Published in final edited form as:
Am J Health Promot. 2013 ; 27(4): 211–221. doi:10.4278/ajhp.110624-QUAN-264.

Health Behavior and Behavioral Economics: Economic Preferences and Physical Activity Stages of Change in a Low-Income African American Community

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Abstract

Purpose—To examine the relationship between physical activity stages of change and preferences for financial risk and time.

Design—A cross-sectional, community-based study.

Setting—A low-income, urban, African American neighborhood.

Subjects—169 adults

Measures—Self-reported physical activity stages of change—precontemplation to maintenance, objectively measured BMI and waist circumference, and economic preferences for time and risk measured via incentivized economic experiments.

Analysis—Multivariable ordered logistic regression models were used to examine the association between physical activity stages of change and economic preferences while controlling for demographic characteristics of the individuals.

Results—Individuals who are more tolerant of financial risks (OR=1.31, $p<0.05$) and whose time preferences indicate more patience (OR=1.68, $p<0.01$) are more likely to be in a more advanced physical activity stage (e.g. from preparation to action). The likelihood of being in the maintenance stage increases by 5.6 and 10.9 percentage points for each 1 unit increase in financial risk tolerance or 1 unit increase in the time preference measure, respectively.

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Conclusions—Greater tolerance of financial risk and more patient time preferences among this low-income ethnic minority population are associated with a more advanced physical activity stage. Further exploration is clearly warranted in larger and more representative samples.

Keywords

Stages of Change; Physical Activity; Behavioral Economics; Risk Preferences; Time Preferences

Indexing Key Words

Manuscript Format: Research; Research Purpose: Modeling/Relationship testing; Study Design: Non-experimental; Outcome Measure: Behavioral; Setting: Local Community; Health focus: Fitness/physical activity; Strategy: Policy and skill building; Target population age: Adults; Target population circumstances: low-income African American

Introduction

The health benefits of physical activity are well established (1–3). Meeting moderate (≥150 minutes/week) and/or vigorous (≥75 minutes/week) physical activity guidelines decreases the risk for numerous chronic diseases such as diabetes, hypertension, coronary heart disease, breast and colon cancer, depression, and premature death (1). Despite these benefits, less than half of US adult men and women are sufficiently physically active (4), with African American men and women less active than their white counterparts. This disparity puts African Americans at risk for increased morbidity and mortality and underscores the need to promote physical activity among this population.

Researchers and intervention developers often utilize behavioral change theories such as the stages of change and processes of change constructs--components of the Transtheoretical Model--to design programs aimed at promoting physical activity among general and at-risk populations (5). The stages of change construct gauges individuals' readiness to change, and places them on a dynamic and temporal continuum. The continuum ranges from the precontemplation category characterized by inactivity without an intention to modify behavior on one end of the spectrum, to currently engaging in an active lifestyle for >6 months—the maintenance stage-on the other end (6). Identifying where individuals and populations are on the stages of change continuum enables individually tailored interventions to promote activity such as increasing awareness of adverse health consequences of an inactive lifestyle for those in the precontemplation stage (5, 6). Numerous studies have employed the stages of change construct in randomized controlled behavioral intervention trials (7, 8), or as an endpoint in observational studies (9, 10). Adults who were older, smoked, married, in racial/ethnic minority groups, and in the lower socio-economic strata were more likely to be in the precontemplation or contemplation stages (9, 10).

Additionally, economic principles, and in particular behavioral economic principles, provide a robust toolset for the study of wide-ranging health behaviors involving trade-offs related to finite resource pools (11). The choice of whether to be physically active, for example, involves decisions about how to allocate time. Allocation of time to physical activity is

costly in terms of time and energy expenditures today, but provides rewards (e.g. lower medical costs) in the future. (12–19). Thus, someone with more patient time preferences might be expected to be more willing to engage in health-enhancing physical activity. There are also risks associated with any sort of lifestyle change. Progression through the stages of change continuum requires individuals to do new activities and may be related to individual risk preferences. Individuals who do not like risk, may be less likely to engage in new health enhancing behaviors.

Behavioral economists might improve standard models by an enhanced understanding of how individuals evaluate risk and time tradeoffs. One way this is done is through identification of individual *preferences* for time and risk and measurement of these preferences through incentivized economic experiments (20). Incentivized economic experiments are used to collect data on participants' decisions in situations where they are paid based on the choices they make. For example, an economic experiment measuring time preferences asks participants to choose between receiving a smaller amount of money now or a larger amount of money six months from now. If participants choose to receive the larger amount of money 6 months from now, they must wait 6 months before collecting their payment, or if they choose to receive the payment now, they get less money. In either case, the penalty for misrepresenting ones true preferences is costly—either receiving less money sooner, or having to wait to receive more money. In general, risk and time preferences need not be over monetary gains/losses; but the economic experiments we will present, are based on financial decisions. Risk preferences describe an individual's preferred level of financial risk; or comfort-level in taking on financial risks (21). Likewise, time preferences measure willingness to forgo immediate monetary gains for delayed (but larger) gains (22). The economic experiments that we use will be presented in greater detail in the Methods section.

Health researchers have long been aware of the link between the inability to delay gratification --what economists would call impatient time preferences--and health behaviors relating to diet, physical activity or smoking resulting in a call for the use of behavioral economic principles in the design of interventions (23–25). Economists have also begun some exploration of these relationships. For instance, behavioral economists have examined the spending behavior of food stamp recipients (26) and the role of group social identification on soup kitchen patrons (27). Although no known studies specifically relate economic preferences for time and risk measured via incentivized economic experiments to physical activity intentions or behavior, several have assessed the relation between proxies of economic preferences and obesity. Survey-based proxies for impatient time preferences (28) and poor savings behavior (29, 30) —also a proxy for impatient time preferences— were positively related to obesity. Incentivized choices in economic experiments should be examined as a more valid means of assessing preferences (20, 31–35).

Extant research from both the health and economic fields has provided evidence of the benefits from examining the nexus of behavioral economics and health behaviors. Hence, we examine the association between economic preferences for time and financial risk measured via economic experiments and physical activity stages of change among a low-income African American community. To our knowledge, no studies to date have examined this relationship in any population. Further, our study focuses on a low-income African

American sample, for which the policy implications of understanding this relationship are significant. African Americans are less likely to engage in sufficient health promoting physical activity than their white counterparts, less likely to have health insurance, yet conversely more likely to be suffer from chronic conditions such as obesity and diabetes, which are often preventable through physical activity promotion (1).

Methods

Design

Study data come from the second cross-sectional wave of data collection (October 2009-February 2010) in a longitudinal research project studying effects of public investment in a low-income, minority neighborhood (36). The urban Texas neighborhood examined has approximately 20,000 residents of which 70 percent are African American and 26 percent are Hispanic. Median annual income in the neighborhood is $19,939 (estimates based on US Census, 2005–2009 American Community Survey 5 Year Estimates).

The Study was approved by the University of Texas at Dallas, University of Texas Southwestern Medical Center and University of Texas Health Science Center Institutional Review Boards. Written consent was obtained from all participants. Participants completed a detailed survey collecting socio-economic, perceptions, lifestyle, and behavioral data. Anthropometric measures were collected by trained personnel at the time participants completed the survey. Trained personnel measured weight and height using a calibrated digital scale and stadiometer (37). Waist circumference was measured at the umbilicus level with a tape measure (Seca 72” Tape). Due to the cost of conducting the economic experiments, a randomly selected subset of these participants were recruited back to participate in monetarily incentivized economic experiments. All participants were compensated for their time: $30- survey and $20 -economic experiments. Additionally, the economic experiments described below and in Figure 1 provided the opportunity to earn additional compensation based on responses to the experimental protocols (mean=$50.42, SD=$21.52). We analyzed these cross-sectional data to examine the association between economic preferences as derived from the economic experiments and participants’ stages of change measured via questionnaires.

Sample

The sample was recruited based on information obtained from a geographically weighted sample selected to represent households at varying distances from 3 new light rail transit stations in the neighborhood. Because the goal of the larger study was to examine the impact of light rail investment on child behavior outcomes, families with children were preferentially selected into the study. Participants were recruited by community-based field researchers who made initial contact at the participants’ home and invited them to come to a community-based field research station to complete the data collection. Survey data and objective obesity measures were collected from 496 participants. Of these, 198 randomly selected participants participated in economic experiments. T-tests were conducted to compare mean characteristics of the sample that participated in the economic experiments versus the sample that completed only survey and obesity measures. The two samples were

not statistically different with respect to gender (t=−0.37), age (t=1.19), marital status (t=−0.53), income (t=−1.14) or physical activity stage of change (t=−1.72). In two cases participants in the economic experiments had missing data, which left us with 196 complete observations of financial risk and time preferences. The sample size was further reduced due to missing data for one or more of the independent variables (13 participants) or the dependent variable (14 participants). The final study is based on a sample of 169 participants with the complete set of variables necessary for the analysis that follows. The sample is described in Table 1.

Survey data were collected by trained community researchers at the field research station where staff were available to answer questions, and in some cases read the questionnaire to participants. Additionally, the staff reviewed all survey answers while the subjects were on-site to check for incorrectly completed questionnaires. These measures were necessary to accommodate participants who were of low-literacy level—22 percent of participants had less than a high school degree—or who had trouble reading the survey due to poor vision, or other disabilities. Finally, to improve clarity of the questionnaire, all questions were field-tested by individuals recruited from the neighborhood, but not included in the study sample, prior to study implementation.

Measures

Risk and Time Preferences—The risk and time preferences were measured using incentivized economic experiments. Economic experiments are distinct from experiments in the traditional sense. Developed by economists, they borrow from a rich tradition in cognitive psychology and related fields, as a methodology for studying behavior and preferences within a controlled setting. In each economic experiment, subjects make choices between alternatives that carry real financial payoffs, and are paid in accordance with their choices. In contrast, in survey measures of behaviors or preferences, subjects can misrepresent their preferences at no cost to themselves, and may do so either consciously or unconsciously to please the experimenter or reinforce their own self-image. The field of experimental economics has developed three key standards to distinguish these methods and add a degree of rigor to the measurement process: (1) the experimenter must never deceive the subject in any way; (2) the experimental protocol must be standardized and pre-tested; and (3) subjects must receive real payment for their decisions that is incentive-compatible and determined by the choices that the subject makes (32). The risk and time preference measures we use are measured via economic experiments that adhere to these standards. Reliability of the risk and time measures is established in Dave et al 2007 (38), in which 156 Canadian adults completed the time and risk preference protocols twice at six month intervals. Comparing test and retest, the risk and time measures both have Cronbach's alpha > .60 and Pearson correlation coefficient >.50; regression analysis found no significant differences between estimates for the two test periods. This result is confirmed in Harrison et al 2005 (39) for a similar risk preference measure in a Danish adult population, and in Meier and Sprenger 2010 (40) for time preferences in US adult taxpayers. The validity of the measures is confirmed in a number of studies relating these measures to risky and shortsighted health behaviors (41, 42).

Sessions in which the economic experiments were conducted consisted of 7 different experiments or tasks, each of which involved incentivized choices. Subjects were told at the beginning of the session that only 1 task would be randomly selected for payment. The task selected for payment was chosen by drawing a number from a bag at the end of the experimental session, and participants were paid according to the choices they made in that task. This is a standard way of conducting economic experiments in a cost-effective manner while still allowing monetary incentives for each task to be substantial enough to encourage participants to reveal their true preferences.

Because our measure of risk preferences involves decisions over monetary gambles, we use the term “financial risk” to refer to this measure of risk preferences. Preferences for financial risk were determined based on participant’s selection from 1 of 6 possible 50/50 gambles: (1) $40/$40; (2) $30/$60; (3) $20/$80; (4) $10/$100; (5) $0/$120; and (6)-$10/$130 The decision sheet presented to participants is displayed in Figure 1. After hearing about the different gambles, participants selected one of the gambles from the sheet. If the financial risk preference task was chosen for payment at the end of the session, participants drew a coin from a bag containing one black coin and one white coin. The coin drawn determined the side of the gamble that was paid. Participants were categorized into 6 mutually exclusive categories (discrete values of 1 to 6) based on the gamble chosen. Higher expected value gambles indicate higher average returns, thus, the gamble chosen indicates the point at which an individual’s risk aversion dominates the desire for higher returns. Higher values for *Financial Risk* indicate more risk-tolerant behavior. *Financial Risk* values of 1 indicate the participant chose the $40/$40 gamble; the individual has taken on no risk. Financial Risk values of 6 indicate the participant chose the −$10/$130 gamble; these participants exhibited risk-seeking behavior.

Time preferences were measured by asking each participant a series of 6 questions; the decision sheet is displayed in Figure 1. For each question, participants chose between receiving $50 tomorrow or a larger sum of money 6 months from tomorrow. The larger amounts of money increased in each consecutive question: $51, $55, $60, $70, $100 or $150, respectively. The series of questions was first explained to participants and they were informed of each of the questions that they would be asked to answer before they were allowed to mark their responses to any of the questions. If this task was chosen for payment subjects drew a number from a bag to determine which of the 6 questions determined their payment; then subjects were paid according to their choice. It should be noted that all payments were in the future—either “tomorrow” or “6 months from tomorrow”—to reduce the likelihood that decisions motivated by a lack of trust that the experimenter will make payments in the future. Due to the large amount of impatient decisions observed, we categorized participants into 3 categories. Participants who always chose to receive the payment now are in the lowest category (category 1). The middle category (category 2) contained participants who choose the “later” payment in at least 1 but not more than 3 of the 6 decisions, and participants who selected the “later” payment in 4 or more of the 6 decisions were in the highest category (category 3). The variable *Time* indicates the category assigned to each participant’s time preferences, where higher categories indicate that more patient time preferences were measured in the economic experiment.

Physical Activity Stage of Change—Physical activity stages of change were determined via questionnaire, based on the literature (5, 9, 10, 43). The physical activity stages of change questionnaire has been used extensively, and has exhibited good reliability (Kappa=0.78) and significant concurrent validity with the 7-Day Physical Activity Recall questionnaire (44).”A scoring algorithm (see Figure 2), placed participants into 1 of 5 mutually exclusive categories: precontemplation, contemplation, preparation, action, and maintenance. Participants who reported performing moderate intensity physical activity (e.g. mowing the lawn, jogging) or -vigorous intensity physical activity (e.g. running, heavy lifting) on a regular basis, were categorized in the ‘action’ stage if indicating they had been active for ≤6 months, or to the ‘maintenance’ stage if active >6 months. Participants who were not physically active were categorized as follows: (1) precontemplation- if not planning to engage in physical activity within the next 6 months; (2) contemplation- if planning to begin engaging in physical activity within the next 6 months, but not within the next month; and (3) preparation- if planning to engage in physical activity within the next month. We assessed concurrent validity by examining associations between pre-adoption stages (i.e. precontempation, contemplation, and preparation) and adoption stages (action and maintenance) to physical activity as measured by the International Physical Activity Questionnaire (IPAQ) (45). We found a significant association between stages and whether participants met the 2008 Health and Human Services physical activity guidelines (46), as measured by the IPAQ (χ^2=46.72 ; P-value<0.001).

Covariables

Multivariable analysis adjusted for the following variables that were measured via questionnaire: gender, age, marital status, presence of children under 18 in the household, income, self-assessed adequacy of health insurance coverage, and self-reported health status. Anthropometric measures--BMI, waist circumference--were also controlled for in the analysis.

Statistical Analysis

Logistic regression models assessed the relationship between economic preferences (independent variables) and physical activity stages of change (dependent variable), while controlling for the covariables described above. Because of the natural ordering of the physical activity stages, an ordered logistic regression was specified (47). The multivariable regression results are reported as adjusted odds ratios (OR) and 95% confidence intervals (CI) for moving from one stage to the next versus remaining in the same category (48). Because the ordered logistic model recognizes the natural ordering of the dependent variable, it allows for estimation of a unique marginal effect for each independent variable and physical activity stage pairing.

These are computed for the primary independent variables (time and financial risk preferences). They indicate the expected change in likelihood of being in a particular stage for a 1 unit change in the independent variables, while holding the other covariables constant at their sample means (47). STATA 12 (STATA, College Station, Texas) was used for all statistical analyses.

Results

Participants were primarily low-income (71% < $20,000 annual income), unmarried (76%), African American (96%) women (63%). Self-reported health status was good or better for 74% of the sample; however, only 29% were not overweight or obese. As depicted in Table 1, just over 60% of the participants were in the action (15%) or maintenance (46%) stage, while 39% were in pre-adoption stages: precontemplation (15%), contemplation (4%), or preparation (20%). Table 2 also presents the frequency of each independent variable by physical activity stage. Higher income individuals tend to be in the more advanced stages. As a sensitivity analysis, we estimated all of the models that we will present below on both the full sample and a sub-sample that included only participants with incomes less than $20,000. The main results and conclusions were the same across the two groups. Next we will present the results from the full sample, but results for the sample restricted to individuals with incomes less than $20,000 are available from the authors upon request.

Stages of Change Results

Table 3 presents the estimated OR for advancing through the stages of change as compared to remaining in the same stage, while controlling for BMI (model 1) and waist circumference (model 2). The anthropometric measures did not have a statistically significant coefficient estimate in either of the models and the coefficient estimates for other variables are very similar across the two models. Individuals who were more tolerant of financial risk ($p<0.05$) and less impatient ($p<0.05$) were more likely to be in a more advanced stage.

Table 4 reports marginal effects for financial risk and time preferences by stage for each model presented in Table 3. Marginal effects may be interpreted as the percentage point change in likelihood of being in a particular stage from a marginal change in the relevant independent variable (47). The marginal effects for Model 1 indicate the likelihood of being in the precontemplation stage decreases by 3.1 percentage points and the likelihood of being in the maintenance stage increases by 5.6 percentage points for each 1 unit increase in financial risk tolerance. An individual who chose the $20/$80 gamble, all else equal, is 5.6 percentage points more likely to be in the maintenance stage and 3.1 percentage points less likely to be in the precontemplation stage than an individual who chose the “safer” $30/$60 option. For more patient individuals, the likelihood of being in precontemplation decreased by 6 percentage points while the likelihood of being in maintenance increased by 10.9 percentage points.

Discussion

Our findings indicate that individuals who are more tolerant of financial risks and have more patient time preferences are more likely to be in an advanced physical activity stage. Specifically, the likelihood of the precontemplation stage decreases, and the likelihood of being in the maintenance stage increases, with an increase in financial risk tolerance and patient time preferences. Hence higher levels of financial risk aversion and lower levels of patient time preferences among this ethnic minority population might be a source of additional barriers for regularly engaging in health-promoting physical activity--factors yet

to be taken into account in public health interventions. To our knowledge this is the first study to examine whether economic preferences are related to physical activity stages of change. The population studied--a low-income African American sample--is of particular interest due to lower prevalence of physical activity, and higher rates of numerous chronic diseases (49). Though many individuals in our sample were in the maintenance stage, the physical activity stages distribution was similar to results reported from a Rhode Island weighted population sample (10), and to national data indicating that 56.5% of African Americans engage in health promoting physical activity (50).

The economic experiments presented here have an established history in economics of measuring preferences for time and risk (20, 32). However, there is no guarantee that urgent financial situations might cause the participants to make different decisions in the economic experiments than they might otherwise do once their immediate financial needs are met. Regardless of whether decisions made in the economic experiments reflect economic preferences that are dependent upon the participants' current financial situation or not, they show significant relationships with participants' physical activity stages; and it is likely that the financial situation faced by participants on the day they participated in the economic experiments is not unusual for them. Participants were only allowed to attend an economic session for which they had been invited and scheduled several days in advance; therefore, participation in the session is unlikely to be correlated with an unusually high need for financial assistance.

While no known studies have explicitly examined the relationship between physical activity stages of change and economic preferences, other studies find that more impatient behavior is related to an increased risk of obesity (28–30) and more financial risk tolerance is related to an increased likelihood of obesity (51). Our results show that more financial risk tolerance is also related to an increased likelihood for being in a more advanced physical activity stage of change while controlling for obesity status. Thus, while tolerance of financial risk is related to a reduced likelihood of maintaining healthy body weight, we show that it is also related to being in a more advanced physical activity stage of change—or an increase in an individual's willingness to engage in new activities or change unhealthy behaviors. Further studies should explore how these relationships might be leveraged to help obese individuals with higher levels of financial risk tolerance.

Additionally, other studies have analyzed socio-demographic predictors of physical activity stages of change (9, 10). However, these other studies examine a population that differs from the current sample both in terms of racial/ethnic composition and income. Because our study sample is quite homogenous with respect to these and other socio-demographic characteristics, our results neither support nor contradict these previous studies—the socio-demographic variables were included as controls in all models, but were never statistically significant. Instead, we focus on a low-income ethnic minority population, and study findings pertain specifically to this disadvantaged population. While little previous work examining the issues studied here has been done in this population, it is a particularly policy-relevant population because of the population's increased propensity for obesity and increased likelihood to use public insurance programs (52).

Our findings regarding the role economic preferences play in modifying low-income individuals' physical activity behavior could inform unique intervention strategies to overcome challenges to physical activity because unlike many socio-demographic characteristics, behavioral economists have found that economic preferences expressed in behavioral choices are malleable (41, 53). For example, information can be delivered in different ways that vary in the degree of persuasion, the anchoring position taken and the simplification of complex decisions (54–56). These elements all work together to create forms of cognitive bias and are particularly relevant when considering low-income consumers who are not necessarily more myopic or less rational when making decisions, but who, because of their severe resource constraints are forced to make many more calculations about even the simplest decisions (57). The risks associated with behavior changes or any health-related change such as changing ones schedule in order to visit a doctor may be greater for individuals with few resources to compensate for any potential negative outcomes resulting from the change. For example, without health insurance or sick leave at work, the decision of when to see a doctor for an illness has many competing consequences. In this situation marketing campaigns such as those often utilized to address influenza symptoms might anchor the position towards seeing a doctor (rather than toughing it out) when flu-like symptoms exist and provide a short list of important symptoms to help simplify the decision. These measures help individuals to properly frame the competing risks associated with seeing and not seeing a doctor.

Impatient time preferences are often addressed by economists through design of pre-commitment mechanisms whereby the decision to choose a particular behavior is removed from the situation in which the behavioral outcome is immediately relevant (58). This makes it easier for less patient individuals to more carefully consider choices that lead to future benefits but incur immediate costs because now both the costs and benefits occur in the future. Pre-commitment devices have been used by economists to increase savings behavior through the design of savings plans in which individuals either elect to allocate a fixed portion of wage increases to savings and the savings is automatically removed from the paycheck and deposited into a savings account or access to accrued savings is restricted (59–63). Similar mechanisms are available for increasing physical activity. For example, in the study neighborhood, churches organize vanpools to transport residents to church activities two or more times per week. Establishing central vanpool pick-up points that are safe-walkable distances from individual's homes (for those residents who are physically able to walk) rather than driving to each resident's home both saves resources by decreasing the distance the van must drive through the neighborhood and serves as a pre-commitment device whereby van pool participants increase physical activity.

Time preferences may also play a roll in the effectiveness of insurance premium reductions that are tied to health behaviors or outcomes. Less patient time preferences may cause the incentive—a reduction in insurance premiums—to be ineffective if the reduction is not realized until long after the behavior change is made. Thus the timing of the insurance premium rebate—at the end of the year or frequently throughout the year—becomes crucially important (25).

Another area in which insights from analyzing economic preferences have been used by economists to promote policies which result in behavior modification is by simplifying the decision making process or providing a non-binding "nudge" towards certain behavioral choices (64). Such interventions help overcome challenges presented by both impatient time preference and risk aversion because individuals can be "nudged" in such a way as to encourage pre-commitment to healthy decisions. Making the healthy decision the default for everyone may reduce perceived risks associated with the decision. In the case of financial behavior, successful "nudges" have been used by carefully selecting a default savings rate or investment strategy for retirement savings plans (65). Individuals are free to change the default setting, but many never do (66). Similarly, some corporations, as part of their health and safety programs, have established physical activity breaks during the workday. Thus, the default option is to take a 15-minute break twice daily to increase physical activity. Other companies allow employees to take such breaks, but do not establish them as the "default option". In addition to improving physical activity of employees, the health benefits of such programs are compatible both with the employer's interests (a healthier work force with fewer sick leaves being taken) and the employee's interests (better physical health) making implementation easier. In low-income communities, the walking school bus program has been shown to provide similar "nudges" towards modifying the default option towards active transit to school (67) and extensions might be applied to increase adult active transport to common destinations such as church, grocery stores, or community centers.

The potential benefits of understanding the relationship between physical activity stages of change and economic preferences, however, must be tempered by limitations of our study. The cross-sectional design prevents determining temporal relationships; and because the study participants are of very low-income, their choices in the economic experiments might have been influenced by immediate financial concerns to a larger degree than we might see in more affluent populations. Subjects reported a high degree of physical activity, yet there is also a high prevalence of obesity. Though we assessed concurrent validity of the physical activity stages measures in reference to a validated questionnaire (68); physical activity measured via self-report often over-estimates actual behavior in comparison to objective measures (e.g. accelerometers) (69). Future research might address the relationship between perceptions of physical activity and objectively measured physical activity among this population. Additionally, because the study sample is relatively small, homogenous and from a specific geographic region, external validity of the findings might be limited. Due to the relatively small and homogeneous sample, analysis was not stratified by gender or race/ethnicity; but rather adjusted for these factors in multivariable analysis.

Nonetheless, the study question and findings are unique and indicate significant promise for supplementing current public health interventions aimed at promoting physical activity among low-income, ethnic minority populations. We find that individuals with more patient time preferences and a greater tolerance for financial risk are more likely to report being in a more advanced stage of change which suggests important levers that may be used to help individuals make health-enhancing behavior changes. Further studies should analyze longitudinal data to see if time and financial risk preferences are also related to progression through the stages of change. Understanding the relationship between economic preferences for financial risk and time and physical activity stages of change can potentially bring about

modifications to the social and physical environment that can help individuals and communities to become more physically active. Appropriately structured nudges—such as those mentioned or others—enacted across an array of activities or situations may create an environment for which less patient time preferences or low tolerance for financial risk are less serious hurdles to engaging in physical activity.

Acknowledgments

We wish to thank researchers affiliated with the CBEES lab at UT Dallas, Moyo Kimathi for assistance in study design and data collection, and the helpful comments of anonymous reviewers. We are also grateful to the Fair Park residents who participated in the study. This study was funded by the National Science Foundation (NSF/SES-0827350). The study was also supported by Grant Number ULIRR024982, titled, “North and Central Texas Clinical and Translational Science Initiative” (Milton Packer, MD, PI) from the National Center for Research Resources (NCRR), a component of the National Institutes of Health (NIH) and NIH Roadmap for Medical Research, and its contents are solely the responsibility of the authors and do not necessarily represent the official view of the NCRR or NIH. Information on Re-engineering the Clinical Research Enterprise can be obtained from http://nihroadmap.nih.gov/clinicalresearch/overview-translational.asp.

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So What?

What is already known on this topic?

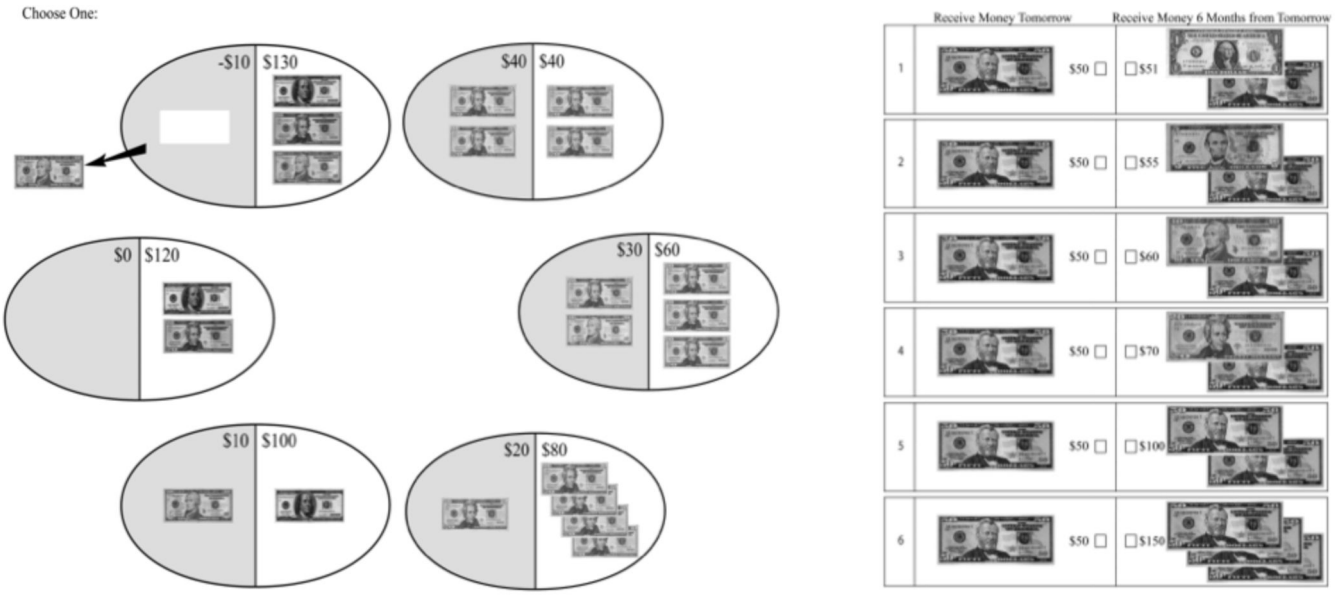
Behavioral economic approaches are being used in public health research to address challenges to behavior modification that stem from individual's preferences for time and risk. However relatively little work has been done to directly examine the relationship between economic preferences measured via the economic experiments and health outcomes—especially among low-income minority populations.

What does this article add?

In our sample of residents from a low-income minority neighborhood, individuals who were more tolerant of financial risk and had more patient time preferences were more likely to be in an advanced physical activity stage.

What are the implications for health promotion and research?

Direct measurement and examination of economic preferences might lead to a more targeted approach at applying behavioral economic concepts to health issues.



Left: Subjects must choose one of six possible 50/50 gambles that they wish to participate in. The gambles start at $40/$40 (no risk), then increase in variance and expected value to a maximum expected value gamble of $0/$120. The last option (an indicator of risk-seeking behavior) increases only in variance and not expected value ($10/$130). An example graphic of the decision sheet presented to participants is shown. Right: Subjects are asked a series of six questions and in each case they choose between receiving $50 tomorrow or a higher amount (ranging from $51 to $150) 6 months from tomorrow. An example of the decision sheet that was presented to the participants is shown.

Figure 1.
Financial Risk Preference Instrument (Left) and Time Preference Instrument (Right)

1. Do you engage in either moderate physical activity (such as walking at a brisk pace, jogging, mowing the lawn) or vigorous physical activity (such as running, heavy lifting) on a regular basis?

☐[1] Yes (Continue down this column)	☐[2] No (Continue down this column)
2. For how long have you been engaging in physical activity? ☐[1] 6 months or less ☐[2] More than 6 months, but less than 1 year (12 months) ☐[3] More than 1 year, but less than 2 years ☐[4] More than 2 years, but less than 3 years ☐[5] More than 3 years, but less than 4 years ☐[6] More than 4 years, but less than 5 years ☐[7] More than 5 years	3. Do you plan to begin engaging in physical activity on a regular basis within the next 6 months? ☐[1] Yes ☐[2] No
Scoring Algorithm: * *Precontemplation*- If question 1=2, and question 3=2. * *Contemplation*- *If* question 1=2, and question 3=1, and question 4=2. * *Preparation*- If question 1=2, and question 3=1, and question 4=1. * *Action*- If question 1=1, and question 2=1 then Action. * *Maintenance*- If question 1=1, and question 2=2-7 then Maintenance.	4. Do you plan to begin engaging in physical activity on a regular basis within the next 1 month? ☐[1] Yes ☐[2] No → **End**

Figure 2.
Physical Activity Stages of Change Instrument and Scoring Algorithm

Table 1

Characteristics of South Dallas Residents

	Sample Analyzed (n=169)
Characteristic	**No. (%)**
Age, mean (SD),y	43.2 (13)
Married	
No	128 (76)
Yes	41 (24)
Annual Income	
<$10,000	80 (47)
[$10,000, $20,000)	41 (24)
[$20,000, $30,000)	18 (11)
[$30,000, $40,000)	10 (6)
>=$40,000	17 (11)
Sex	
Men	63 (37)
Women	106 (63)
Race	
African American	162 (96)
Hispanic	6 (4)
Perceived Health	
Excellent	18 (11)
Very Good	43 (25)
Good	65 (38)
Fair	39 (23)
Poor	4 (2)
Adequate Health Insurance[1]	
No	65 (38)
Yes	104 (62)
Children <18 y living at home	
No	74 (44)
Yes	95 (56)
BMI, kg/m^2[2]	
Underweight	6 (4)
Normal weight	42 (25)
Overweight	42 (25)
Obese 1	30 (18)
Obese 2	23 (14)

	Sample Analyzed (n=169)
Characteristic	**No. (%)**
Obese 3	26 (15)
Waist Circumference (inches)[3]	
Small	21 (14)
Medium	40 (26)
Large	16 (10)
Extra-Large	78 (50)
Physical Activity Stages of Change	
Precontemplation	25 (15)
Contemplation	7 (4)
Preparation	34 (20)
Action	26 (15)
Maintenance	77 (46)
Risk[4]	
40/40	60 (36)
30/60	45 (27)
20/80	31 (18)
10/100	14 (8)
0/120	10 (6)
−10/130	9 (5)
Time[5]	
0	69 (41)
1	17 (10)
2	36 (21)
3	23 (14)
4	9 (5)
5	6 (4)
6	9 (5)

[1] Participants were asked whether their health insurance was adequate to meet their needs.

[2] *BMI* was calculated using the standard formula (kg/m^2), and was categorized as follows: Underweight: BMI <18.5; Normal: BMI 18.5–24.9; Overweight: BMI 25–29.9; Obesity (Class I): BMI 30–34.9; Obesity (Class II): BMI 35–39.9; and Extreme Obesity (Class III): BMI ≥ 40(70)

[3] *Waist circumference* was categorized as small, medium, large, and extra large. Gender appropriate cut points were used for men (<33, 33–36.9, 37–39.9, ≥40 inches) and women (<32, 32–35.9, 36–38.9, ≥39 inches)(71).

[4] *Risk* indicates the preferred 50–50 gamble chosen by participants; gambles increase in variance and expected value (see Fig. 1)

[5] *Time* is the number of times a participant chose to receive a smaller amount of money sooner (rather than a larger amount later) in the time preference task (see Fig. 1)

Table 2

Sample Characteristics by Physical Activity Stage of Change Category[1]

	Precontemplation	Contemplation	Preparation	Action	Maintenance
	No (%)	No (%)	No (%)	No (%)	No (%)
Age, mean (SD),y	44.4	45.6	43.8	40.8	43.8
Married					
No	17 (80.95)	4 (57.14)	27 (90)	20 (83.33)	51 (69.86)
Yes	4 (19.05)	3 (42.86)	3 (10)	4 (16.67)	22 (30.14)
Annual Income					
<$10,000	13 (65)	3 (42.86)	14 (46.67)	14 (58.33)	28 (38.36)
[$10,000, $20,000)	4 (20)	2 (28.57)	12 (40)	5 (20.83)	15 (20.55)
[$20,000, $30,000)	1 (5)	1 (14.29)	0 (0)	1 (4.17)	15 (20.55)
[$30,000, $40,000)	0 (0)	0 (0)	1 (3.33)	4 (16.67)	5 (6.85)
>=$40,000	2 (10)	1 (14.29)	3 (10)	0 (0)	10 (13.7)
Sex					
Men	8 (38.1)	4 (57.14)	21 (70)	18 (75)	42 (57.53)
Women	13 (61.9)	3 (42.86)	9 (30)	6 (25)	31 (42.47)
Race					
African American	20 (95.24)	7 (100)	29 (96.67)	24 (100)	68 (94.44)
Hispanic	1 (4.76)	0 (0)	1 (3.33)	0 (0)	4 (5.56)
Perceived Health					
Excellent	1 (4.76)	0 (0)	4 (13.33)	1 (4.17)	10 (13.7)
Very Good	1 (4.76)	1 (14.29)	8 (26.67)	8 (33.33)	22 (30.14)
Good	7 (33.33)	1 (14.29)	14 (46.67)	9 (37.5)	28 (38.36)
Fair	12 (57.14)	5 (71.43)	3 (10)	5 (20.83)	12 (16.44)
Poor	0 (0)	0 (0)	1 (3.33)	1 (4.17)	1 (1.37)
Adequate Health Insurance					
No	14 (66.67)	5 (71.43)	17 (56.67)	15 (62.5)	45 (61.64)
Yes	7 (33.33)	2 (28.57)	13 (43.33)	9 (37.5)	28 (38.36)

	Precontemplation	Contemplation	Preparation	Action	Maintenance
	No (%)	No (%)	No (%)	No (%)	No (%)
Children <18 y living at home					
No	11 (52.38)	3 (42.86)	14 (46.67)	10 (41.67)	27 (36.99)
Yes	10 (47.62)	4 (57.14)	16 (53.33)	14 (58.33)	46 (63.01)
BMI, kg/m^2					
Underweight	0 (0)	1 (8.33)	0 (0)	0 (0)	4 (5.48)
Normal weight	5 (23.81)	2 (16.67)	7 (23.33)	6 (25)	17 (23.29)
Overweight	6 (28.57)	1 (8.33)	4 (13.33)	5 (20.83)	22 (30.14)
Obese 1	2 (9.52)	2 (16.67)	8 (26.67)	4 (16.67)	13 (17.81)
Obese 2	3 (14.29)	1 (8.33)	6 (20)	4 (16.67)	7 (9.59)
Obese 3	5 (23.81)	5 (41.67)	5 (16.67)	5 (20.83)	10 (13.7)
Waist Circumference (inches)					
Small	2 (9.52)	2 (28.57)	4 (13.33)	6 (25)	7 (9.59)
Medium	7 (33.33)	1 (14.29)	5 (16.67)	2 (8.33)	25 (34.25)
Large	1 (4.76)	0 (0)	3 (10)	4 (16.67)	8 (10.96)
Extra-Large	11 (52.38)	4 (57.14)	18 (60)	12 (50)	33 (45.21)
Risk					
40/40	8 (38.1)	4 (57.14)	10 (33.33)	8 (33.33)	23 (31.51)
30/60	7 (33.33)	1 (14.29)	8 (26.67)	8 (33.33)	17 (23.29)
20/80	1 (4.76)	2 (28.57)	9 (30)	5 (20.83)	13 (17.81)
10/100	2 (9.52)	0 (0)	0 (0)	1 (4.17)	10 (13.7)
0/120	3 (14.29)	0 (0)	0 (0)	1 (4.17)	6 (8.22)
−10/130	0 (0)	0 (0)	3 (10)	1 (4.17)	4 (5.48)
Time					
0	12 (57.14)	1 (14.29)	14 (46.67)	9 (37.5)	27 (36.99)
1	3 (14.29)	0 (0)	3 (10)	2 (8.33)	8 (10.96)
2	3 (14.29)	2 (28.57)	8 (26.67)	6 (25)	15 (20.55)
3	1 (4.76)	3 (42.86)	2 (6.67)	5 (20.83)	8 (10.96)

	Precontemplation	Contemplation	Preparation	Action	Maintenance
	No (%)	No (%)	No (%)	No (%)	No (%)
4	0 (0)	0 (0)	3 (10)	1 (4.17)	5 (6.85)
5	1 (4.76)	1 (14.29)	0 (0)	1 (4.17)	3 (4.11)
6	1 (4.76)	0 (0)	0 (0)	0 (0)	7 (9.59)

[1]Percentages are expressed as the column percentages or the percentage within the same Stages of Change Category

Table 3

Multivariable Ordered Logit Regression--Dependent Variable is Stages of Change (5 Categories)

	Model 1 OR (95%CI)	Model 2 OR (95%CI)
Risk[2]	1.308*	1.290*
	(1.054 – 1.622)	(1.041 – 1.597)
Time[3]	1.677*	1.629*
	(1.062 – 2.647)	(1.035 – 2.564)
Male	1.1	1.171
	(0.553 – 2.189)	(0.595 – 2.306)
Age (continuous)	1.004	1.003
	(0.979 – 1.029)	(0.978 – 1.028)
Married (yes/no)	1.495	1.476
	(0.684 – 3.269)	(0.678 – 3.215)
Children <18 y living at home (Yes/no)	1.733+	1.687
	(0.910 – 3.301)	(0.888 – 3.208)
Adequate Health Insurance (yes/no)	1.416	1.5
	(0.752 – 2.665)	(0.797 – 2.824)
Annual Income [$10,000, $20,000)	1.182	1.215
	(0.574 – 2.433)	(0.590 – 2.503)
Annual Income [$20,000, $40,000)	4.490**	4.524**
	(1.691 – 11.92)	(1.705 – 12.01)
Annual Income > = $40,000	1.854	1.842
	(0.639 – 5.378)	(0.636 – 5.336)
Perceived Health	0.669*	0.655*
	(0.485 – 0.923)	(0.474 – 0.905)
BMI	0.902	
	(0.732 – 1.112)	
Waist Circumference		1.013
		(0.780 – 1.318)
N	169	169

*** p<0.001

** p<0.01

* p<0.05

+ p<0.10

Table 4

Marginal Effects[1] for Risk and Time Preferences according to Physical Activity Stage of Change

Stages of change category	Model 1 ME (95% CI)		Model 2 ME (95% CI)	
	Risk	**Time**	**Risk**	**Time**
Precontemplation	−0.031*	−0.06*	−0.026*	−0.057*
	(−0.057 – −0.005)	(−0.114 – −0.006)	(−0.052 – −0.001)	(−0.112 – −0.002)
Contemplation	−0.006**	−0.012**	−0.005**	−0.012**
	(−0.012 – 0)	(−0.025 – 0.001)	(−0.011 – 0.001)	(−0.024 – 0.001)
Preparation	−0.018**	−0.034*	−0.016**	−0.034*
	(−0.032 – −0.003)	(−0.064 – −0.003)	(−0.03 – −0.001)	(−0.066 – −0.002)
Action	−0.002**	−0.003**	−0.002**	−0.004**
	(−0.006 – 0.003)	(−0.012 – 0.006)	(−0.006 – 0.002)	(−0.014 – 0.005)
Maintenance	0.056*	0.109*	0.049*	0.107*
	(0.013 – 0.1)	(0.016 – 0.201)	(0.005 – 0.094)	(0.011 – 0.204)

*** p<0.001

** p<0.01

* p<0.05

+ p<0.10

[1] Marginal effects are calculated based on the models presented in Table 3.