Utilizing Behavioral Economics to Understand Adherence to Physical Activity Guidelines among a Low-Income Urban Community

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Short title: Behavioral Economics and Physical Activity

Manuscript type: Original Research

Funding: The Fair Park Study was funded by the National Science Foundation (NSF/SES-0827350).

Keywords: physical activity; monetary savings; low income; urban population

Abstract word count: 190

Manuscript word count: 2,826

Tables: 3

Figures: 0

ABSTRACT

Background: Behavioral economics studies have found that individuals with more patient time preferences, i.e. greater willingness to forgo current costs for future benefits, are more likely to save money. Although research has observed significant relationships between time preferences and health-promoting behaviors, scant evidence exists with physical activity as an outcome.

Methods: We examined the association between monetary saving behaviors and physical activity among adults of low-income who reside in an urban community. Specifically, we assessed the relationship between saving behaviors (checking/saving account, monthly savings, and planning family finances), and future orientation to physical activity as a dichotomous (meeting guidelines) and continuous (total and domain specific) endpoint.

Results: In multivariable regression, being future-oriented and having a checking/saving account were related to a 1.3 and 2.1 times higher (respectively) likelihood of meeting physical activity guidelines ($p < 0.05$). When examining physical activity continuously, all measures were significantly related to leisure-time activity ($p < 0.05$).

Conclusions: Our study findings establish a relationship between future time preferences and increased levels of physical activity among low-income adults. Future research should prospectively explore the efficacy of various schemes that help individuals overcome impatient time preferences to determine a causal relationship.

Ample evidence from epidemiological, experimental and physiological studies supports a causal relationship between sufficient physical activity and the prevention or delay of numerous chronic diseases (e.g. type 2 diabetes) and premature mortality from all causes, cardiovascular disease and cancer.¹ Specifically, a recent analysis of burden of disease and life expectancy worldwide, has estimated that not meeting physical activity guidelines significantly increases the risk for coronary heart disease by 16%, type 2 diabetes by 20%, breast cancer by 33%, colon cancer by 32%, and all-cause mortality by 28%.² For chronic disease mortality and morbidity prevention current Health and Human Services Guidelines encourage engaging in physical activity of moderate intensity for 150 minutes or of vigorous intensity for 75 minutes weekly (or a combination of both).¹ Yet despite these recommendations, less than half (48.4%) of US adults meet these recommendations based on a nationally representative survey.³

To increase the population's physical activity levels it is paramount to first understand the underlying factors that impede engaging in health promoting physical activity.⁴ While numerous studies have utilized health behavioral theories and constructs, such as the transtheoretical model and stages of change, to understand and promote physical activity,⁵ scant research has been conducted in the context of behavioral economics and physical activity. Behavioral economics, the application of psychology to economics, seeks to understand the boundaries of rational decision-making, as well as the social, emotional and cognitive factors that influence decisions.^{6,7} When bounded rationality and other social or cognitive factors lead to sub-optimal behavioral choices, behavioral economists have suggested intervention and policy approaches that prompt (or 'nudge') individuals to engage in healthful behaviors to reduce future disease risk.⁸⁻¹⁰

Impatient time preferences, in which individuals experience an inherent preference for immediate utility over delayed benefits in the future, often leads to present-bias decision-making.¹¹ For example, regularly engaging in health-promoting physical activity involves immediate tangible costs, such as loss of time; however, the benefits (e.g. reduced risk for hypertension) are delayed and appear uncertain.¹² Thus, due to this intangible and often delayed benefit, individuals with less patient time preferences might not engage in physical activity. A lack of patient time preferences has been associated in numerous studies with unhealthy lifestyle behaviors, such as smoking and heavy drinking.^{13–15} Scant empirical evidence exists, however, pertaining to time preferences and physical activity. Our research attempts to bridge this gap in the literature by examining the association between time preferences and physical activity among a sample of adults from the Fair Park Study.

Methods

Participants and Design

Our data come from the third wave of data collection of the repeated cross-sectional Fair Park Study, which is elaborately described elsewhere.^{12,16} The primary study aim was to assess the impact of public investment on behaviors and outcomes of Fair Park neighborhood residents. The Fair Park neighborhood is located in Dallas, Texas, and primarily comprises low-income (median household income: \$19,939), ethnic minority individuals (70% African American and 26% Hispanic).¹⁷ Participants in the current analytic sample consisted of 420 adults aged 20 to 75 years (of 504 from the entire wave conducted between April to May 2012) who provided information pertaining to the primary independent and dependent variables. Analytic samples

varied slightly in the models due to some missing responses (see Tables 2 and 3). The research was approved by the University of Texas at Dallas Institutional Review Board, and all Fair Park study participants provided written informed consent.¹⁶

Measures

Physical activity, the dependent variable, was based on participants' responses to the Short Questionnaire to Assess Health-enhancing physical activity (SQUASH).¹⁸ In the SQUASH, participants were asked to report the frequency, duration and intensity (when germane) of physical activity during a typical week in the past month. Specifically, individuals were queried about their physical activity in four domains: commuting (e.g. cycling to work), leisure time (e.g. walking, sports), household (e.g. washing dishes), and occupation (e.g. heavy lifting at work) activities. Reported frequency and intensity of each activity was multiplied by a metabolic equivalent (MET) value based on the physical activity compendium.¹⁹ MET minutes of physical activity per week were summed across domains to provide domain-specific MET values. In addition, overall physical activity was computed by summing MET values across domains. For analysis, we examined the continuous MET values for total physical activity, commuting, leisure time activity, and work-related physical activity (a compilation of household and occupational METs). We combined household and occupation METs, since 64.3% of the sample were unemployed. Moreover, physical activity was dichotomized into meeting current Health and Human Services physical activity guidelines of ≥ 500 MET minutes per week (yes/no).¹

In addition, four primary independent variables were used as proxies of time preferences: future orientation; having a checking, savings, and/or investment account (henceforth 'checking/saving'); monthly monetary savings; and planning family finances. The first variable

is based on a psychological measure of time preference, while the remaining three relate to monetary saving behaviors, which is a commonly used proxy for time preferences.^{20,21} Future orientation was determined based on responses to a survey question asking participants to indicate the degree to which they are future oriented (rarely/never, occasionally, often, and almost always).²⁰ In addition, participants were asked to indicate whether they have a checking/saving account, and to specify the dollar amount they save each month. While having a checking/saving account was regarded as a dichotomous (yes/no) variable, monthly savings (\$) was grouped into 4 categories: \$0, \$1 to <\$50, \$50 to <\$100, and $\geq$ \$100. Additionally, the time horizon considered when planning family finances was examined as a categorical variable: next few months, next year, next few years, 5 to 10 years, and $\geq$ 10 years.²¹

Covariates

We adjusted for the following covariates in multivariable analyses: age, sex, race/ethnicity, employment status, marital status, income, education, children <18 years, self-reported health status, health insurance, and body mass index (BMI). All covariates were based on survey responses except BMI, which was based on objectively measured height and weight using the standard formula (kg/m^2).

Statistical Analysis

Descriptive statistics were utilized to depict participants' characteristics. The association between the primary independent variables related to time preference (i.e. future oriented, checking/saving account, monthly savings, and planning family finances) and the dependent

variable (meeting physical activity guidelines) was examined using logistic regression in both adjusted and unadjusted models. In addition, Tobit regression models were computed with total physical activity and domain-specific physical activity (leisure, work-related, and transportation) as continuous dependent variables, while controlling for covariates. Separate models were constructed for each primary independent variable in relation to total physical activity and domain-specific physical activity. Analyses were performed using STATA version 13 (College Station, Texas).

Results

Participant characteristics are depicted in Table 1. On average, participants were 44.1 years old ($SD=12.3$), slightly less than half were women (48.8%), and most (88.3%) were Non-Hispanic blacks. In addition, 81.7% were not married, 73.1% did not have children, and 38.3% did not have health insurance. With regards to health, on average participants were in the overweight category (mean BMI=29.9, $SD=7.8$), and 30.9% reported poor or fair health. In addition, 71% met Health and Human Services guidelines for physical activity, mostly stemming from leisure time and work-related physical activity (Table 1). Most (93.6%) reported an annual household income of $< \$40,000$, and 76.6% reported having a checking/saving account. On average, participants saved \$62.10 ($SD=107.5$) monthly.

The bivariate and multivariable association between the independent variables and meeting physical activity guidelines is presented in Table 2. In bivariate analysis, future orientation, having a checking/saving account, saving more money on a monthly basis, and planning ahead with regards to family finances, were all significantly associated with meeting physical activity

guidelines ($p < 0.05$ for all, Table 2). In each case, the bivariate results supported the association between more patient time preferences and an increased likelihood of meeting physical activity guidelines. When examining these associations while adjusting for covariates in multivariable logistic regression, two independent variables remained statistically significant: being future oriented, and having a checking/saving account (Table 2). Specifically, a one-unit increase towards becoming more future oriented (e.g. from ‘occasionally’ to ‘often’ future oriented) was related to a 1.3 times higher likelihood of meeting physical activity guidelines (OR=1.29; 95% CI=1.04-1.58). Similarly having a checking/saving account (versus not having an account) was associated with a 2.1 times higher likelihood of meeting physical activity guidelines (OR=2.07; 95% CI=1.19-3.57).

Table 3 presents multivariable regression estimates for the relationship between monetary savings and future orientation to physical activity measured as a continuous variable. Each of the primary independent variables was significantly related to the continuous measure of leisure-time physical activity (Table 3). For example, when planning family finances, transitioning to a higher category (versus not changing categories) was associated with an average increase of 276.3 MET minutes per week (95% CI=12.88–539.67) for leisure-time physical activity. None of the relationships between the independent variables and the other domains of physical activity were statistically significant (Table 3).

Discussion

The current study aimed to explore the relationship between monetary savings and future orientation (as proxies of time preferences) and engaging in health-promoting physical activity. Our findings indicate that individuals who have more patient time preferences, that is, who are willing to ‘pay immediate costs’ (e.g. loss of time) in return for future, often uncertain, benefits (e.g. improved long-term health),⁹ are more likely to engage in health-promoting physical activity. Specifically, we observed that those who indicated that they were future oriented were 29% more likely to meet physical activity guidelines. Individuals with checking/saving accounts were more than twice as likely to meet guidelines, controlling for income and other potential confounders. In addition, having a longer time horizon with regards to planning family finances, as well as saving money on a monthly basis, were significantly associated with higher leisure time physical activity levels, yet not with meeting guidelines. Previous research has found time preferences to be related to a number of modifiable health behaviors (e.g. smoking, diet), yet scant research has examined its association with physical activity.^{11,13} In an earlier study, focusing on a smaller sample,¹² we found time preferences to be related to the intention to be physically active (via the stages of change model). In contrast, Adams and Nettle (2009), examining data collected from a web-based survey of urban locations in the US, did not find an association between time preferences and physical activity.²²

Our significant findings with regards to leisure-time physical activity (but not other domains, such as transportation), suggest that time preferences are primarily associated with the explicit choice to engage in physical activity.²³ The motivation to engage in leisure-time physical activity differs from motivations for work-related and transportation physical activity.²⁴ Among this very low-income population, access to a private motor vehicle is often limited,²⁵ hence transportation

physical activity might often be undertaken not because the individual is choosing physical activity to promote health, but because there is no alternative means of transportation. Likewise, as employment opportunities are limited, occupational physical activity is likely chosen because such jobs are more readily available, rather than the desire to be physically active to achieve the health benefits associated with an active lifestyle. The fact that the relation between time preferences and physical activity is most robust for leisure-time physical activity, which is also the domain in which decisions are based most fully on an explicit intent to be physically active, is in line with the extant literature of theories for investment in health promoting activities.²⁶⁻²⁹

While our analysis was only able to assess the cross-sectional relations between time preferences and physical activity, a causal relationship has theoretical support.²⁶⁻²⁹ In fact, Zimmerman (2009) has called for the use of behavioral economics to promote physical activity,³⁰ yet few empirical studies have been conducted. Specifically, impatient time preferences may be viewed as producing decision errors whereby individuals forgo costly activities that are in their long-term best interests (e.g. physical activity). Hence, physical activity might be viewed, particularly among those with impatient time preferences, as costly not only in terms of actual monetary costs (e.g. required for fitness club membership), but also costly in terms of the time and energy required to exercise, which might lead to inactivity despite future health benefits. The growing body of behavioral economics literature aims to exploit these inherent decision errors to improve health behaviors and subsequently lower the risk for adverse health outcomes. Leowenstein et al. (2007) suggest enabling health behaviors to be less costly (i.e. more convenient), and for incentives (or rewards) to be immediate to facilitate health behavior change.^{8,9} For example, Volpp (2008) found a weight loss intervention guided by behavioral economics (including immediate financial ‘consequences’ and participant feedback) to be efficacious in short-term

weight loss.³¹ For the case of physical activity, providing regular physical activity breaks during the work day coupled with immediate and tangible incentives from the employer and/or insurer might be a feasible avenue to improve health and productivity, particularly for individuals with less patient time preferences.^{9,12}

Further, clinicians and public health professionals may seek to design innovative interventions that allow for tailoring based on individual time preferences. In the public health realm, it is acceptable practice to place individuals on a continuum from precontemplation to maintenance of health behaviors (i.e. stages of change) to tailor appropriate interventions, such as to provide knowledge of the health benefits of physical activity for precontemplators.³² It is likewise feasible to ‘screen’ individuals for time preferences.¹² Thus intervention tailoring could then proceed through use of tools such as pre-commitment contracts, supplementing current health approaches for behavior modification.³³ Pre-commitment contracts, voluntary self-imposed constraints on future choices, have been applied to weight loss interventions to increase their likelihood of success.^{33,34} For example, a sum of money is deposited prior to the initiation of a weight loss program and is lost if not achieving a-priori goals, with the underlying aim of making individuals more cognizant of future risks at present time.^{33,35} This approach has been found to be efficacious in some clinical trials of weight loss, however their effectiveness warrants further examination.^{31,33} Furthermore the feasibility and effectiveness of pre-commitment contracts should be tailored and examined further in low-income urban communities. Additionally, decreasing the costs (both monetary and time-related) associated with physical activity in urban communities by providing safe and accessible exercise facilities and parks conducive to exercise is paramount alongside increasing present-day awareness to the risks associated with physical inactivity.³⁶

In addition, one hurdle in advancing the understanding of the relationship between time preferences and physical activity is definition of an easily applied measure of time preferences. The gold standard for measuring time preferences is economic experiments.^{12,37} However, this method is often prohibitively costly to implement in many study settings. In the current study, we analyzed a variety of survey measures that have been used by other researchers as proxies for time preferences, since these types of measures are more feasible for researchers to consider adding to existing data collection protocols.^{38,39} These measures, based on self-report of psychological tendencies and self-report of financial behaviors, provide consistent estimates of a statistically significant relationship with physical activity, despite not using the gold standard of economic experiments.

Study results should be interpreted while taking into account several limitations. First, the study design is cross-sectional, therefore cause–effect between time preferences and physical activity cannot be established; this should be examined utilizing prospective designs to determine a temporal relationship. Second, though the study sample is larger than our previous study,¹² it is relatively small and focuses on a very low-income ethnic minority population within a specific geographic location. Although caution should be taken when generalizing findings, results are likely to be applicable to other communities with similar socio-economic traits. Finally, physical activity was measured using a self-report survey measure which may be subject to recall bias, resulting in over- or under-reporting.^{18,40} The high prevalence (71%) of participants meeting physical activity guidelines in this sample is consistent with findings in the previous wave of this study (69%),¹⁷ yet higher than in the state of Texas overall (63.7%).⁴¹ Future research on this topic should measure physical activity using both self-report survey instruments and activity

monitors (e.g. accelerometers) to provide a more comprehensive assessment of physical activity.⁴²

Nonetheless, these study findings are novel and establish a relation between participants' time preferences and physical activity. Specifically, we find more patient time preferences to be related to an increased likelihood of engaging in leisure-time physical activity among a low-income underserved population of adults. These findings are of particular importance due to the higher propensity of this population to experience chronic diseases, yet the potential inability to treat disease onset due to limited resources. Hence promoting a physically active lifestyle among this population is of paramount importance. Utilizing insights from behavioral economics, with a specific focus on time preferences, may have the potential to modify physical activity patterns and subsequently impact morbidity and mortality outcomes.^{11,31,33} Future research should incorporate time preference measures into longitudinal studies and prospectively explore the efficacy of various schemes (e.g. timing of incentives, pre-commitment contracts) on physical activity promotion to determine a cause-effect relationship.

Acknowledgements

We are grateful to the Fair Park residents who participated in the study. Additionally, we thank John Daniel, MA of the American Cancer Society for editorial assistance.

Funding

The Fair Park Study was funded by the National Science Foundation (NSF/SES-0827350). The authors do not have any conflicts of interest to declare.

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Table 1: Characteristics of Fair Park Study Participants (N=420)^a

Characteristic	n (%)
Age (years)-mean (SD)	44.1 (SD=12.3)
Body Mass Index (kg/m ²)- mean (SD)	29.9 (SD=7.8)
Gender	
Women	205(48.8)
Men	215 (51.2)
Race/Ethnicity	
Non-Hispanic Black	371 (88.3)
Non-Hispanic White	6 (1.4)
Hispanic	36 (8.6)
Other	7 (1.7)
Employed	
No	270 (64.3)
Yes	150 (35.7)
Children <18 years	
No	307 (73.1)
Yes	113 (26.9)
Married	
No	343 (81.7)
Yes	77 (18.3)
High School Education	
No	86 (20.5)
Yes	334 (79.5)
Health Insurance	
No	161 (38.3)
Yes	259 (61.7)
Household Annual Income (\$)	
<20,000	302 (71.9)
20,000-39,999	91 (21.7)
≥40,000	27 (6.4)
Health Status	
Poor	18 (4.3)
Fair	112 (26. 6)
Good	142 (33.8)
Very Good	99 (23.6)
Excellent	49 (11.7)
Meeting Physical Activity Guidelines ^b	
No	122 (29.0)
Yes	298 (71.0)
Total Physical Activity ^b (METs)- mean (SD)	3281.2 (4566.8)

Leisure Time Physical Activity ^b (METs)- mean (SD)	1469.9 (2603.6)
Work-related Physical Activity ^b (METs)- mean (SD)	1603.8 (2677.2)
Transportation Physical Activity ^b (METs)- mean (SD)	207.5 (924.9)
Future Oriented ^c	
Never/rarely	70 (16.7)
Occasionally	137 (32.6)
Often	87 (20.7)
Almost Always	126 (30.0)
Checking/Saving account ^c	
No	97 (23.4)
Yes	318 (76.6)
Monthly Savings (\$) ^c	
0.0	200 (48.8)
1.0-49.9	59 (14.4)
50.0-99.9	46 (11.2)
≥100	105 (25.6)
Planning Family Finances ^c	
Next Few months	231 (56.6)
Next year	59 (14.5)
Next few years	52 (12.8)
Next 5 to 10 years	34 (8.3)
≥10 years	32 (7.8)

^a Some categories do not total 420 due to missing data; percentages are rounded

^b Metabolic equivalent (MET) minutes per week were derived from responses to a survey, assessing the frequency, duration and intensity of physical activity. Total physical activity and domain specific physical activity (leisure, work-related, and transportation) were determined from the survey. Meeting physical activity guidelines (no/yes) was based on the 2008 Health and Human Service Guidelines for health promoting physical activity (i.e. ≥500 MET minutes per week).

^c Future orientation was determined based on a survey question gauging the degree to which individuals are future oriented (rarely/never, occasionally, often, and almost always). Participants were also asked to indicate whether they have a checking/saving account and to specify the dollar amount they save each month. While having a checking/saving account was regarded as dichotomous (no/yes), monthly savings (\$) was grouped into 4 categories: \$0, \$1 to <\$49.9, \$50 to <\$99.9, and ≥\$100. The time period considered when planning family finances consisted of: next few months, next year, next few years, 5 to 10 years, and ≥10 years.

Table 2: Future Orientation, Monetary Savings, and Meeting Physical Activity Guidelines, Fair Park (Dallas, Texas)

	UNADJUSTED ^a Meeting Physical Activity Guidelines ^b			ADJUSTED ^a Meeting Physical Activity Guidelines ^b		
	Odds Ratio	95% confidence Interval	P-value	Odds Ratio	95% Confidence Interval	P-value
Independent Variable						
Future Oriented ^c	1.38	1.13, 1.69	0.002	1.29	1.04, 1.58	0.019
Checking/Saving account ^c	1.78	1.10, 2.88	0.018	2.07	1.19, 3.57	0.009
Monthly Savings (\$) ^c	1.20	1.00, 1.43	0.044	1.16	0.96, 1.41	0.130
Planning Family Finances ^c	1.20	1.00, 1.42	0.045	1.17	0.97, 1.41	0.093

^a Unadjusted analysis was conducted by entering each primary independent variable separately into a logistic regression model with meeting physical activity guidelines as the dependent variable. In comparison, multivariable logistic regression was utilized with separate models for each independent variable in relation to meeting physical activity guidelines, while adjusting for: age, sex, race/ethnicity, employment status, marital status, income, education, children <18 years, health status, health insurance, and body mass index. The sample sizes varied in models due to missing responses: future oriented: n=420; checking/saving accounts: n=416; monthly savings: n=411; and planning family finances: n=409.

^b Meeting physical activity guidelines (no/yes) was based on the 2008 Health and Human Service Guidelines for health promoting physical activity (i.e. ≥ 500 MET minutes per week).

^c Future orientation was determined based on a survey question gauging the degree to which individuals are future oriented (rarely/never, occasionally, often, and almost always). Participants were also asked to indicate whether they have a checking/saving account and to specify the dollar amount they save each month. While having a checking/saving account was regarded as dichotomous (no/yes), monthly savings (\$) was grouped into 4 categories: \$0, \$1 to <\$49.9, \$50 to <\$99.9, and $\geq$ \$100. The time period considered when planning family finances consisted of: next few months, next year, next few years, 5 to 10 years, and ≥ 10 years.

Table 3: Future Orientation, Monetary Savings, and total and domain specific Physical Activity, Fair Park (Dallas, Texas): Adjusted Models^a

	Total Physical Activity ^b			Leisure Time Physical Activity			Work-Related Physical Activity			Transportation Physical Activity		
	METs	95% CI	P-value	METs	95% CI	P-value	METs	95% CI	P-value	METs	95%CI	P-value
Independent Variable												
Future Oriented ^c	828.37	396.03, 1260.72	0.000	849.67	537.16, 1162.18	0.000	255.41	-15.75, 526.56	0.065	-103.06	-401.18, 195.06	0.497
Checking/Saving account ^c	1073.14	-100.77, 2247.06	0.073	993.23	134.08, 1852.37	0.024	420.41	-311.46 1152.28	0.259	-175.98	-968.41, 616.46	0.663
Monthly Savings (\$) ^c	334.67	-65.26, 734.61	0.101	347.16	55.63, 638.68	0.020	132.07	-115.50, 379.63	0.295	6.81	-267.87, 281.50	0.96
Planning Family Finances ^c	318.21	-46.43, 682.85	0.087	276.28	12.88, 539.67	0.040	68.31	-157.53, 294.15	0.552	97.10	-145.74, 339.95	0.432

MET- Metabolic Equivalents; CI- Confidence Intervals

^a Multivariable Tobit regression was utilized with separate models for each independent variable in relation to total physical activity and domain specific physical activity (leisure, work-related, and transportation) as continuous variables, while adjusting for: age, sex, race/ethnicity, employment status, marital status, income, education, children <18 years, health status, health insurance, and body mass index. The sample sizes varied in models due to missing responses: future oriented: n=420; checking/saving accounts: n=416; monthly savings: n=411; and planning family finances: n=409.

^b Physical Activity: Metabolic equivalent (MET) minutes per week were derived from participants' responses to a survey, assessing the frequency, duration and intensity of physical activity. Total physical activity and domain specific physical activity (leisure, work-related, and transportation) were determined from the survey as well.

^c Future orientation was determined based on a survey question gauging the degree to which individuals are future oriented (rarely/never, occasionally, often, and almost always). Participants were also asked to indicate whether they have a checking/saving account and to specify the dollar amount they save each month. While having a checking/saving account was regarded as dichotomous (no/yes), monthly savings (\$) was grouped into 4 categories: \$0, \$1 to <\$49.9, \$50 to <\$99.9, and ≥\$100. The time period considered when planning family finances consisted of: next few months, next year, next few years, 5 to 10 years, and ≥10 years.