Behavioral Economic Tools for Promotion of Physical Activity

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Abstract

Habitually engaging in physical activity has been linked to the prevention of numerous chronic diseases. However, most individuals do not meet recommended physical activity levels and trends indicate declining physical activity levels. Behavioral economics can be utilized to better understand the often-complex decision to engage in physical activity, which in turn will provide suggestions for improving implementation of established interventions and indicate why some interventions may be more effective in different contexts. We describe two key behavioral economic constructs (time and risk preferences) and four key behavioral economic tools (default, incentives, pre-commitment and framing) and their application to physical activity. We also offer some suggestions for future research utilizing cross-disciplinary strategies. Behavioral economics offers the potential for unifying public health and economic approaches to increasing engagement in physical activity.

Introduction: The Importance of Physical Activity

Habitually engaging in physical activity, defined as movement that involves skeletal muscle contractions resulting in increased energy expenditure above resting rate (U.S. Department of Health and Human Services, 1996), has been linked to the prevention of numerous health conditions including cardiovascular diseases, type 2 diabetes, weight control, certain cancers (e.g. breast and colon), depression, recurrent falls, hip fractures, cognitive dysfunction, and premature death (U.S. Department of Health and Human Services, 1996, 2008). A causal relationship between physical activity and health is supported by ample evidence from randomized controlled trials, well designed observational studies and basic science. For example, worldwide it has been estimated that insufficient physical activity results in a 16% increased risk for coronary heart disease, 20% risk for type 2 diabetes, 33% for breast cancer, 32% for colon cancer, and 28% for mortality from all- causes (Lee et al., 2012).

Public Health Physical Activity Guidelines

To avoid the increased health risks associated with physical inactivity, the U.S. Department of Health and Human Services recommends in the 2008 Physical Activity Guidelines that adults engage in 150 minutes of moderate intensity physical activity (e.g. brisk walking) and/or 75 minutes of vigorous intensity physical activity (e.g. swimming) per week. For children, 60 minutes of daily physical activity is recommended. Engaging in more physical activity will likely result in additional health benefits, based on studies finding a dose-response relationship between physical activity and morbidity and mortality prevention. For example, a cohort study that followed over 660,000 men and

women for an average of 14.2 years, found a 31% lower risk for mortality among those engaging in physical activity at 1-2 times the recommended levels, whereas being physically active 3-4 times the recommended levels had a 37% reduced mortality risk (Arem et al., 2015).

Unfortunately, most individuals do not meet the recommended levels, let alone exceed them. According to nationally representative data in the U.S., only about half (49.2%) of adults meet physical activity guidelines, based upon self-report measures (Centers for Disease Control and Prevention, n.d.). The data based on objectively measured physical activity (i.e. using accelerometers) are even more dismal, indicating that less than 5% of U.S. adults meet the recommended activity levels (Troiano et al., 2008). The rate of physical activity differs markedly by age and gender, with men more active than women, and children more active than adolescents and adults. Moreover, when examining accelerometer determined physical activity by race/ethnicity among adults aged 20-59 years, there are differences, however, mostly in men. Specifically, among men, non-Hispanics whites on average engaged in 34.6 minutes a day of moderate-to vigorous intensity physical activity (MVPA), non-Hispanic blacks engaged in an average of 37.9 minutes of MVPA daily, whereas Hispanics engaged in 45.7 minutes of MVPA on average (Troiano et al., 2008). In women, non-Hispanic whites' engagement averaged 19.7 minutes per day of MVPA, non-Hispanic blacks averaged 20.0 minutes of MVPA daily, and Hispanics averaged 22.1 minutes of MVPA (Troiano et al., 2008). Additionally, Troiano et al. (2008) found that 42% of children aged 6-11 years

met physical activity guidelines, as determined by accelerometers, whereas only 8% of adolescents aged 12-15 years and 7.6% of 16-19 year olds met these guidelines.

Assessment and Trends in Physical Activity Levels

Physical activity rates have declined over the past several decades due, in large part, to increased automation and the time saving devices at home and on the job (Ng & Popkin, 2012; Shuval et al., n.d.). Occupational related activity has declined as well, as has active transportation (e.g., cycling or walking in lieu of driving), and household work (Archer et al., 2013; Ng and Popkin, 2012). Recreational physical activity, however, has remained fairly constant (Archer et al., 2013; Ng and Popkin, 2012). The energy costs of physical activity are expressed as units of metabolic equivalent of task (MET). A MET of 1 reflects a resting state while sitting; a MET of 3-5.9 represents moderate intensity activity (e.g. mowing the lawn); and a MET≥6 indicates vigorous intensity activity (e.g. swimming laps) (Ainsworth et al., 2011). To compute total energy expenditure during the week, the MET value from the various types of physical activity is multiplied by the duration and frequency of activity. For example, an individual walking for pleasure (MET=3.5), three times a week for an hour each time, will result in a total of 630 MET minutes per week (i.e. $3.5_{\text{METs}} * 180_{\text{minutes/week}}$).

Total physical activity in the U.S. averaged 265 MET minutes per week for adults in 1965, while only 160 MET minutes per week in 2009. Further, average weekly MET minutes were estimated to be 126 METs by 2030 (Ng & Popkin, 2012). The Physical Activity Guidelines reported above correspond to 500 MET minutes weekly; thus both past and current levels of activity are alarmingly low. In addition, nationally

representative U.S. time use data, found that women allocated ~26 hours each week to household work in 1965 compared to ~13 hours weekly in 2010, with non-employed women doing less household work than employed women (~17 and ~7 hours decline per week respectively) (Archer et al., 2013). Conversely, screen based media use (e.g. TV viewing) doubled during the study period from ~8 hours per week in 1965 to ~16 hours weekly in 2010 (Archer et al., 2013).

Costs of Inadequate Physical Activity Levels

Low levels of physical activity impair people's health and directly impact medical costs. A study by Katzmarzyk et al. (2000) estimated $2.1 billion Canadian dollars were spent on medical care related to physical inactivity. They estimated that boosting bodily activity by 10% would reduce medical expenditures by $150 million Canadian dollars per year. An examination of medical claims data from Blue Cross and self-reported physical activity data from the Behavioral Risk Factor Surveillance System estimated that the insurers' expenditures resulting from insufficient physical activity were $83.6 million U.S. dollars, or $56 U.S. dollars per person ((Garrett, Brasure, Schmitz, Schultz, & Huber, 2004)). Additionally, individuals with high levels of cardiorespiratory fitness at midlife, a result of habitual physical activity and genetics, had reduced medical care costs at the end of life. The average annual cost of health care use was $7,569 US dollars among participants with high fitness levels, in comparison to $9,379 for patients who were moderately fit, and $12,811 for low fit group patients. Similarly, average annual costs from cardiovascular disease alone were lowest among the highly fit group, as were the number of office visits to the physician (Cooper, Berry, & Willis, 2015).

Economists have shown that increased physical activity is associated with higher personal earnings but the direction of causality is not entirely clear (Lechner & Sari, 2015; Maruyama & Yin, 2012). Low levels of physical activity are associated with both lower income and higher health care costs, making individuals living in low-income neighborhoods particularly vulnerable to the negative consequences of physical inactivity. Low-income households frequently live in neighborhoods least amenable to physical activity (e.g. high crime, inadequate parks, unkempt sidewalks), lack transportation and/or wealth resources to circumvent these challenges by for example, paying for gym memberships, and are least likely to have adequate health insurance. Booth and Hawley (2015), emphasize that to avoid the 'economic death march' associated with physical inactivity and high health care costs it is paramount to implement interventions to markedly reduce the epidemic of physical inactivity.

Overview of the Literature

Public Health Strategies to Improve Physical Activity

Public health interventions attempting to increase physical activity have primarily focused on individual behavior change (Healy et al., 2013; Sallis et al., 2006). These interventions, however, are often not sustainable and cannot be disseminated to the community at large (Sallis et al., 2006). For example, the seminal Diabetes Prevention Program (DPP) study demonstrated that an intensive physical activity and dietary intervention succeeded more than medication (metformin) or a placebo in reducing the incidence of type 2 diabetes among pre-diabetics (Diabetes Prevention Program Research

Group, 2002). Although the DPP lifestyle intervention proved to be a cost-effective approach over a 10 year period, some DPP programs have encountered difficulties in implementation in 'real world' settings (Faridi et al., 2010; The Diabetes Prevention Program Research, 2012).

In contrast to individual-level interventions, an ecological approach acknowledges that physical activity and inactivity are impacted by a multitude of factors on the individual (e.g. lack of self-efficacy), social/cultural (peer-support), organizational (e.g. workplace), environmental (e.g. parks and trails), and policy (e.g. school sitting/standing policies) levels (Owen et al., 2011; Sallis et al. 2012; Sallis et al., 2006). Interventions on multiple levels might be more sustainable and effective than targeting the individual level alone. For example, a population level intervention (e.g. community rail trail) promoting walking and cycling was a cost-effective means of increasing the physical activity of community members (Laine and Kuvaja-ko, 2014). Additionally, interventions promoting active transport among children and adolescents through the community, schools and parents have been successful in facilitating behavior change (Chillón et al., 2011; Felipe et al., 2015). Land use policies can also enable physical activity, such as ensuring the connectivity of sidewalks and making the environment more welcoming. Health et al. (2012) suggest that community wide environmental and policy changes be implemented to ease access to pertinent facilities, as well as improvements in urban design.

Economic Strategies to Increase Physical Activity

Traditionally, economists have focused on understanding how individuals make decisions related to physical activity and how these decisions can be explained by individuals' allocation of scarce time and financial resources. This decision framework was first applied to health in the Grossman model of health investment (Grossman, 1972, 2000). The Grossman model incorporates the idea that individuals are both consumers and producers of health and has been extended to include physical activity as a critical component of health production (Cawley, 2004; Meltzer & Jena, 2010).

Economists have long posited that like many other decisions, the decision to engage in health promoting physical activity is a rational response to the costs and benefits associated with physical activity. Individuals value health and physical activity, but they must allocate time and money across a wide array of competing activities and goods that are also valuable. Thus, an avenue for intervening to increase physical activity lies in increasing the incentives for physical activity. Numerous interventions have been developed that financially incentivize physical activity. Overall, these studies find that financial incentives hold promise for increasing physical activity in the short-run, but may be less successful at long-term change (E.A. et al., 2013; Finkelstein, Brown, Brown, & Buchner, 2008; Kane, Johnson, Town, & Butler, 2004; Mitchell et al., 2013). For example, incentivized gym membership increased gym visits during the 1-month study window, but these visits remained elevated only for participants who had never used the gym prior to the study (Charles and Gneezy, 2009). The success or failure of financial incentives may be better understood by incorporating behavioral economic constructs. For example, financial incentives may fail if they signal that physical activity is something so onerous that one should be paid to do it (Gneezy et al., 2011).

Additionally, group-based incentives have been found to be more effective than individual incentives. Kullgren et al., 2013). Importantly, the Grossman model and subsequent studies have assumed that individuals rationally consider all competing costs and benefits when deciding to engage in physical activity. However, behavioral economists have provided evidence suggesting that individuals do not always behave as predicted by the rational choice model (Kagel and Roth, 1995).

To this end, Grossman's model of health production has been expanded to include many of these behavioral economic constructs. These constructs have been empirically related to physical activity (Chiteji, 2010; Huston and Finke, 2003; Mckillop and Leonard, 2013), and are now considered as prime levers for increasing physical activity alongside implementation of more traditional public health and economic incentive approaches.

Behavioral Economic Approaches

Thus far, strategies for increasing physical activity across all disciplines have met with mixed results. In some cases, robust strategies have been developed but implementation is a challenge (Faridi et al., 2010) or long-term behavior change is not achieved (i.e. economic incentive programs) (Charles and Gneezy, 2009; Kane et al., 2004; Mitchell et al., 2013). In other cases, strategies meet with varied results in different study populations or contexts (Joseph et al., 2014). The remainder of this chapter will explore behavioral economic constructs and their potential for unifying public health and economic approaches.

Behavioral economics can be utilized to better understand the often-complex decision to engage in physical activity, which in turn will provide suggestions for improving implementation of established interventions and indicate why some interventions may be more effective in different contexts. We also offer some suggestions for future research utilizing cross-disciplinary strategies. Specifically, we address measurement and data collection considerations that will improve the study of behavioral economic constructs. These constructs may be important mediators of intervention effectiveness and better understanding of their role in physical activity interventions is needed to improve the incorporation of behavioral economic tools in randomized multi-level interventions.

Behavioral Economic Constructs Related to Physical Activity

Behavioral economics provides a framework for understanding the decision to engage in health promoting physical activity by focusing on the process by which individuals make judgments given limited information, and how they utilize these judgments to make choices (Camerer and Loewenstein, 2004). Deciding to engage in physical activity requires individuals to make judgments of costs and benefits in an uncertain environment. The environment is characterized by future and varied probabilistic benefits and more immediate costs that have a relatively higher probability of occurrence. Thus uncertainty occurs in two domains: “will the cost/benefit occur” and “when will the cost benefit/occur”. For example, one might go for an evening jog tonight in order to reduce the likelihood of cardiovascular disease 10 years from now. The

certainty of the immediate costs of an evening jog (e.g., lost time, exhaustion) are salient, but one is uncertain whether cardiovascular disease will be a health concern 10 years from now, or the degree to which the evening jog tonight will be influential in ameliorating that risk. Despite the complexity of a fully rational judgment, individuals make these decisions daily. As a result, we observe judgments related to the uncertain nature of cost/benefits of physical activity that side-step the inherent complexities of a fully rational approach and instead rely upon oversimplification of the decision frame, seek cues to resolve the uncertainty, or ignore uncertainty completely by simply basing behaviors on past habits (Camerer and Loewenstein, 2004).

Observed choices regarding the level of an individual's physical activity is a result of both judgments (which thereby become the information upon which the decision is based) and an individual's preferences--their relative like or dislike (e.g., for physical exhaustion, or lower risk of cardiovascular disease). In addition to assuming that individuals make fully rational judgments, the standard economic model (such as the Grossman model) also implicitly assumes that preferences are stable, invariant, and not context dependent. However, upon closer inspection, behavioral economists have found that preferences are not stable (Slovic, 1995). Instead, individuals "construct preferences" based upon the context at hand (Payne et al., Bettman, & Johnson, 2003). Preferences are malleable. Thus in addition to a need to make frequent choices based upon uncertain judgments, we observe people making choices pertaining to physical activity that vary with the decision context and with time.

Behavioral Regularities Related to Resolving Uncertainty and Intertemporal Decisions

The decision to engage in physical activity has two key characteristics addressed by the behavioral economics approach: (1) individuals must make judgments related to risk and uncertainty and (2) physical activity decisions involve intertemporal choices, or choices that have costs and benefits that occur at different points in time.

Risk & Uncertainty

Individuals tend to deviate from the standard economic model regarding the resolution of uncertainty and risk when the decision involves events that occur with very high or very low probabilities (Camerer and Loewenstein, 2004). Physical activity, as a preventive health behavior, might be directed towards the prevention of low-probability events. For example the 10-year risk of dying from a heart attack is less than 1% for a healthy young adult.[1] As a result, individuals might deviate from the prediction of the standard economic model in several ways.

First, individuals experience loss aversion because they evaluate losses and gains differently (Tversky and Kahneman, 1991). A loss and a gain of equivalent magnitudes are viewed differently; the loss is weighted more heavily. Thus the lost time and energy associated with physical activity is both more certain and will tend to be more heavily weighted than the gain of improved health.

Second, individual judgments are influenced by the current set of circumstances. This tendency takes many forms. Judgments are reference dependent in that they vary depending upon the way in which the uncertainty is presented or framed (Kahneman and

[1] Computed using the Framingham Risk Score (http://cvdrisk.nhlbi.nih.gov/calculator.asp).
Assuming a 26 year old female; total cholesterol 190 mg/dl; HDL cholesterol 45; Systolic blood pressure: 110 mm/Hg; Non Smoker; and not currently taking medication for high blood pressure.

Tversky, 1979; Zimmerman, 2009). Judgments are also frequently made out of habit without consideration (or re-consideration) of the information at hand giving rise to status quo bias and anchoring (Roberto and Kawachi, 2014; Samuelson and Zeckhauser, 1988). For example, a young adult who is healthy and active, might be going for five kilometer runs daily, not because they consider the cost/benefits of the decision each and every day, but simply because it's "what they do" routinely. In addition, anchoring is a tendency to base a decision on the initial information provided without considering information that may later become evident or require some additional search. Specifically, one's own behavior in the past as well as present surrounding social norms can serve as an anchor, which, in turn, can impact behavior in general and physical activity in particular (Zimmerman, 2009). Habit formation of an active lifestyle during early childhood can serve as an anchor for sustained physical activity later on. Additionally, anchoring may explain why social pressures are so effective at influencing physical activity levels, although the most influential peers have proven to be those with the lowest levels of physical activity (Carrell et al., 2011; John and Norton, 2013; Kullgren et al., 2014).

Intertemporal Choices

In order to engage in physical activity, individuals often have to reconcile how they *want* to use their leisure time for other purposes (e.g., screen time, sleep) with the way they know that they *should* use that time (e.g., exercising) to improve their health in the future. This "want/should" tradeoff involves intertemporal choices or decisions with costs and benefits that occur at different points in time (Milkman et al., 2008). In studies of savings behavior, people value money in the future significantly less than they value

money today, that is, one dollar today has been viewed as equivalent to $0.53 one-year from today (Angeletos et al., 2001). It is not surprising that savings rates are generally sub-optimal since even the most rewarding investment options fail to provide a comparably high level of return. Because the costs of physical activity occur in the present while the benefits occur in the future, individuals are likely to discount the future health benefits associated with physical activity. In fact, empirical evidence exists linking savings behavior, self-efficacy, future planning, and other measures of impatience with physical activity levels (Schwarzer et al., 2007; Shuval et al., 2014).

Individuals also tend to take a portfolio approach to thinking about intertemporal decisions balancing "good" and "bad" decisions over time (Milkman et al., 2008). Some studies refer to this as "compensatory behavior". For example, individuals in an intervention aimed at increasing physical activity, were found to have significantly higher levels of physical activity (suggesting an effective intervention), but no difference in body composition (Rosenkilde et al., 2012). The study authors suspect that participants engaged in off-setting behaviors in domains not impacted by the intervention, such as increased caloric intake or being more sedentary outside of the measured physical activity sessions. Finally, decision-making over intertemporal choices appears to be even more sub-optimal when it occurs alongside other cognitively challenging situations (Shiv and Fedorikhin, 1999). This is particularly problematic for want/should decisions regarding how to spend one's time--such as the decision to engage in physical activity. Cognitive loads are often the highest when time is most scarce. Thus sub-optimal decision-making is most likely to occur precisely when the need to optimize one's behavior is greatest.

Behavioral Economic Tools

One application of behavioral economics has been the development of tools that may be employed to guide the design of policy, interventions, and environments so as to make the "right" decision easier while not limiting the choice set, also known as asymmetric paternalism (Loewenstein et al., 2007; Wisdom et al., 2010). These tools are motivated by an understanding of how time and risk preferences can sometimes present challenges to decision-making and generally aide in overcoming one or more of the aforementioned behavioral regularities that result when individuals are faced with complex intertemporal choices over uncertain outcomes, such as the decision to engage in physical activity. A key aspect of behavioral economic tools for improving decisions is that they do not inhibit the individual's ability to choose, yet will make the 'right' choice easier.

Public health interventions designed to increase physical activity often take a paternalistic approach by providing a 'prescribed' amount of physical activity that participants in a program are asked to adhere to. While participants may choose to not follow the prescribed regime, such a prescription often has the effect of making engaging in physical activity less of a decision and more of an edict. Such interventions, while successful in increasing physical activity levels during the intervention, have limited long-term impacts on physical activity once the admonition is lifted and the perception of free choice is once again obtained (Epstein, 1998). Behavioral economic tools are unique in that they have the potential to insinuate a "prescription" for physical activity without

actually being viewed as an edict; they aim to encourage the choice that involves physical activity while discouraging the inactive alternative (Thaler and Sunstein, 2008).

Defaults and environmental structures

An important tool for assisting individuals in optimally assessing risk and uncertainty is careful construction of the default behavior from which all other choices are evaluated. For example, work place culture can establish default behaviors that are for or against engaging in physical activity during the workday. Stairwells can be inviting, welcoming wide places with background music, or desolate, poorly lit areas. Point of decision prompts can be placed in prominent places to encourage making the 'right' decision, such as taking the elevator instead of the stairs (Guide to Community Preventive Services, 2015). In addition, industry campuses can be designed to promote walking between office buildings with parking and roads only along the periphery or they can place buildings so that large parking lots and roads separate them. Companies can support walking clubs, work breaks, and provide 'active workstations' (e.g. treadmill desks). Neighborhoods can be built with open green spaces, playgrounds, wide side-walks and bike trails to facilitate activity (Sallis et al., 2006). When neighborhoods are designed to encourage activity and more residents walk and bike, the shift in default behavior is made possible. For example, a study conducted in Curitiba, Brazil, observed that neighborhood walkability was positively associated with increased physical activity irrespective of income (Reis et al., 2013). Similarly, standing desks, active recess and physical education classes could be

the default in school thereby decreasing sedentary behavior while increasing activity (Neuhaus et al., 2014).

Incentives

As mentioned previously, financial incentives have the potential to encourage physical activity by moving the benefits from the future into the present, thereby overcoming present-time bias. Behavioral economists have contributed to this work by hypothesizing why some incentive schemes might be more effective than others. For example, incentives for physical activity have shown some promise in increasing activity even after the incentives have ended because they change habits, or an individual's default behavior (Acland and Levy, 2010; Charles and Gneezy, 2009). A systematic review by Mitchel et al. (2013) examined the design attributes of studies where incentives successfully encouraged adherence to physical activity. The authors observed that incentivizing based on objectively measured exercise (e.g. via pedometers) rather than self-report was successful in producing meaningful behavior change. Additionally, guaranteed incentives (rather than lottery based), and larger incentives produced more favorable effects, though the sums of the incentives were relatively low (~$3-~$47). Further, more frequent incentives have the potential to bring the benefits of physical activity into the present, particularly pertinent for those with impatient time preferences. Nonetheless, additional research into the specific design needed to establish longer-term activity, and how individual time preferences are related to incentive effectiveness is clearly warranted.

Pre-commitment

One reason why intertemporal want/should decisions are often difficult is because our brain engages in different mental processes when considering immediate versus more distant decisions. Immediate decision-making is less deductive and information seeking, while future decisions are considered in greater detail (Milkman et al., 2008). Thus tools designed to aid in immediate decision making should embrace simplicity, such as the "Let's Move" campaign aimed at increasing physical activity among youth, rather than offering elaborate explanations of benefits in meeting physical activity guidelines ("Let's Move!,"; Roberto and Kawachi, 2014; Zimmerman, 2009). Additionally, pre-commitment devices are an effective tool of moving the decision frame from the immediate future to a more distant future when cognitive processes tend to be more information seeking and rational regarding weighing the costs and benefits of want/should decisions. For example, buying a parking decal that requires one to walk an extra 500 yards to and from work each day is one way in which individuals might pre-commit to engage in meaningful physical activity on a daily basis without having to make the decision repeatedly each morning on the drive into work when excuses for parking closer (i.e. the "want" as opposed to the more distant "should") are likely predominate.

Evidence from gym membership purchases and utilization behaviors suggest that individuals may be willing to engage in costly pre-commitment to addresses behavioral tendencies that often present hurdles to making physically active choices. Specifically, individuals are more likely to pay monthly gym membership fees rather than using pay-as-you go alternatives. However, on average, gym members would have saved significant

amounts of money by using the pay-as-you-go option because they did not use the gym often enough to benefit from any pricing advantage inherent in a flat monthly fee (Epstein, 1998). Either individuals are over-confident about future gym use, or they are willing to pay a premium to pre-commit to gym use, even if it is at a lower rate than they had hoped for. It is difficult to differentiate between these two alternate explanations since we do not know whether pre-commitment (by paying the monthly fee) causes increased gym use over what would have occurred under a pay-as-you-go plan (Epstein, 1998).

Framing

Framing is a tool that may be used to address decision-making challenges arising from both uncertainty and intertemporal choices. Physical activity may be framed in ways that make the costs or benefits more salient (Zimmerman, 2009). A meta-analysis of 94 studies of health intervention messaging found that framing around the gains of preventive health behaviors as opposed to loss-based framing was significantly more likely to increase preventive health behavior uptake, and in particular increased physical activity (Gallagher and Updegraff, 2012). Framing is also a consideration in creating community-wide strategies for improving physical activity. Framing physical activity as a common goal for which all actors play a positive (rather than negative) role has been suggested as a more effective strategy than attributing barriers to segments of the community. For example, the VERB™ campaign conducted by the Centers for Disease Control and Prevention in collaboration with marketing experts, applied a branding

strategy to specifically increase exercise among tweens (Asbury et al., 2008). The campaign focused on creating a brand ('VERB™ It's what you do') that is a unique and fun experience for all tweens rather than pointing out lack of physical activity as a common problem among tweens.

Next Steps in Utilizing Behavioral Economics to Increase Physical Activity

Behavioral economic tools hold promise for improving physical activity. However, the tools have rarely been incorporated into randomized intervention studies; and when incorporated, studies are often not designed to measure the direct impact of the behavioral tool alone. Thus conclusions pertaining to the efficacy and later on the effectiveness of behavioral economic tools for increasing physical activity are premature. The existing "evidence base" relies heavily on extrapolations from observational studies showing that behavioral economic constructs (e.g. time and risk preferences) are related to physical activity levels (Anderson and Mellor, 2008; Leonard et al., 2013; Shuval et al., 2013) or assertions that behavioral economic constructs inherent in some intervention designs are important to promote physical activity (Gallagher and Updegraff, 2012). Therefore, a more regimented, interdisciplinary research approach is necessary to improve our understanding of how behavioral economic tools may be utilized to improve the adoption and maintenance of physical activity using well designed randomized controlled trials.

Measurement

In order to improve the reliability of randomized interventions designed to test the use of behavioral economic tools for increasing physical activity levels, rigorous standards of measurement for both physical activity and behavioral economic constructs must be employed. Studies that employ rigorous measurement in one domain often, fall short in the other, frequently due to funding limitations, or lack of cross-disciplinary knowledge. Highly integrated multi-disciplinary research teams can contribute by helping to establish guidelines for measurement along with discussion of how best to measure the constructs, given limited budgets. These guidelines can aide researchers in developing new studies or data collection efforts, and will also help to standardize the field so that studies are more comparable.

Measurement of Physical Activity (self-report 'versus' objective)

Much of the population-wide evidence on the health benefits of habitually engaging in physical activity stem from self-reported physical activity and their impact on morbidity and mortality outcomes (Haskell, 2012; U.S. Department of Health and Human Services, 1996, 2008). Large cohort studies, such as Harvard's Nurses' Health Study (Manson et al., 1999) rely on self-reported physical activity data in which participants report the type, frequency and duration of activity. Self-reported information is subject to recall-bias and is likely, in the case of physical activity, to be an overestimation of the actual behavior. Indeed, data gathered from accelerometers, a small device that assess the intensity levels of physical activity via the measurement of accelerations confirms that the physical

activity levels are much lower than self-report (Shuval et al. (2015)). However, it is important to note that while accelerometers are an objective measure of physical activity, they have inherent limitations and should not be considered the gold standard. Examples of limitations are the relatively brief measurement period (usually worn for a week) and they do not measure all types of activity (e.g. swimming, cycling). Moreover, accelerometers do not measure the location or context of the activity(Haskell, 2012), and wearing a device on the waist might result in the Hawthorne effect, that is, participants change their behavior because they are being observed (Mccarney et al., 2007; Smith-Spangler et al., 2007).

Measurement of Behavioral Economic Constructs

The physical activity decision is related to two key economic constructs often studied by behavioral economists to explain deviations from predictions of the rational choice model: risk preferences and time preferences. Risk preferences describe the degree to which individuals are willing to take on risk. In general, most people try to avoid risk, which gives rise to risk averse preferences. However, people vary in terms of the degree to which they are risk averse. Time preferences describe the relative value of a good at an earlier date compared to its valuation at a later date. Someone with patient time preferences will be more likely to save money, while someone with impatient time preferences would be unlikely to sacrifice enjoyment in the present for some tangible, but future reward.

The gold standard for measurement of these constructs is economic experiments (Davis and Holt, 1993; Kagel and Roth, 1995). However, these are costly data to collect and the context-free nature of economic experiments sometimes inhibits our ability to measure preferences that are relevant in situations when context matters. Additionally, while experimental economists have developed standards for the conduct of economic experiments and some general guidelines for how to measure time and risk preferences; there is lack of consensus on the ``perfect'' experimental design, particularly for time preferences. Researchers wishing to implement economic experiments to measure time and risk preferences should implement tested protocols that have been validated in sub-populations most similar to the population being studied. For risk preference elicitation, the most widely used protocol is from Holt and Laury (2002). There is less consensus regarding the best experimental method for eliciting time preferences, but the most widely used methods involve asking participants to choose between receiving a larger amount of money in the future versus a smaller amount of money today (Frederick et al., 2002).

When economic experiments are too costly to implement, then self-report proxies of time and risk preferences may be used. However, proxy measures often do not correlate well with experimental measures and/or explain outcomes as one would expect (Anderson and Mellor, 2009; Burks et al., 2012). Future work exploring survey-based measures is necessary to improve the reliability with which time and risk preference measures can be incorporated into surveys.

Incorporation of Behavioral Economic Tools within Behavioral Interventions

The early part of this chapter discussed several behavioral economic tools that may be incorporated into multi-level behavioral interventions aimed at modifying physical activity levels. To date, the evidence base for when and how these tools work is lacking. It is likely that some tools may be more/less effective in different contexts, which include multiple levels and sectors. Behavioral economic tools might be particularly useful in overcoming existing challenges at the individual level. For example, pre-commitment devices may be helpful for increasing exercise levels. However, because we know that there are multiple levels that influence the decision to engage in physical activity, behavioral economic tools must be used within a multi-level perspective. A given tool might only be helpful when implemented beyond the individual level. For example, due to peer effects and the reported tendency of people to be influenced by others lack of physical activity (John and Norton, 2013), pre-commitment devices to improve gym use may be most effective if enacted at the neighborhood level such that all gym users engage in pre-commitment. Nevertheless, these ideas remain speculative and warrant further study. It is important for future researchers to report carefully on the type of behavioral economic tool used and the context in which it is implemented so that study results can be compared to determine which tools are most effective, for which sub-populations, and in which contexts. Randomized multi-level interventions will be best equipped to provide compelling answers to these questions.

Behavioral Economic Constructs as Modifiers

It is also quite possible that behavioral economic constructs (e.g. time and risk preferences) are important modifiers in physical activity behaviors. Correlations between time and risk preferences and physical activity as well as other preventive health behaviors have been widely reported. This suggests that time and risk preferences might also be important modifiers for the effectiveness of behavioral economic tools and intervention participation. However, no known studies have examined these possibilities. Future studies should measure time and risk preferences as an important aspect of the individual-level context in which interventions are implemented. A better understanding of time and risk preferences as modifiers will improve future intervention design and targeting. Further, this work may also inform a clearer understanding of the endogenous determinants of time and risk preferences for the development of new tools aimed at overcoming challenges that impatience and risk aversion play in increasing physical activity.

Conclusion

The decision to engage in physical activity is challenging because it involves both uncertainty (regarding the future benefits) and intertemporal choices (giving up time/comfort now in exchange for improved health in the future). The way in which individuals handle both uncertainty and intertemporal choices is related to physical activity levels. Thus, there is likely much to be gained from leveraging behavioral economic tools designed to improve intertemporal decision-making in uncertain environments, and to design and target interventions for increasing both individual and

population physical activity levels. Researchers and intervention designers have a wealth of established behavioral economic tools to choose from, but these tools have rarely been applied to the field of physical activity. Future randomized behavioral interventions incorporating behavioral economic tools and constructs have great potential for high impact advances in understanding how to improve physical activity levels.

The research agenda in this area should include key elements. First, there is a need for better dissemination of validated methods for measuring both physical activity and behavioral economic constructs to improve the quality of cross-disciplinary studies. Second, increased incorporation of these measures in future studies will help researchers elucidate the role of behavioral economic constructs as mediators of physical activity and/or intervention effectiveness. Third, implementation of multi-level randomized behavioral interventions is necessary to test the effectiveness of behavioral economic tools for increasing physical activity. Behavioral economists and public health researchers alike have much to gain from a joint research agenda that can improve both public and private efforts to increase physical activity, which in turn is a prime lever for reducing risk of morbidity from a host of chronic diseases.

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