspective used. Further work is required to expand these findings to more representative samples.

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