Beyond health messaging: a behavioural economics approach to increasing self-selected distance during an acute bout of cycling

By: Aaron T. Piepmeier, Jennifer L. Etnier, and Kimberly S. Fasczewski

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Abstract:

The purpose of this study was to explore the effects of the perceived purpose of exercising on the self-selected distance peddled during an acute cycling task. Participants were randomly assigned to one of three groups (health, wealth, charity). All participants watched a video emphasizing the health benefits of performing at least 30 min of daily exercise. Those in the health group were not provided any additional information. Those in the wealth group were then informed that they would earn money for every two kilometres cycled. Those in the charity group were informed that they would earn money for a charity for every two kilometres cycled. Participants were not given a time/distance limit and were instructed to cycle until they chose to stop. Analyses revealed that participants in the wealth and charity group cycled significantly farther than those in the health group (approximately twice as far). Additionally, a significant sex by group interaction showed that women cycled farther for charity while men cycled farther for wealth. These results suggest that health messages used to increase exercise behaviour may benefit from exploring how paradigms from behavioural economics influence behaviors that have relevance to public health.

Keywords: Exercise | health | psychology | performance | self

Article:

Introduction

It is probably fair to say that *everyone* knows that exercise is "good for you." However, according to the Center for Disease Control and Prevention only 49.8% of people in the U.S. meet the recommended level of physical activity ("Recommendations & Guidelines for Physical Activity, CDC," 2017). Health messaging strategies have been explored as a way to elucidate this exercise paradox (i.e. knowing that exercise is good for you, yet not exercising) (Brawley &

Latimer, 2007; Latimer, Brawley, & Bassett, 2010; Latimer, Salovey, & Rothman, 2007; O'Keefe & Jensen, 2007). In a narrative review, Brawley and Latimer (Brawley & Latimer, 2007) suggest effective physical activity health messaging should translate current physical activity guidelines in presenting the information to the target audience. This includes information such as 1) the recommended dose of physical activity, 2) methods to accrue the recommended dose, and 3) the benefits received from a physically active lifestyle.

Health messaging has been categorised as being either gain-framed or loss-framed. While gain-framed messaging focuses on the positive outcomes from leading a physically active lifestyle (e.g. reduced risk of heart disease), loss-framed messaging focuses on the negative outcomes from leading a sedentary lifestyle (e.g. increased risk of developing osteoporosis). Findings from a recent narrative review suggest that gain-framed health messaging may lead to greater physical activity behaviour in sedentary adults (Latimer et al., 2010). However, even though gain-framed messaging has been used in conjunction with highly promoted and successful public health initiatives, such as Michelle Obama's *Let's Move!* campaign, the exercise paradox endures. Therefore, other approaches to behaviour change should be investigated in order to address this paradox.

The field of behavioural economics uses knowledge about our economic decision making to predict behaviour (Laibson & List, 2015). By employing a behavioural economics approach to health behaviour, we gain insight into the effect of gain-framed health messages within the context of monetary gain. Indeed, meta-analytic evidence has shown that financial incentives have been shown to improve health behaviors such as physical activity (Mantzari et al., 2015). Further, work by Ariely, Bracha, and Meier (Ariely, Bracha, & Meier, 2008) used two groups to explore the power of a monetary reward to increase the number of miles cycled in a single 10-minute bout. For each group, the number of miles cycled determined the amount of the subsequent monetary reward. While participants in both groups were told that their exercise performance would generate a charitable donation, participants in one group were also told that they would receive a personal monetary payment. Results showed that participants cycling for both a charitable donation and personal payment cycled more miles than those in the charity group alone. However, the nature of this study complicates the interpretation of this study. Specifically, given that participants were not randomly assigned to groups, we are not able to infer that personal payment caused the increase in cycling. For example, it is possible that non-randomized heterogeneity between groups in terms of cycling experience was the true cause of the effect. Additionally, the overall inferences of the findings are limited by the lack of a non-payment control group and by including payments to charity in each group. In order to determine the causal economic factor affecting cycling distance, it is necessary to randomly assign participants to distinct treatment groups.

Market-based evidence for this intriguing strategy may be seen by the various health and fitness applications (apps) that have been designed to employ a behavioural economics approach to improving health behaviors. By leveraging advances in mobile health technology (e.g. smart phones, activity trackers), apps such as *HealtyWage, Pact, DietBet,* and *Fitstudio,* reward users' as they improve health behaviors such as increased physical activity, weight loss, and healthier food choices with personal monetary payment, while apps like *Charity Miles* generate charitable donations as their users increase their physical activity. The success of such entrepreneurial ventures adds to the need for scientific investigations into the use of behavioural economics to improve health behaviors.

Given the enduring low levels of physical activity participation and the need to identify methods that can encourage increased levels of physical activity, it is important to consider how behavioural economics may be used to increase physical activity behaviour. Therefore, the purpose of the study was to use a randomized control trial design to explore the effects of the perceived purpose of exercising on the self-selected distance peddled during an acute cycling task within a behavioural economics framework. The goal was to assess differences in the total distance (km) cycled between groups provided different purposes for their performance: to improve health, to increase wealth, or to generate a charitable donation.

Methods

Participants

Inclusion criteria required participants to be within 18-35 years of age. Participants were excluded if they had known medical conditions preventing them from performing an acute bout of aerobic exercise, or if they exercised more than 30 min per day on at least three days per week. A total of 64 male ($n = 30$) and female ($n = 34$) (18 to 34 years, $M = 21.7$ years) young adults from a southeastern university participated in the study. While, the participants' programmes of study varied, most participants were undergraduate Kinesiology students. All participants met safety requirements of the American Heart Association/American College of Sports Medicine Health/Fitness Facility Pre-Participation Screening Questionnaire and were deemed safe to exercise at a moderate intensity. Study protocols were submitted to, and approved by, an institutional review board for testing of human subjects. All participants signed an approved informed consent prior to data collection.

Measures

Current Physical Activity Behaviour: Current level of physical activity was assessed by the physical activity portion of the National Health Interview Survey (Benson & Marano, 1998), and was defined as the frequency and type of physical activity performed by the participant in the previous two weeks. Participants reported the total number of times they had performed various types of physical activity in the last two weeks, how many minutes were spent actually performing the activities, and the perceived change in heart rate and breathing during the activity (i.e. small increase, moderate increase, large increase, no increase, they do not know). This information was used in conjunction with the American College of Sports Medicine (ACSM) compendium of physical activities (Ainsworth et al., 2000) to estimate the total metabolic equivalent (METs) of the participant's daily physical activity over the previous two weeks. To increase the likelihood of homogenous groups, as well as to obtain a sample that does not include endurance athletes, exclusion criteria specified that participants currently performing more than 30 min of exercise on more than 3 days per week were not permitted to take part in this study. However, those who exceeded the predetermined exercise level due to non-endurance forms of exercise (e.g. basketball, handball, ballet) were allowed to participate.

Cycling: Cycling was performed on a Lode Corival Recumbent Cycle-Ergometer (Lode BV, Groningen, The Netherlands). Performance was assessed as the total km cycled. The display of the recumbent cycle-ergometer control panel provided a readout km that was visible to both the researcher and the participant.

Heart Rate (HR): HR was assessed using a Polar Heart Rate monitor (F6 computer) with chest strap (T-31 Coded). The HR monitor automatically synchronises with the control panel on the cycle-ergometer and displays HR information to the experimenter without being visible to the participant.

Rating of Perceived Exertion (RPE): RPE was assessed by the Borg Rating of Perceived Exertion Scale, a valid and reliable scale that assesses the participant's subjective level of exertion (Borg, 1990). This 15-item scale has a range from 6 (no exertion at all) to 20 (maximal exertion).

Randomization: A random number generator (Random.org) was used to create a list of three treatment groups. Assignment to each group was determined by the participants' location on this list based on the order in which they were recruited.

Treatment Groups: Purpose for Cycling: Participants were randomly assigned to one of three treatment groups consisting of three different purposes for cycling (health, wealth, charity). All participants viewed the 3-minute video "Exercise is Medicine™ – Keys to Exercise – Exercise and Your Health" produced by the ACSM which provided standardized information that directly addresses the importance of performing "at least 30 min of aerobic activity" 5 days per week. This video is available on ACSM's YouTube channel (http://www.youtube.com/watch?v = UjET7Lw5upM).

Participants in the health group did not receive any additional information regarding the cycling task. Participants in the wealth group were informed that their cycling would generate a personal monetary reward for every 2 km cycled during the session. Participants in the charity group were informed their cycling would generate a charitable donation for every 2 km cycled during the exercise (the participants selected a charity from a list prepared by the researcher). The monetary reward/charitable donation structure was calculated using a declining per unit payment scale, a standard scale in behavioural economics research (Hall & Lieberman, 2012). The first 2 km cycled generated $1.00, and the amount decreased $1.00, and the amount decreased by $0.10 with each additional 2 km cycled. Therefore, km cycled past the 20-km mark resulted in a $0.01 per 2-km payment. A visual scale was used during the explanation of the reward structure to help explain the paradigm to participants.

It is important to note that participants were not given information pertaining to any treatment group other than the one group to which they were randomly assigned. All participants were asked to perform the cycling task with the understanding that the duration and pace of the task were completely self-selected.

Procedures

Following completion of the informed consent, pre-participation screening questionnaire, and physical activity questionnaire, participants were fitted with a HR monitor and remained in a seated position for 5 min in order to obtain a measure of resting HR. During this time, participants watched the ACSM video on the health benefits of exercise. Next, the saddle of the cycle was adjusted so that participants heel could be placed on the furthest pedal with a straight leg, and participants were instructed in the use of the RPE scale, were reminded that the duration and pace they chose to cycle was up to them (i.e. self-selected), and then began the cycling task.

The first 5 min of the cycling task was utilized to identify the participant's preferred wattage to cycle for the duration of the task. Participants were instructed that “the goal is to get to a resistance level (i.e. wattage) that is the most comfortable for you to continue cycling.” Participants began cycling at 80W, and wattage increased by 20W for minutes two and three. At the minutes four and five, participants were given the choice to either remain at the current wattage or increase/decrease by the same (20W) or a lesser (10W) amount. The final wattage ranged between 80W and 160W. Therefore, based on the compendium of physical activities stationary bicycle effort levels [i.e. 100W – light effort (5.5 METS), 150W – moderate effort (7.0 METS), and 200W – vigorous effort (10.5 METS)] (Ainsworth et al., 2000) participants self-selected cycling intensity levels considered to be “very light”, “light”, “moderate”, or approaching “vigorous”. This self-selected wattage remained unchanged for the remainder of the cycling task. HR and RPE were assessed at 5-minute intervals throughout the session. The session concluded as soon as the participant decided he/she wished to end the session.

Statistical analyses

A Chi-square analysis was used to test the sex distribution across the treatment groups. Analysis of variance (ANOVA) was used to test for differences in self-reported physical activity between treatment groups. A between-subjects ANOVA was performed to assess differences in km cycled as a function of treatment group. An exploratory 2 (sex) by 2 (treatment group) ANOVA was performed to consider the potentially moderating role of sex on total km cycled.

Since participants were allowed to self-select the duration of the session, and HR and RPE were assessed in 5-minute intervals, participants did not have the same number of data points for HR and RPE. Thus, three time points were used in the analyses and were chosen to represent HR and RPE over the course of the cycling; the first recorded measure, the measure that represented the mid-point, and the last recorded measure. Separate repeated measure ANOVAs were performed to assess differences in HR and RPE as a function of time, treatment group, and time by treatment group interactions. Mauchly's test of sphericity was utilized, and a Huynh-Feldt adjustment was used for degrees of freedom if warranted.

All analyses were performed using PASW 18.0 statistical software package and were considered significant at an alpha level of 0.05

Results

Data was collected from 30 men and 34 women. One person's performance data was identified as an outlier (more than two standard deviations above the mean for total km cycled) and data from this individual were excluded from analyses. Therefore, the final sample consisted of 29 men ($M = 22.24$ years, $SD = 3.27$) and 34 women ($M = 22.15$ years, $SD = 3.68$). A chi-square analysis revealed a non-significant difference in sex distribution across treatment groups, $\chi^2(2) = 0.454$, $p > 0.05$. There was no significant difference in current level of daily physical activity between treatment groups (health $M = 2.42$, wealth $M = 1.76$, charity $M = 1.71$), $F(2,60) = 1.02$, $p > 0.05$. See Table I for descriptive statistics.

Table I. Sample characteristics

Variable	Range	Mean	SD
Female (N = 34)			
Age	18–34	22.15	3.68
PA Level	1–3	1.65	0.81
Male (N = 29)			
Age	18–32	22.24	3.27
PA Level	1–3	1.86	0.83

Note: PA Level= 2-week physical activity history.

The total km cycled was significantly different between treatment groups, $F(2,57) = 4.02$, $p = .02$, partial $\eta^2 = 0.12$. Pairwise comparisons show that those in the wealth ($M = 12.50$, $SD = 9.72$) and charity groups ($M = 11.46$, $SD = 6.38$) cycled significantly more km than those in the health group ($M = 7.13$, $SD = 3.86$) (see Figure 1).

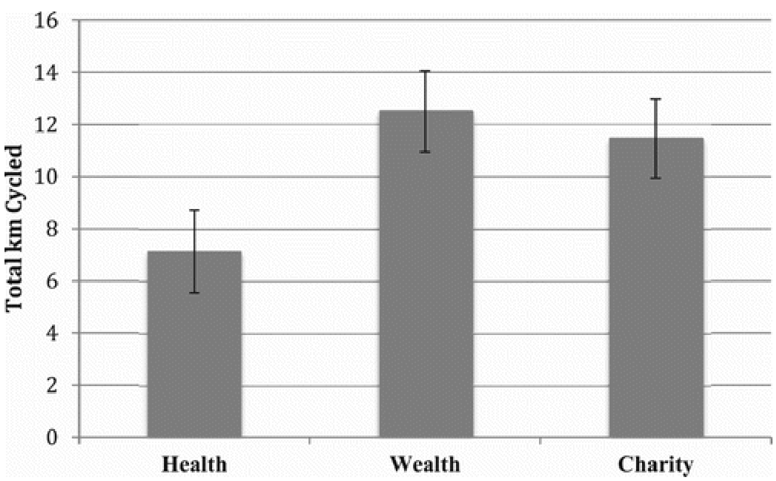

Figure 1. Differences in total km cycled by treatment group.

The exploratory 2 (sex) by 2 (treatment group) ANOVA revealed a significant effect for treatment group, $F(2,57) = 4.02$, $p = 0.02$, partial $\eta^2 = 0.12$, and a significant main effect for sex, $F(1,57) = 11.96$, $p = 0.00$, partial $\eta^2 = 0.17$. These main effects were superseded by a significant interaction of treatment group x sex, $F(2,57) = 3.81$, $p = 0.03$, partial $\eta^2 = 0.12$. The nature of this interaction was such that men cycled more km in the health group and women cycled more km in the charity group (see Figure 2).

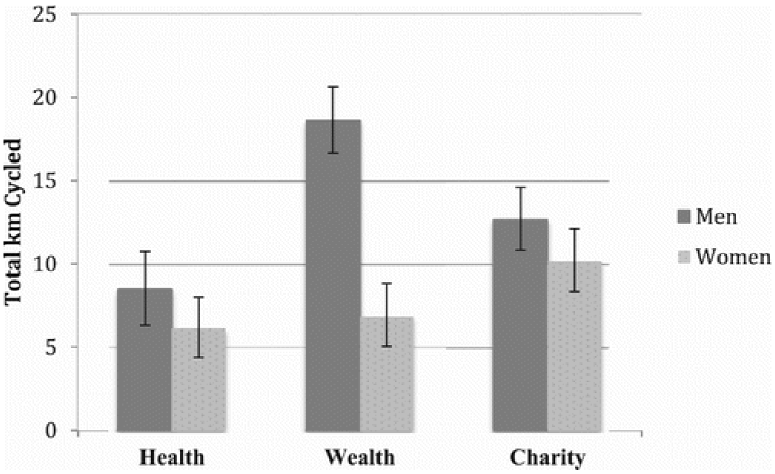

Figure 2. Treatment group by sex interaction in total km cycled.

Both HR, $F(1.86,109.92) = 35.60$, $p < 0.001$, and RPE significantly changed as a function of time, RPE: $F(1.434,84.59) = 46.09$, $p < 0.001$. Pairwise comparisons showed that HR increased from baseline ($M = 111.31$) to mid-point ($M = 149.66$), and from mid-point to the final measure ($M = 156.42$) ($p < 0.001$). However, RPE increased from baseline ($M = 9.32$) to mid-point ($M = 16.50$) ($p = 0.002$), and decreased from mid-point to the final measure ($M = 16.00$) ($p = 0.83$). There were no significant changes as a function of treatment group for HR or RPE, as well as no significant interactions $p > 0.05$.

Discussion

In this study, participants were randomized to one of three groups, each receiving a specific declared purpose for exercising in the study: to improve health, to increase wealth, or to generate a charitable donation. To assess how the purpose for exercise effected performance, participants performed an acute bout of cycling with self-selected intensity, pace, and duration, and the differences in total distance (km) cycled between groups was assessed.

Participants in the two groups that were given an economic purpose for cycling performed the greatest amount of physical activity. Indeed, those in the wealth and charity groups cycled approximately 75% more than those in the health group. Interestingly, those in the wealth ($M = 29.41$ min) and charity ($M = 28.86$ min) groups both cycled for approximately 30 min, a dose of moderate intensity aerobic exercise that meets ACSM's daily aerobic exercise recommendations, while those in the health ($M = 19.77$ min) group cycled approximately 10 min shy of the recommendation. However, the acute nature of this study limits the inferences that can be made to increasing physical activity behaviour across multiple sessions. Longitudinal studies are needed in order to understand how these effects may impact long-term physical activity behaviors.

This study provides an important extension to previous research because the design makes it possible to attribute the results directly to a specific type of behavioural change message. By having three different treatment groups, individuals in each group maintained a focused purpose for physical activity. In this case, economic incentives of personal monetary payments and charitable giving seem to have a similar effect on acute physical activity behaviour, resulting in the greatest distance cycled. These results are in line with recent research suggesting that financial incentives increase specific physical activity outcomes, however these same outcomes are not seen with unconditional incentives such as free gym memberships (Barte & Wendel-Vos, 2017).

Participants' current physical activity behaviour was not significantly different between groups. These data were used to calculate participants' total daily METs expended over the last two weeks. This is an important finding in regards to interpreting results. For example, if significant differences in total daily METs existed between groups, this would certainly raise concerns of group differences potentially confounding the primary outcome. Therefore, based on the experimental design employed in this study, these data indicate that the total distance cycled was indeed due to the "treatment" (group assignment), and not due to participants' current physical activity behaviour. Further, the foundation of our interpretation of these findings is supported by our use of a randomized control trial design. By randomizing participants to different groups, any potential group differences at baseline are by definition non-systematic. Therefore, we may imply that group differences in total distance cycled is due to treatment. Importantly, exclusion criteria required participants to have a current level of physical activity well below levels recommended by ACSM (less then 30 min/day, less than three days/week).

The sex by group interaction suggests that different economic incentives for cycling had differing effects on men and women. While women cycled more km in the charity group, men cycled more km in the wealth group. Social psychology research has long demonstrated that women are more nurturing and possess higher levels of tender-mindedness than men (Feingold, 1994; Fiske, Gilbert, & Lindzey, 2010); this difference could help explain the aforementioned gender differences in incentives. Motivation to participate in a physical activity charity event is strongly driven by a desire to help others (Filo, Funk, & O'Brien, 2011; Goodwin, Snelgrove, Wood, & Taks, 2017). Donating to a charity to help others could be an expression of the inherent nurturing and tender-mindedness characteristics exhibited in higher levels by women.

Interestingly, according to a recent meta-analysis, gender differences in overall levels of motivation for physical activity are not different (Guerin, Fortier, Bales, & Sweet, 2012); however, research does suggest that the type of motivation experienced is different. Men tend to be more motivated by competition and women tend to be more motivated by social connections (Patay, Patton, Parker, Fahey, & Sinclair, 2015). Charity events tend to be social events where personal connections drive people to participate (Goodwin et al., 2017). The inherent desire to help others in combination with the increased social connections of this type of event suggests that charity events might provide motivation to help increase physical activity specifically by women. This is an area that future research should explore in-depth, as it has implications with respect to the design of future health message initiatives. This future research would lead to better understandings of how to effectively target health messages to specific segments of the population.

Future direction and implications

Although somewhat speculative, the results from this and future studies may be able to assist in the development of initiatives to increase long-term exercise adherence. An example of a potential initiative, taking place at the level of the University community, could consist of student recreation centres recording (by scanning student ID cards) and providing incentives for student exercise behaviour. Students who have exhibited a certain amount of exercise behaviour could receive refunds from the student health insurance fees, or as in the study by Fricke, Lechner, and Steinmayr (Fricke, Lechner, & Steinmayr, 2017), financial payment could be used to encourage participation in on-campus sports and exercise programmes. A behavioural economics approach could also provide opportunities for student organisations to formulate charity drives based on exercise behaviour. Exercise equipment (e.g. exercise bikes, treadmills) could utilize card scanners that, when activated with a student ID card, tracked the total number of miles/km the specific student performed at each exercise session. The student would be able to select how the "exercise credits" would be applied (i.e. health insurance fee refund, charitable donation).

Limitations

The complicated nature of the declining per unit payment scale may have made it difficult for the participants to keep a running account of the total money they had earned during the exercise session. Simple adjustments, such as placing a card on the cycle's display that shows the total amount of money earned, could be made to increase the participant's awareness of the total amount of money earned by cycling. Another limitation of this study is that its sample consists entirely of university students, thus restricting the generalizability of its findings to other populations.

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