# Time Preferences and Physical Activity: Insights from Behavioral Economics

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## Abstract

**Objective-** To examine the relationship between time preferences and physical activity among adults.

**Methods-** Cross-sectional study of 7,071 US adults. Time preferences were elicited based on a hypothetical dollar amount today or a larger sum in 30 days (30d), and a dollar amount 30 days from now or a larger sum in 60 days (60d). Physical activity was self-reported.

**Results-** In multivariable analysis, high future time preferences were 1.2 times more likely to meet guidelines than those who were not future oriented (30d: OR=1.24, 95%CI 1.02-1.52; 60d: OR= 1.23, 95%CI=1.06-1.44).

**Conclusions-** Study findings demonstrate a positive relationship between future time preferences and physical activity. Future research should aim to assess this relationship using prospective designs.

**Keywords:** Time Preferences, Physical Activity, Behavioral Economics

There is abundant evidence pertaining to the health benefits of a physically active lifestyle. Meeting physical activity guidelines (150 minutes of moderate and/or 75 minutes of vigorous activity per week) is related to significant risk reductions in non-communicable diseases, while concurrently increasing lifespan, overall well-being, cognitive functioning, and quality of life.[1] Specifically, habitually engaging in physical has been associated with reduced risk for type 2 diabetes, some cancers (e.g. colon cancer), hypertension, coronary heart disease, and premature death from all-causes, cardiovascular diseases, and cancer.[1,2] This evidence stems from both observational studies and randomized controlled trials. For example, a large cohort study by Moore et al. (2012), examining over 650,000 adults over a median follow-up of 10 years, found that moderate physical activity (e.g. brisk walking) for up to 75 minutes per week was related to a 1.8 years gain in life expectancy in comparison to engaging in no leisure time activity.[3] Higher levels of physical activity resulted in further reductions in mortality risk in this study, which is indicative of a dose-response relationship. Despite this overwhelming evidence, many Americans are not sufficiently physically active to achieve these health benefits. Specifically, approximately half of US adult meet physical activity guidelines based on self-reported data, whereas only ~5% meet activity guidelines based on accelerometer measurements.[4,5]

Thus despite the fact that most adults are cognizant that physical activity will benefit their health, most are not sufficiently active.[6] In essence, by not engaging in an active lifestyle, people are acting against their own self-interest. Behavioral economics, the application of cognitive psychology to economics, has the potential to explain this phenomenon by acknowledging that human decision making is bounded, that individuals tend to adhere to the default options, and they put a greater emphasize on present costs than on future wellfare.[7–9] Following default option refers to people following the 'path of least resistance' (i.e. status qua bias),[7] which in the case of physical inactivity, refers to a society that has 'engineered' exercise out of our daily lives due to increased automation for transportation, at work, and at home.[10] Indeed, while leisure time physical activity has remained fairly constant of the years, whereas occupational, transportation and home related activity have all markedly declined.[10–12] In addition, from an economic perspective, physical activity can be viewed as an intertemporal tradeoff between present costs and future gains.[13–15] Specifically, engaging in physical activity

could be costly in terms of time and energy expenditure at present, while the benefits (e.g. decreased morbidity and mortality) are in the distant future and not salient.[13,15] Thus, individuals with less patient time preferences will hypothetically be less willing to allocate the necessary time at present to exercise in order to achieve health benefits that are not tangible.[14] There is, however, a dearth of empirical evidence pertaining to time preferences and physical activity, particularly among national samples of adults. The evidence to date has primarily examined the relationship between intertemporal choices and unhealthy behaviors, such as smoking, excessive alcohol intake and obesity.[16,17] Thus, in the current study we extend the literature by examining the relationship between time preferences and physical activity among a large sample of adults in the United States (US).

## METHODS

### Design and Sample

This study cross-sectionally examines the association between time preferences and physical activity among a sample of adults responding to a web-based survey pertaining to health behaviors in families.[18] Information on recruitment and the methods of the survey appear elsewhere.[18] Briefly, a total of 14,400 households from the Nielsen National Consumer Panel (a national sample of the contiguous US) were invited to participate.[18] Of these, 10,244 households responded to the survey of which 7,071 adult respondents had prior demographic information provided to Nielson. This information was subsequently linked to the current data. Additionally, these participants provided information pertaining to time preferences (exposure) and physical activity (outcome). The current study received exempt status from the Institutional Review Board of Morehouse School of Medicine.

### Measures

**Time Preferences:** Participants were queried via two separate survey questions,[19] pertaining to time preferences. They were asked to indicate whether they preferred to receive a hypothetical dollar amount today or a larger sum 30 days from now (question 1); and if they preferred a hypothetical dollar amount in 30 days or

a larger amount in 60 days (question 2). Specifically, participants were asked to choose one monetary amount for each of the following scenarios: Scenario A: $10 today or $12 in thirty days (question 1); and $10 in thirty days or $12 in sixty days (question 2); Scenario B: $10 today or $15 dollars in thirty days (question 1); and $10 in thirty days or $15 dollars in sixty days (question 2); and Scenario C. $10 today or $18 dollars in thirty days (question 1); and $10 today in thirty days or $18 dollars in sixty days (question 2). Each scenario where a future time preference was selected (i.e. willingness to receive future monetary compensation over an earlier period) was coded as '1', whereas a non-future preference was coded as '0'. For each of the two questions (30d and 60d time horizons), the sum of the three scenarios was added resulting in a score ranging from '0' (indicative of very low future time preference) to a maximum score of '3' (indicative of future preference for the three scenarios). While '0' was regarded as having 'very low' future time preference, '1' was considered having a 'low' future time preference, '2' was regarded as having a medium future time preference, and '3' as having a 'high' future time preference. This approach, where a higher score is indicative of a more patient time preference, is consistent with previous studies examining time preferences in relation to physical activity stages of change and obesity as outcome measures.[14,15]

**Physical Activity:** Physical activity was based on responses to questions, adapted from the International Physical Activity Questionnaire (IPAQ),[20] pertaining to the frequency of engaging in physical activity during the past week for more than 20 minutes. Specifically, participants were asked to select one of the following categories regarding the frequency of moderate and vigorous intensity physical activity during the past week: a. 0 times; b. 1 time; c. 2-3 times; d. 4-6 times; e. 7-10 times. From these responses, MET (metabolic equivalent of task) values were computed for moderate (4 METs) and vigorous (8 METs) intensity activity.[21] The intensity levels were then multiplied by 20 minutes of activity and additionally multiplied by the frequency of activity; while selecting the lowest category to take a conservative approach. For analysis, the total $MET \cdot min \cdot wk^{-1}$ was computed and examined both continuously and dichotomously, that is, categorized into meeting Physical Activity Guidelines ($\geq 500\ MET \cdot min \cdot wk^{-1}$): no/yes.[1]

**Covariates:** Covariates included participants' age (21-29, 30-39, 40-49, 50-59, ≥60 years), college education (no/yes), annual household income (<$30,000, $30,000-44,999, $45,000-69,999, ≥$70,000), married (no/yes), self-rated health (low, medium, high), race/ethnicity (non-Hispanic black, non-Hispanic white, Asian, Hispanic, other), self-rated health status (low, medium, high), and obesity (BMI≥30): no/yes.

## Statistical Analysis

The relationship between future time preferences (30d and 60d time horizons) and meeting physical activity guidelines was examined using multivariable logistic analyses. Since the 30d and 60d time horizon variables were highly correlated (Spearman rho=0.66, p<.01), each was considered a separate primary independent variable. When examining the association between the primary independent variables to physical activity (dependent variable) two models were constructed. Model 1 adjusted for age, race/ethnicity, marital status, income, and education; whereas Model 2 adjusted for the variables in the first model plus obesity and health status. Separate ordinary least squares (OLS) models were constructed for each time preference variable in relation to the total $MET \cdot min \cdot wk^{-1}$, whereas logistic regression models were computed for meeting physical activity guidelines. Stata version 11.2 (StataCorp LP, College Station, Texas) was utilized to perform all analyses.

## RESULTS

As presented in Table 1, in this sample of adult participants, 70% were married, 46% had a college degree, and ~37% had an annual household income of ≥$70,000. Participants were, on average, overweight (mean=28.4, SD=6.1), and 25.2% met physical activity guidelines. With regard to time preferences, 53.3% had a high future time preference (30d time horizon) and 40.5% had a high future time preference with a 60d time horizon. When examining the association between time preferences and physical activity in multivariable analyses (Table 2), findings reveal a dose-response association between time preferences and physical activity. Specifically, participants with higher future time preferences were more likely to meet physical activity guidelines (30d: p

for linear trend= 0.003; 60d: p for linear trend= 0.035). When examining time preferences categorically in the fully adjusted model, participants with high future time preferences were 1.2 times more likely to meet physical activity guidelines than those who were not future oriented (30d: OR=1.24, 95% 1.02-1.52; 60d: OR= 1.23, 95%CI=1.06-1.44). When examining this relationship with physical activity as a continuous measure, similar findings were observed. For example, in the fully adjusted model, a high future time preference (30d horizon) was associated with 43.28 more MET·min·wk$^{-1}$ than the reference group.

## DISCUSSION

Study findings indicate that a higher propensity for future time preferences is significantly related to a physically active lifestyle. Thus, individuals who have less patient time preferences are less inclined to invest the time/energy required to exercise at present to reduce the burden of chronic disease later in life. While the relationship between intertemporal preferences and various outcomes (e.g. health, educational attainment) has long been the focus of investigation for both economists and psychologists,[13] this pursuit has not been sufficiently explored in the public health realm.[15] These results suggest that time preferences should be taken into account when examining correlates of physical activity. These findings from a national sample confirm results from our previous studies on smaller samples of low income residents from a single geographical location.[15,8] These prior studies, however, utilized either a proxy of time preferences (e.g. monetary savings),[8] or the intention to engage in exercise (i.e. stages of change) rather than physical activity itself as an endpoint.[15] Hence in the current investigation we establish a relationship between more patient time preferences and the increased likelihood to engage in physical activity (both continuously and categorically) among a large sample of adults.

Impatient time preferences have been associated with other health related behaviors. For example, Shapiro (2005), examining short term impatience among food stamp recipients, found a 10-15% decline in caloric consumption over the month.[22] Thus those with impatient time preferences were more likely to run out of food before the end of the month. Outside the health realm, a longitudinal study found that impatient time preferences

at adolescents adversely impacted educational achievement, job prospects, and income later in life.[23] In addition, impatience has been related to overspending among both adolescents and adults, higher credit card debt, and less saving in 401Ks.[16,24] Research by Choi et al. (2002) has observed that in the case of saving for retirement, individuals tend to take the path of least resistance by choosing the default saving option, or lack thereof, offered by the employer.[24] Thus, once the default option is enrollment in a retirement plan, participation rates significantly increase. This finding is applicable to health behaviors in general and physical activity in particular.

The present study has a number of limitations that should be taken into account. First, the study design is cross-sectional, therefore a causal relationship cannot be inferred. Second, physical activity was assessed via a survey (IPAQ) rather than using objective measurement (e.g. accelerometers). Therefore, recall-bias might have occurred. Triangulating between self-reported and objectively measured activity would have been preferable.[25] Third, the IPAQ was modified slightly (e.g. categories were created to increase the response rate rather than open-ended questions), which might have affected the psychometric properties of the questionnaire. Fourth, gender was not reported by many participants (74%), and thus was not included in the analysis. We additionally used multiple imputation,[26] a statistical technique for analyzing incomplete data, to impute gender. Including the imputed gender variable into the multivariable models did not change results materially, therefore we opted not to include this variable. Finally, a more diverse racial/ethnic sample is necessary to generalize findings.

In summary, the present study identifies a relationship between time preferences and physical activity among a large sample of US adults. Future public health research and practice should aim to assess time preferences and their relationship to objectively measured physical activity in population based longitudinal studies. In addition, future experimental research is warranted to explore ways to increase the current costs (e.g. pre-commitment contracts) associated with physical inactivity both at the individual, social and environmental levels in order to decrease hurdles leading to an active lifestyle.

## IMPLICATIONS FOR HEALTH BEHAVIOR OR POLICY

Since automation at home and on the job is pervasive in today's society,[10] most Americans take the path of least resistance,[7] resulting in a sedentary lifestyle.[27] Changes to the social and physical environment, such as implementing sit-stand desks/active workstations in schools and workplaces or building more sidewalks and open spaces in neighborhoods,[28] have the potential to reduce sedentary time and increase physical activity. This is of particular importance to impatient individuals who might be particularly prone to inactivity, and once the cost required to exercise is lower at present and the benefits appear more salient, the propensity for these individuals to habitually engage in activity will likely increase. Therefore, increasing individuals' cognizance of their susceptibility to being impatient might, in turn, lead to increased willingness to commit to their health through pre-commitment contracts.[29] While there is some evidence that time preferences are malleable, particularly in early childhood,[30] increasing awareness to these preferences is paramount with regards to pre-commitment contracts. These contracts involve self-imposed present day costs which lead to improved future behavior. For example, a sum of money is deposited prior to beginning an exercise program, and if the predetermined goals for the prescribed exercise are not met the money will be lost or given to a charity. While this concept has been applied successfully to smoking cessation programs and weight loss interventions,[31,32] it has not been sufficiently explored in the context of promoting physical activity,[33] and thus warrants further investigation.[7] Moreover, providing immediate and frequent financial incentives by employers or insurers for adhering to exercise programs could increase awareness to the immediate benefits of exercise, thus making the benefits more tangible than merely providing information of the health benefits of physical activity.[7,8]

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