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The relationship between monetary incentives, social status, and physical activity☆,☆☆

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ABSTRACT

We conduct a field experiment to better understand the role of social status with and without monetary incentives as motivation to increase physical activity. We find that social status alone does not induce a change in physical activity. When social status is combined with monetary incentives, however, we find a change in the number of daily steps. This change is heterogeneous. Individuals with low physical activity increase their number of steps by 12%, while those with high physical activity decrease the number of steps by 25%. An incentives treatment with exogenous social status – uncorrelated with physical activity – provides robustness to our findings and, together with the control condition, rules out potential experimenter demand effects and other factors driving the results. Our results call for a cautionary approach for analyzing the role of social status, in many cases unobserved, for physical activity intervention programs.

1. Introduction

Insufficient physical activity is recognized as one of the contributing factors for various health risks — mortality and morbidity (Philipson & Posner, 2008). Albeit increased cardiorespiratory fitness can reduce health related risks, in the United States, for example, only 24.2% of adults meet the federal physical activity guidelines for aerobic and muscle-strengthening activity (CDC, 2022; Gaesser, Angadi, & Sawyer, 2011; Gaesser, Tucker, Jarrett, & Angadi, 2015; Ross, Blair, de Lannoy, Després, & Lavie, 2015). People are more sedentary today, likely due to structural changes in their living and working environments (Finkelstein, Ruhm, & Kosa, 2005). Previous literature has documented successful interventions that increase physical activity through self-funded commitment (Royer, Stehr, & Sydnor, 2015), nudges (Beatty & Katare, 2018; Calzolari & Nardotto, 2017), financial incentives (Charness & Gneezy, 2009; Katare, 2021), and community efforts (Kahn et al., 2002; Luepker et al., 1996). In general, previous literature has shown that different incentives, both monetary and non-monetary, have the potential to encourage increased exercise in individuals. As such, these incentives address both the extrinsic and intrinsic motivation to engage in more exercise. We explore a different channel for promoting physical activity through social status with and without monetary incentives, both of which we directly relate to physical activity.

The influence of social status on human behavior in purchasing goods and services has been well documented (Arrow & Dasgupta, 2009; Bagwell & Bernheim, 1996; Mandel, 2009; Veblen, 1899). One of the key components of social status is that a *desirable* status has to be visible to others. In this regard, social media provide potential channels to showcase a desirable physical activity status with an increasing number of media posts related to physical activity, including walking, running, biking, and so on. Prior studies explore the influence of status on physical activity and any potential drivers for physical inactivity among low socioeconomic status (Ford et al., 1991; Giles-Corti & Donovan, 2002; Kämpfen & Maurer, 2016; Meltzer & Jena, 2010; Stalsberg & Pedersen, 2010; Tucker-Seeley, Subramanian, Li, & Sorensen, 2009). Few studies explore social effects such as receiving feedback about activity or the gamification of physical activity as a group (Beatty & Katare, 2018; Kurtzman et al., 2018). Some studies

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have shown that feedback on performance is related to reduced efforts by the top performers and increased efforts from those who lag (Ludwig & Lünser, 2012). Effort resulting from feedback from one period to another is also related to differences in expected performance and actual performance (Kuhnen & Tymula, 2012). However, it is unclear how social status may affect the most vulnerable populations (i.e., those with low physical activity, low income, poor health, etc.) though some studies have explored the effect of other (non-status) incentives on those with poor health (Andrade, Barry, Litt, & Petry, 2014; Patel et al., 2016; Petry, Andrade, Barry, & Byrne, 2013). In this study, we implement a controlled field experiment to evaluate the effects of social status with and without monetary incentives on physical activity. The main objective of this study is to understand whether social status with and without monetary incentives may differentially incentivize or erode the motivation of different subgroups in the domain of physical activity based on their assigned social status.

We conducted a field experiment over a three-day period with the same cohort of participants. On their initial visit, we distributed pedometer watches that participants used to record the number of steps they took during the study. The number of steps was collected 24 h later (Period 1) as a baseline for each participant. Then, subjects were randomly assigned to a social status treatment. We manipulated the mechanism of assigning social status into four randomly assigned conditions: (1) a control condition with no social status and no monetary incentives; (2) a social status treatment without monetary incentives where social status was awarded based on the physical activity level during Period 1; (3) a social status with monetary incentives treatment where social status was based on physical activity during Period 1 and carried a monetary reward; and (4) an incentives treatment with exogenous social status based on the scores of a general knowledge quiz, with monetary incentives unrelated to physical activity. In the Social Status without monetary incentives treatment, social status (high or low) was determined by the number of steps participants walked during the baseline Period 1. There were no additional monetary incentives associated with high social status on this treatment. In the Social Status with Monetary Incentives treatment, social status also was determined by the number of steps, but there was a higher monetary reward for the high-status group. In the Incentives with Exogenous Social Status treatment, monetary incentives and social status were determined by participant scores on a general knowledge quiz (Clingingsmith & Sheremeta, 2018). In this case, the conferred social status was exogenous (uncorrelated) with the level of physical activity, thus providing us a monetary incentives treatment but also ruling out experimenter demand together with the control treatment. In all three treatment groups, the social status of each participant was publicly announced, and the high-status group received recognition following a procedure inspired by Ball, Eckel, Grossman, and Zame (2001), who used gold stars to award social status. After the random treatment assignment, the number of steps taken the following day was collected to observe the effect of the assigned social status on subsequent physical activity (Period 2).

In general, exercise treatments with and without monetary incentives do not change the average number of steps between Period 1 (baseline) and Period 2 (treatment). Additionally, subjects do not change their average number of steps in the Control and the Incentives with Exogenous Social Status treatment because of monetary incentives. That is, we do not find evidence of experimenter demand effects. The result in the Control group implies that using the pedometer itself does not change the average number of steps taken, which aligns with previous studies that provide a fitness tracker alone (Butler & Dwyer, 2004; Freak-Poli, Cumpston, Albarqouni, Clemes, & Peeters, 2020; Kim, Lumpkin, Lochbaum, Stegemeier, & Kitten, 2018; Noah et al., 2018; Patel, Asch, & Volpp, 2015; Rote, 2017; Takahashi, Quigg, Croghan, Schroeder, & Ebbert, 2016). When we separate participants based on their physical activity during the baseline Period 1, we find two opposite behaviors when participants are offered a combination of social status and monetary incentives. We find that those who are less active increase their step count by 12.1 percent when they are awarded status with monetary incentives. This result is generally consistent with the previous literature on physical activity interventions, which found a positive effect of monetary incentives, particularly among low-activity people (Carrera, Royer, Stehr, & Sydnor, 2020; Hajat, Hasan, Subel, & Noach, 2019). Meanwhile, the high physical activity types in the exercise treatment with monetary incentives showed a relationship consistent with a crowding-out effect by decreasing the average number of steps by 25.2 percent. We speculate that the extrinsic rewards in the form of monetary gains may crowd out the intrinsic motivation to exercise (or engage in other activities) for those who are already physically active (Deci & Ryan, 1985; Frey & Jegen, 2001; Gneezy & Rustichini, 2000; Heyman & Ariely, 2004; James, 2005; Kreps, 1997). Specifically, higher monetary incentives may decrease the participants' enjoyment of physical activity (Moller, Buscemi, McFadden, Hedeker, & Spring, 2014).

The findings from our exploratory study suggest that utilizing monetary incentives to reward physical activity should be carefully considered when applied to certain subgroups and are layered with other incentives. Social status awarded for physical activity with monetary incentives could encourage those who are less active to exercise more, whereas this intervention discourages the intrinsic motivation to exercise among those who are highly active. Thus, the same intervention works in the opposite direction in different subgroups of people, which may potentially weaken the intervention effects (Sunstein, 2016). When considering potential policy implementation for encouraging physical activity, decision-makers should proceed with caution when designing customized financial incentives along with the status corresponding to the health behavior under a public setting, especially for highly active individuals. Social status could be a potential (unobservable) nuisance, given the extensive use of social media that may affect the outcomes of physical activity intervention programs.

The rest of the paper consists of the following sections. Section 2 provides the related literature regarding physical activity interventions and the influence of social status on other domains. Section 3 illustrates the experimental design and procedures of the experiment. We discuss our hypotheses in Section 4 and present our main results in Section 5. Section 6 offers conclusions and discusses the implications of our findings.

2. Related literature

Two different strands of literature exist pertaining to physical activity intervention programs: non-financial incentivized and financially incentivized programs. Non-financial incentivized programs for physical activity include providing health-related education or recommendations (Luepker et al., 1996; Sparling, Howard, Dunstan, & Owen, 2015), sending reminders to go to the gym (Calzolari & Nardotto, 2017), e-health interventions in which health services are provided via electronic platforms and devices such as the internet, mobile applications, or text message interventions (Agboola et al., 2016; Beatty & Katare, 2018; Hall, Cole-Lewis, & Bernhardt, 2015; Hekler et al., 2016; King et al., 2007; Kwan et al., 2020; Martin et al., 2016; Peels et al., 2013; Smith, Duque, Huffman, Healy, & Celano, 2020), the use of mobile trackers or pedometers (Freak-Poli et al., 2020; Kang, Marshall, Barreira, & Lee, 2009; Lynch, Bird, Lythgo, & Selva-Raj, 2020; Noah et al., 2018; Patel et al., 2015), or classroom-based physical activity (Beets, Beighle, Erwin, & Huberty, 2009; Watson, Timperio, Brown, Best, & Hesketh, 2017). Previous physical activity intervention programs were found to provide moderate effects on increasing physical activity rates (Peels et al., 2013). Social comparison and peer effects has a positive effect on physical activity (Agarwal et al., 2021; Babcock & Hartman, 2010; Beatty & Katare, 2018; Butera, Metcalfe, Morrison, & Taubinsky, 2022; Patel et al., 2017).

Table 1
Effect size comparisons in the relevant literature.

Relevant literature	Effect size	Explanation of main finding
Hunter et al. (2013)	0.07	No significant difference in minutes of physical activity with financial incentives.
Bachireddy et al. (2019)	0.09	Increase in steps with financial incentives
Hajat et al. (2019)	0.44	Increase in step counts and overall physical activity with financial incentives.
Acland and Levy (2015)	1.30	Increased gym attendance with financial incentives
Pope and Harvey-Berino (2013)	0.60	Significant gym goals achieved with financial incentives.
Royer et al. (2015)	0.40	Self-funded commitment increased exercise activities.
Charness and Gneezy (2009)	0.77	Increased gym attendance with financial incentives.
Carrera et al. (2020)	0.12	Sporadic financial incentives increase gym visits.
Beatty and Katare (2018)	0.06	Large lottery incentive increases gym attendance; no effect from social norming.
Babcock and Hartman (2010)	0.87	Increased gym visits with incentives and friends.

Meanwhile, an emerging literature assesses the effects of financial commitment devices on physical activity in field experiments (Hunter, Tully, Davis, Stevenson, & Kee, 2013; Jones, Molitor, & Reif, 2019; Luong et al., 2021). Several studies found that providing monetary incentives increases the number of visits to the gym (Acland & Levy, 2015; Bachireddy et al., 2019; Cawley & Price, 2013; Hajat et al., 2019; Pope & Harvey-Berino, 2013; Rohde & Verbeke, 2017). In contrast, the gym attendance rate also increases when the commitment device is based on self-funded deposits in which the money committed by subjects is donated elsewhere if they fail to achieve their gym attendance goals (Royer et al., 2015). In addition to the commitment mechanism, subjects are more likely to visit the gym when the incentive stakes are large (Charness & Gneezy, 2009). Specifically, Charness and Gneezy (2009) show that when participants are incentivized with a high reward ($100 for attending the gym 8 times during a 4-week period) the average attendance rate increased by 0.64 times per week relative to 0.06 per week increase in the low-stake treatment ($25 for attending the gym once a week). However, a few studies found that the highest attendance rate is observed when the incentive is consistently provided. For example, Carrera et al. (2020) show that the attendance rate marginally increases with front-loaded incentives in which the offer is different at the beginning, such as $25 per visit followed by $5 per visit, compared to a constant incentive of $10 per visit during the incentive period, but with the same maximum possible earnings with the front-loaded incentive. Bachireddy et al. (2019) found that consistent incentives increase the number of steps with pedometers more than increasing or decreasing incentives when the possible total earnings are the same in all incentive treatments. We summarize key findings from the literature that explores financial incentives in Table 1.

The effect of financial commitment interventions on physical activity varies by individual characteristics, particularly by physical activity. For example, Royer et al. (2015) found that the fraction of existing gym members and non-members using the gym at least once per week increases about 20.0 and 18.2 percent, respectively, during the incentive period. Other studies document that the largest increase in gym attendance during the incentive periods is mainly contributed by participants who do not regularly go to the gym (i.e., non-members or those in the low-activity group) (Carrera et al., 2020; Hajat et al., 2019). The attendance rate increases with financial incentives for those who regularly visit the gym (i.e., existing gym members or those in the highly active group); however, the magnitude is smaller than for those who do not regularly go to the gym (Carrera et al., 2020; Hajat et al., 2019). Some concerns about crowding out intrinsic motivation by utilizing extrinsic rewards have been raised in psychology and economics studies (Deci & Ryan, 1985; Esteves-Sorenson & Broce, 2016; Frey & Jegen, 2001; Gneezy & Rustichini, 2000; Heyman & Ariely, 2004; James, 2005; Kreps, 1997). For instance, incentivizing an enjoyable task decreases its performance (Deci & Ryan, 1985). In addition, high financial incentives for healthy behavior are more likely to reduce enjoyment in physical activity and pursuing healthy diets than low incentives, controlling for general motivation for healthy behavior (Moller et al., 2014). In that sense, the highly active group experiences less enjoyment or interest in exercising when monetary payments are implemented. A potential explanation based on expected utility theory might be that highly active individuals may derive utility from receiving monetary payments and they need less physical activity to achieve the same level of utility. In this regard, we explore the heterogeneous effect for low activity and high activity groups.

Overall, previous interventions showed modest increases in physical activity, particularly for low-activity individuals. To our knowledge, little is known about the mechanism in heterogeneous effects in physical activity level for low and high activity groups related to social status with and without monetary incentives. Our study utilizes social status, which reflects low and high activity groups, with exogenously assigned payments to explore the role of social status on physical activity.

3. Experimental design

The study was conducted from September 2019 to March 2020[2] at a large university campus in the United States. We recruited 313 participants from the pool of students (undergraduate and graduate) and staff members on campus using bulk emails. Subjects agreed to participate in a 3-consecutive-day experiment. They were asked to attend all 3 days at the same session time. Session times were 11 am, 2:30 pm, 4 pm, and 5:30 pm.[3] For all 3 days, participants showed up at the lab, signed in, signed a consent form, and were seated in a classroom with two session monitors.

3.1. Treatments

All participants first received the same informational session where pedometers were distributed.[4] The first period (Period 1) provides a

[2] All data was collected before the local COVID-19 lockdown mandates.

[3] The first week featured a 9:30 am session instead of a 5:30 pm session, but using evidence from other studies at the lab, we decided to change the 9:30 am session to a 5:30 pm session in the following weeks for greater attendance and more accessibility for staff members to participate.

[4] Pedometer distributed was a Fanmis unisex pedometer watch military multifunctional 50M waterproof digital outdoor sports watch, chosen primarily to fulfill the need for a waterproof wrist worn device that does not provide walking reminders to avoid priming our participants.

Table 2
Treatments.

Treatment	Status assignment	Payment
Control - No Status	None	$10 for all
Social Status without Monetary Incentives	Exercise-based	$10 for all
Social Status with Monetary Incentives	Exercise-based	$10 for low status $15 for high status
Incentives with Exogenous Social Status	Quiz-based	$10 for low status $15 for high status

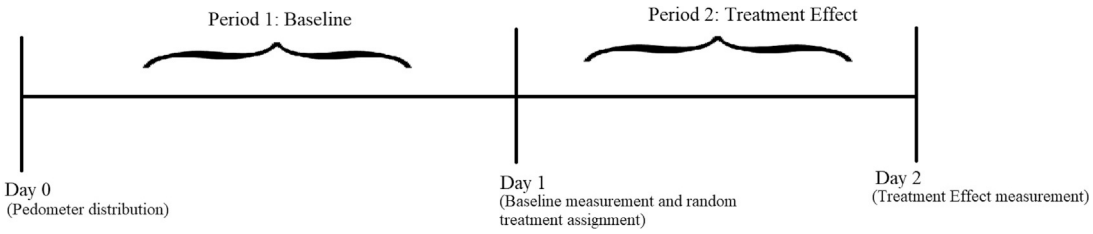

Fig. 1. Experiment timeline.

baseline for the number of steps without any intervention. Then, participants were randomly assigned to one of four conditions at the session level. The conditions determined how social status was assigned, as well as how this information affected their payments. The number of steps was measured again in Period 2 to identify the effects of the treatments relative to the baseline[5] (see Table 2). In the "Control-No Status" condition, no status was assigned to any participant, and all participants earned $10. This condition is useful to evaluate whether the experiment of the use of pedometers influences the number of steps. In the "Social Status without Monetary Incentives" treatment, status was assigned based on the number of steps during Period 1; that is, when the step count information was collected, the monitors split the group in half. The group with a higher step count (relative to the median) was assigned "High" status and the other half was assigned "Low" status. Participants were then asked to move to the side of the room that corresponded to their earned status, as instructed by the monitors. Regardless of status, participants in this treatment earned $10, which is the same as in the control condition. In the "Social Status with Monetary Incentives" treatment, status was assigned based on the number of steps as in the Social Status without Monetary Incentives treatment, but each status was paid differentially, such that those in the High status and in the Low status received $15 and $10, respectively. Finally, in the "Incentives with Exogenous Social Status" treatment, participants completed a 5-minute, 10-question general knowledge quiz after their step data had been collected. After they completed the quiz, the monitors graded the quiz and assigned High status to those who ranked in the top half and Low status to those who ranked in the lower half. With this treatment, we wanted to rule out the possibility that subjects changed their behavior based on a setting where social status was not tied to their physical activity or the monetary incentive associated with status, hence measuring any potential experimenter demand effects. Similar to the other two treatments, participants were asked to sit with their corresponding status group and were paid by status.

All of our treatments pertain to social status since this is the novel question we introduce and we want to understand its effect with and without monetary incentives. In addition to understanding the effect of social status on physical activity, we want to also understand how monetary incentives interact with social status given the extensive evidence of financial incentives alone on physical activity, as discussed in the previous section and summarized in Table 1. Given the extensive literature on financial incentives that already exists, we chose not to include a pure incentives treatment (without social status) and focused on social status and its interaction with incentives. We discuss this further in the discussion section.

Fig. 2. Example of pedometer set up.

3.2. Day 0 (Set Up)

The first day was an informational session. Participants were given the instructions and pedometers (which they kept after the study). They were told they would be required to participate in all three days to receive full payment, and would be required to wear their pedometers for the duration of the experiment. Participants received a compensation of $10 per visit ($30 for all three visits) plus any additional earnings according to their assigned treatment and status. The instructions were read to participants by one of the monitors. Once the instructions were read, and questions were answered, two session monitors handed out the pedometers. Each participant was then asked to place the pedometers on their wrist, after which the monitors attached a uniquely numbered zip tie, ensuring that the pedometer could not be easily removed and that removal would be easily identified by the unique zip tie number. Once the pedometer was attached to the participant, the monitors cleared the pedometer to ensure the total step count was reset to zero and that the step function was turned on. After all the participants had their pedometer and zip tie attached, they received the $10 daily participation fee and were dismissed until the next day (see Figs. 1 and 2).

[5] This article is part of a larger study that also measured the correlation between physical activity and food purchases. Physical activity and food purchases were recorded again in day 3, but they are not relevant to our research question. The additional measures occurred after the completion of our experimental conditions so it does not affect our results.

3.3. Day 1 (Baseline measurement and random assignment)

When the participants returned, the monitors read a welcome message and instructed them to wait while the monitors checked the step count of each participant, which served as the baseline step count. The monitors used a covered clipboard to record the cumulative step count of every participant, associating data through the unique zip tie number. Monitors first cut off the zip tie and requested that the participant remove the pedometer. Once the baseline step count was collected for each participant, a social status was assigned based on their randomly assigned treatment and the additional payment for each status was announced. Participants had no prior knowledge that a social status would be assigned, nor how it would be assigned, until this point in the study. Participants earned additional money according to the treatment and status (if applicable) assigned, as well as their $10 daily participation fee. At the end of the sessions, participants placed the pedometers back on their wrist and were zip tied with a new, uniquely identified zip tie. The pedometers were also set to zero at this time by the session monitors.

3.4. Day 2 (Treatment effect measurement)

Day 2 proceeded much the same as Day 1 for collecting the number of steps for the treatment (Period 2). We were interested in studying how the effect of assigning social status with and without monetary incentives affect behavior; that is, how status differentially incentivizes or erodes the motivation of different groups regarding physical activity, so it was important to study this over the two periods. Therefore, the step data collected in Period 2 served as the treatment effect on physical activity behavior from the randomly assigned treatment in Day 1. Participants received their $10 daily participation fee plus any additional earnings. They were informed that they could keep the pedometer and were dismissed. For the 3-day period, the average compensation was approximately $50 plus the pedometer watch.

4. Hypotheses

We are interested in two key research questions: first, how assigned social status affects physical activity, and second, how assigned social status combined with monetary incentives increase or erode motivation for physical activity for low and high activity subgroups.

To address these two questions, we looked at the change in each participant's number of steps between the baseline period (Period 1) and treatment period (Period 2). Our experimental design randomly assigned people to a social status treatment, but participants did not know until Day 1. Hence, the change in the number of steps between the two periods was driven by how social status and the incentives were assigned on Day 1 after the baseline period. By assigning social status and observing the subsequent behavior, we are also able to assess how monetary incentives affect the behavior of different types of individuals. Building on previous literature, we formulated four main hypotheses related to each treatment.

Hypothesis 1. A social status based on physical activity has a non-negative effect on step count.

Awarding a high status without monetary incentives may motivate people to either maintain their social status or try to attain a higher status. Previous literature on social status shows that individuals in a low-status group seek to mimic the high-status group (in order to belong). Hence, we expect that people who are assigned a low status because of their low physical activity level would increase their activity in order to be part of the high-status group if social status is an incentive reward, or not react if social status incentives are not a motivation. Similarly, high-status individuals would seek to showcase their status through consumption behaviors (Bearden & Etzel, 1982; Clingingsmith & Sheremeta, 2018; Corneo & Jeanne, 1997; Heffetz, 2011; Kuhn, Kooreman, Soetevent, & Kapteyn, 2011; Veblen, 1899). We expect that those assigned high status would likely maintain their level of activity or increase it in order to remain in the high-status group. Furthermore, the literature shows that social comparison and peer effects have a positive effect on physical activity (Agarwal et al., 2021; Beatty & Katare, 2018; Patel et al., 2017).

Hypothesis 2A. Low status with monetary incentives based on physical activity will motivate individuals to increase their number of steps.

Previous studies showed that the desire for acceptance by a referenced high-social-status group induces people to mimic those with higher status (Bearden & Etzel, 1982; Corneo & Jeanne, 1997; Heffetz, 2011; Kuhn et al., 2011; Mason, 2018). Meanwhile, it is plausible that a person may simply desire to be satisfied with the fact that their performance is acknowledged with monetary incentives (Abbink & Herrmann, 2011; Bogliacino, Grimalda, & Pipke, 2021; Fehr, Glätzle-Rützler, & Sutter, 2013). In line with this notion, we conjecture that the desire to achieve a higher status combined with monetary incentives would motivate the low-status group to increase their activity to achieve a higher status. We hypothesize that with monetary incentives, the effect would be stronger. In previous studies, people – particularly low-activity individuals – responded to financial incentives by increasing their physical activity in the short-term (Acland & Levy, 2015; Charness & Gneezy, 2009).

Hypothesis 2B. A high status with monetary incentives based on physical activity will crowd out motivation and decrease the number of steps.

Financial incentives for engaging in a pleasurable activity are known to decrease intrinsic motivation (Deci & Ryan, 1985; Esteves-Sorenson & Broce, 2016; Frey & Jegen, 2001; Gneezy & Rustichini, 2000; James, 2005; Kreps, 1997), particularly in terms of physical activity (Moller et al., 2014). The high-status group may be sensitive to this phenomenon since their high activity levels may be a sign that they enjoy physical activity. Previous literature shows that when financial incentives are offered for pro-social behavior, the willingness to perform the pro-social behavior declines (Heyman & Ariely, 2004). Hence, awarding a high status, which could be interpreted as a non-pecuniary incentive in the social economy, might lead to a decrease in the number of steps when combined with monetary incentives.

Hypothesis 3. A status with monetary incentives exogenous to physical activity will have no effect on the number of steps.

Since social status for a knowledge quiz is exogenous to physical activity, there should be no change in physical activity behavior. This treatment is a robustness check to rule out potential experimenter demand effects and other factors driving the results. That is, physical activity should remain unchanged if experimenter demand effects are not an issue in our experiment.

5. Results

In total, 284 individuals completed all three visits.[6] As described in the experimental procedures, all participants received the same information and were given pedometers during the first visit. Table 3 features the sample characteristics. We conducted an orthogonality test and found that our sample was balanced across treatments (Appendix Table A.1). Table A.2 in the appendix shows the sample distribution by treatment and social status.

[6] 313 people started the experiment; however, only 284 completed all three visits. A power calculation estimates about 55 participants based on Hajat et al. (2019) to observe an effect of 80% power.

Table 3
Sample characteristics by treatments.

Characteristics	Sample mean	Treatments			
		Control	No incentives	Incentives	Exogenous incentives
Age (mean)	24.17	25.69	23.33	24.34	23.67
	(7.3)	(8.5)	(6.3)	(7.7)	(6.67)
Female	0.59	0.69	0.63	0.53	0.52
	(0.5)	(0.4)	(0.5)	(0.5)	(0.5)
Household Size (mean)	2.5	2.5	2.5	2.5	2.6
	(1.5)	(1.6)	(1.5)	(1.4)	(1.7)
Race					
White	0.31	0.34	0.3	0.35	0.25
	(0.5)	(0.5)	(0.4)	(0.5)	(0.4)
Hispanic	0.21	0.2	0.2	0.21	0.23
	(0.4)	(0.4)	(0.4)	(0.41)	(0.4)
Black	0.06	0.07	0.08	0.04	0.07
	(0.24)	(0.3)	(0.3)	(0.2)	(0.2)
Native American	0.007	0	0	0.01	0.01
	(0.1)	(0)	(0)	(0.1)	(0.1)
Asian	0.43	0.41	0.44	0.4	0.45
	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)
Year in School					
First, undergraduate	0.18	0.12	0.15	0.15	0.28
Second, undergraduate	0.09	0.14	0.07	0.12	0.08
Third, undergraduate	0.13	0.14	0.16	0.12	0.12
Fourth+, undergraduate	0.17	0.21	0.13	0.2	0.16
Graduate	0.35	0.28	0.44	0.36	0.32
Staff	0.06	0.12	0.05	0.05	0.04
Annual Income Category					
<$45,000	0.43	0.45	0.44	0.36	0.48
$45,000 - $49,000	0.04	0.02	0.07	0.05	0.02
$50,000 - $59,000	0.07	0.09	0.05	0.11	0.04
>$60,000	0.34	0.29	0.36	0.38	0.38
N	284	58	75	76	74

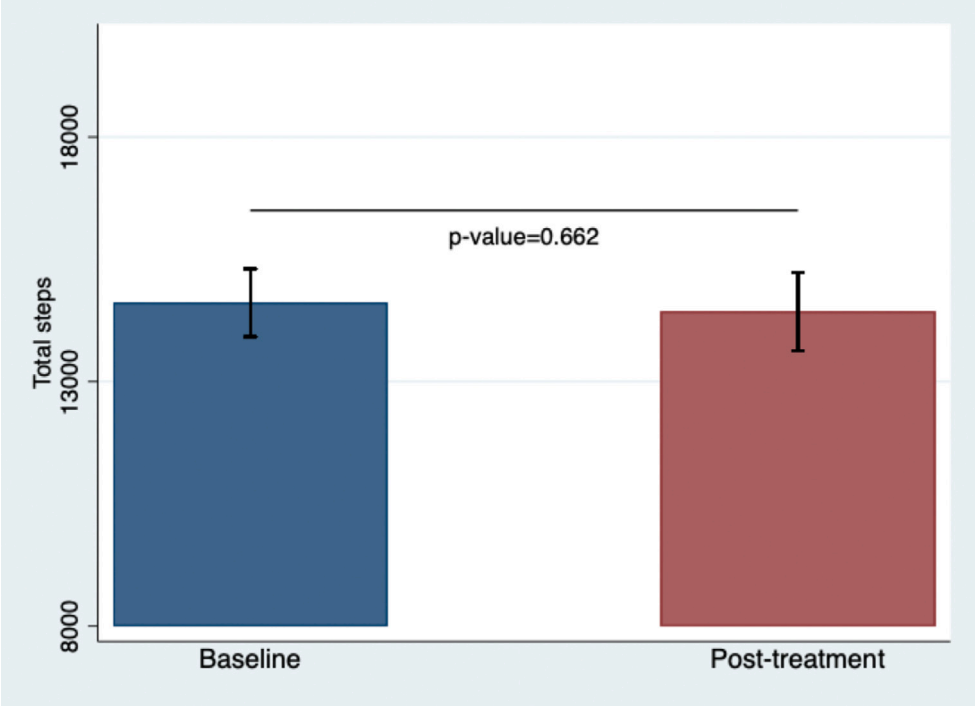

Fig. 3. Total step count for periods 1 and 2 for Control group (no status).

For all treatments, we used the step count measured during Period 1 as a baseline. We conducted Wilcoxon rank sum tests for the main results. We provide summary statistics on the step counts in Table A.3. In the appendix Fig. A.1, we present a graph showing all the baseline measurements across the randomly assigned treatments. The randomization was successful and we find no difference in these baseline measurements. Fig. 3 features the total step count in Period 1 (baseline) and Period 2 (treatment) for the Control group. As we would expect,

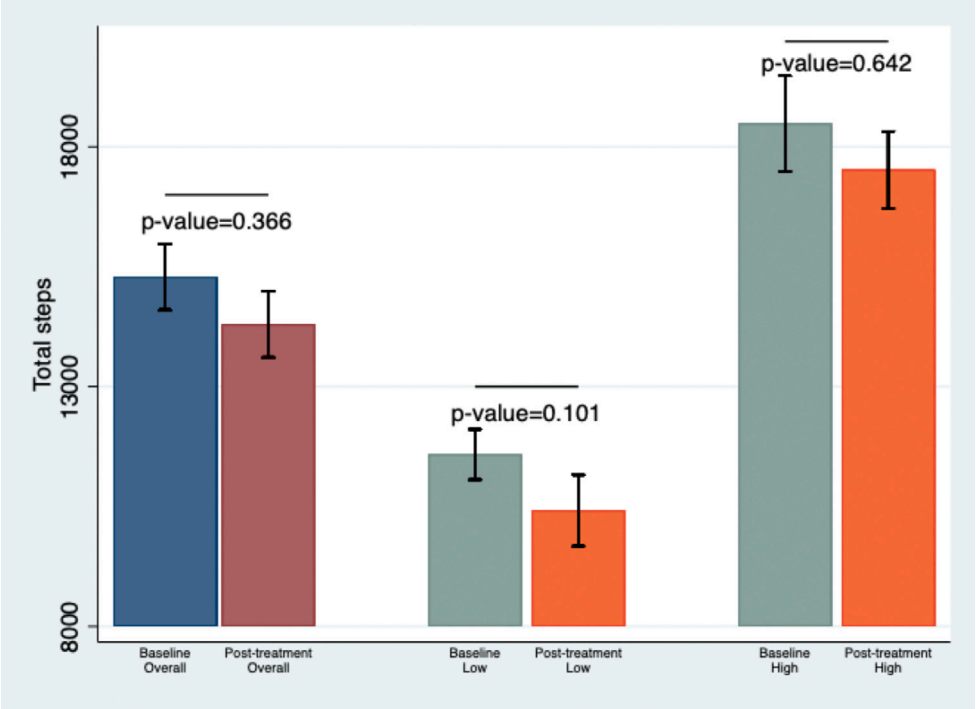

Fig. 4. Total step count for periods 1 and 2 for Social Status without Monetary Incentives Treatment.

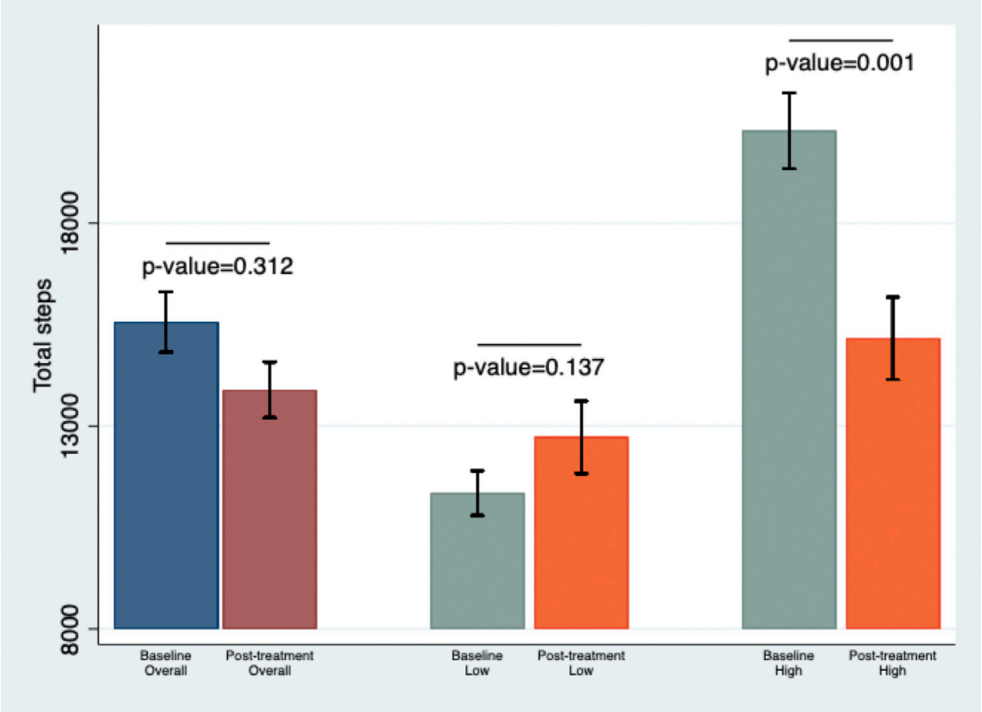

Fig. 5. Total step count for periods 1 and 2 for Social Status with Monetary Incentives Treatment.

the total number of steps between those two days did not significantly change; we can therefore conclude that the activity trackers did not induce changes in physical activity in our experiment (Butler & Dwyer, 2004; Kim et al., 2018; Rote, 2017; Takahashi et al., 2016).

Result 1. *A status solely based on physical activity behavior without monetary incentives does not change the number of steps.*

Figs. 4 and 5 show the total step count for Period 1 and Period 2 for the Social Status without monetary incentives and the Social

Table 4
Difference-in-difference estimations of treatments and status on difference in steps.

	(1)	(2)
Status w/o Incentives, Low	−3835.1***	−4107.3***
	(1387.9)	(1275.9)
Status w/o Incentives, High	3129.3**	2214.0
	(1559.5)	(1350.7)
Status Monetary Incentives, Low	−550.9	−702.1
	(1830.9)	(2200.7)
Status Monetary Incentives, High	8494.3***	8028.8***
	(1916.3)	(2300.0)
Exogenous, Low	−445.4	−883.6
	(1417.1)	(1349.1)
Exogenous, High	−762.7	636.2
	(1365.8)	(1379.2)
Period 2	−217.8	−488.8
	(571.2)	(578.9)
Status w/o Incentives, Low × Period 2	−1054.2*	−748.7
	(1039.8)	(1098.8)
Status w/o Incentives, High × Period 2	−664.3	−354.5
	(930.8)	(966.2)
Monetary Incentives, Low × Period 2	1593.3	2006.0**
	(952.8)	(983.4)
Monetary Incentives, High × Period 2	−4867.7***	−4640.7***
	(1466.4)	(1523.0)
Exogenous, Low × Period 2	712.2	1102.8
	(1131.2)	(1164.6)
Exogenous, High × Period 2	888.9	351.5
	(1080.3)	(1038.1)
Constant	15766.8***	18159.6***
	(951.2)	(1647.1)
Controls?	No	Yes
N	581	541
R^2	0.206	0.232

Note: The outcome variable is change in steps. Specification (1) does not include demographic controls while specification (2) includes them. Both specifications control for session effects. Errors are clustered at the individual level. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, **** $p < 0.01$.

Status with Monetary Incentives treatments, respectively. The first two sets of bars in these graphs are the total step counts for the overall treatment, for which we observe no significant difference when social status was assigned based on physical activity but carried no monetary incentives. However, when social status based on physical activity was combined with monetary incentives, we observe an overall decrease in steps. The analysis showcases a differential effect by social status, which represents heterogeneous responses by low and high activity subgroups.

One potential cause for this association between combined status and monetary incentives may be due to effect of regression to the mean, which is particularly noteworthy due to the short-term nature of our study. While we do not assign any status in the Control group, we have the data in the Control group to be able to differentiate the behavior of the low and high activity subgroups between their respective average baseline behavior and post-treatment behavior. We observe their step count in Fig. A.2. We observe that the effect of regression to the mean does not occur in our Control group, even after separating the analysis by subgroups despite the lack of status assignment. That is, while the tendency for the low physical activity type is to increase step count and the tendency for the high physical activity type is to decrease step count, these tendencies are not statistically different in the control without status assignment hence providing support to the main result that social status treatment effects are driving the results. Therefore, we can consider our associations in these incentives noteworthy despite some of the limitations discussed in our next section.

Result 2A. *Monetary incentives for those with low social status (i.e., low physical activity) increase the number of steps.*

Result 2B. *Monetary incentives for those with high social status (i.e., high physical activity) decrease the number of steps.*

When we separate the physical activity with monetary incentives treatment by the social status assignment, we observe differences. Those assigned a low status in Period 1 increased their step count by 12% ($p = 0.137$). The results for the step change for the low status group is not significant using a Mann–Whitney test; using a t-test shows a marginal increase in the number of steps with $p = 0.097$. Subsequent regression analysis presented in Table 4 indicates a positive and significant difference after adding sociodemographic control variables, $p = 0.042$. Conversely, those assigned a high status in Period 1 reduced their step count by 25% ($p < 0.001$). Hence, the overall decrease in steps is largely driven by a reduction in the number of steps among participants with high status (and high physical activity level).

Result 3. *A social status exogenous to physical activity does not change physical activity even when a monetary reward is given for the conferred status.*

In Fig. 6, we present the total step count of those who were randomly assigned to the Incentives with Exogenous Social Status treatment. As expected, there is no change in physical activity overall or by social status assignment between Period 1 and Period 2. This result provides robustness to the main results as it helps to rule out any experimenter demand effects of using the pedometers or other facts driving the results. When separate the Exogenous Income Social Status treatment by the types in the group, as seen in Fig. 6, the result remains the same.[7]

[7] While no status was assigned in the Control treatment, we explored the difference in step count for high physical activity types and low physical activity types between the two periods. We observe no differences in step count. When separating the exogenous treatment between the two types, we

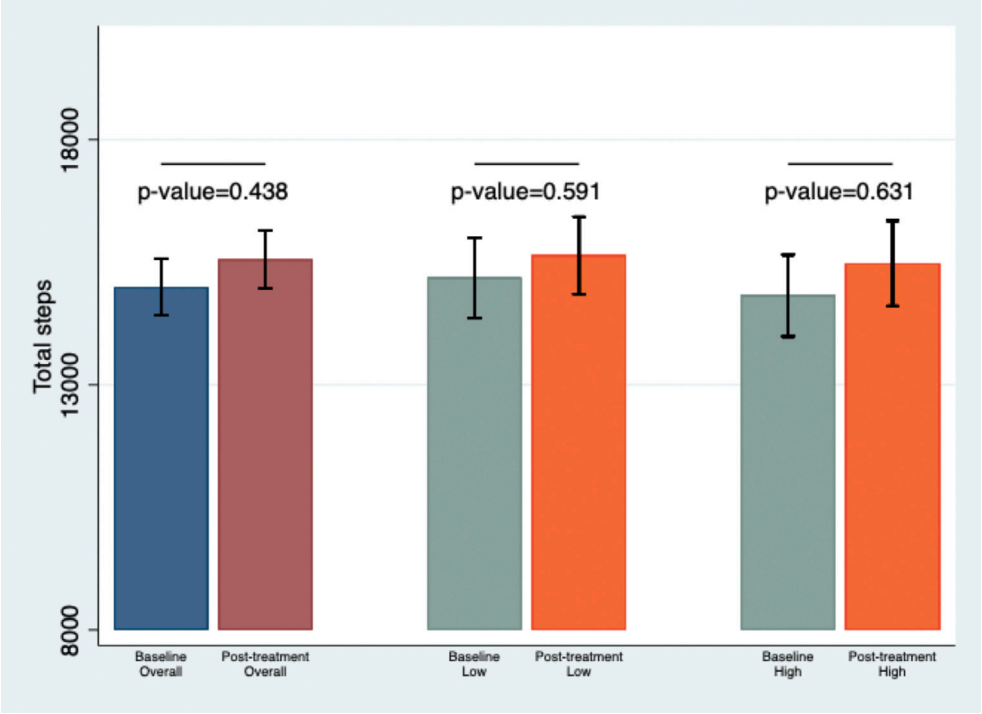

Fig. 6. Total step count for periods 1 and 2 for Exogenous Treatment.

Table A.5 in the appendix reflects the results of a multiple hypothesis test (List, Shaikh, & Xu, 2019), which confirm the results that the high-status group in the Monetary Incentives treatment did decrease their step count between Periods 1 and 2, but show no effect for the low-status group. We further explore the change in steps between Period 1 and Period 2 through a difference-in-difference analysis, as displayed in Table 4, to include control variables. The outcome variable is difference in steps, and we regress it on the social status by treatment, and sociodemographic control variables. Our regression Eq. (1) is

$$\Delta Y = \beta_1(B_R * A) + \beta_2(\gamma_t) + \beta_3(B_R * A * \gamma_t) + \sum_{i=3}^{K} \gamma_i X_i + e \quad (1)$$

where ΔY is $Y_2 - Y_1$, $B_R, R = \{F, M, E\}$ denotes an indicator variable for each treatment, γ_t is an indicator for the second period, $A\{L, H\}$ is an indicator variable for status, and X_i represents a set of demographic controls. The results in Table 4 align with the unconditional result in Fig. 5, where we observe the low status with monetary incentives group increases their step count by 12%, and the High Status with Monetary Incentives treatment results in over a 25% decrease in the number of steps. The result for high-status group is robust to the inclusion of sociodemographic control variables. While the increase in steps for the low-status with monetary incentives group is not significant in the Mann–Whitney test and the specification (1), we find significance after we account for sociodemographic control variables ($p = 0.042$). We can further confirm from Table 4 that the exogenous treatment has no effect on the number of steps, regardless of status assignment. Notably, this difference-in-difference analytic approach to our data reflects that those who are high physical activity types assigned to the social status combined with monetary incentives treatment decrease their step count significantly compared to the other treatments in the post-treatment window.[8]

6. Discussion and conclusions

In this experiment, we find two contrasting effects when physical activity is incentivized with both social status and monetary rewards. Those who are in the low-status group (i.e., low physical activity types) increase their step count by 12%, while those in the high-status group (i.e., high physical activity types) decrease their step count by 25%. While the low-status group seeks to attain higher status, we observe a crowding-out effect from those in the high-status group. We find no effect when physical activity is awarded only based on social status without monetary incentives. With a study that is short-term like ours, we may expect to find a large magnitude in our effect sizes. However, we find no effect when physical activity is awarded only by status without monetary incentives or the incentives treatment unrelated to physical activity. The exogenous treatment provides validity to these early associations and rules out experiment demand effects or other potential drivers for the results in the main treatments.

Our findings from the Social Status with Monetary Incentives treatment are consistent with those from previous literature regarding financial incentives and incentivized activity more broadly in the social economy as presented in Table 1. Specifically, previous literature as listed in Table 1 show that when monetary incentives are offered, it may encourage overall physical activity largely driven by those who are less active, but the intrinsic motivation for physical activity is reduced for those who are active pre-intervention (Charness & Gneezy, 2009; Moller et al., 2014). Our findings add to this line of work by exploring the combination of social status and monetary incentives in the realm of physical activity and confirming that for those who are highly active,

see an increase in step count for the low physical activity type ($p = 0.0017$), but not for the overall treatment.

[8] The results hold using a simple OLS regression. See the estimates in Table A.6.

their intrinsic motivation is reduced and this effect may be observed early in the intervention. This effect may be better observed in a longer-term study to observe intrinsic motivation. Meanwhile, we find that for those with low physical activity, the combination of social status and monetary incentives increases their physical activity. Previous literature further suggests that people with low physical activity increase their activity in response to monetary incentives (Charness & Gneezy, 2009). Status based on performance does not hinder this effect for people with low physical activity. A simpler explanation could be that high performers learn that relative to others, they have a much higher step count and can attain the same number of steps to reach a higher status. This phenomenon has been documented in other domains when individuals receive ranking feedback on performance (Kuhnen & Tymula, 2012; Ludwig & Lünser, 2012).

The existing literature that focuses on physical activity has predominantly utilized pedometers. Providing a pedometer or device that tracks fitness alone has either no effect on overall physical activity or health outcomes, as seen in our control setting, (Butler & Dwyer, 2004; Freak-Poli et al., 2020; Kim et al., 2018; Noah et al., 2018; Patel et al., 2015; Rote, 2017; Takahashi et al., 2016) or is found to have mixed evidence (Bachireddy et al., 2019; Hajat et al., 2019; Lynch et al., 2020). In fact, fitness trackers may have a positive effect when targeting particular populations that benefit the most from increased physical activity rather than randomized controlled trials (Bravata et al., 2007; Chaudhry et al., 2020; Ferguson et al., 2022; McMurdo et al., 2010). However, combining fitness tracker provisions with behavioral interventions generally have a favorable behavioral change depending on the design of the intervention, particularly for subgroups who are not already physically active (Bachireddy et al., 2019; Noah et al., 2018; Singh, Zopf, & Howden, 2022). While interventions that combine some behavioral nudges with a fitness tracker generally have positive effects, sustaining the behavioral change after the intervention is challenging, as evidenced in the literature (Carrera et al., 2020; Finkelstein et al., 2016; Hasan, Klintworth, & Hajat, 2021; Jakicic et al., 2016; Rote, 2017).

The main focus of our paper is to understand the effect of social status and its interaction with incentives on changes in physical activity. While we posit that the monetary incentive itself would increase the physical activity level followed by previous literature as listed in Table 1, its effect associated with social status would bring heterogeneous effect by different physical activity levels. Nonetheless, evaluating the incentive effect only to the physical activity level would help to assure our findings in the effect of the social status associated with incentives on changes in physical activity level.

While we observed these early associations over the span of three days, we focused solely on positively framed incentives. However, we did not explore negatively framed incentives. For physical activity, scholars have looked briefly at financial disincentives; however, in order to implement these, justifications need to be strong and they will likely not encourage a positive behavioral change or, even worse, reduce motivation to exercise (Barte & Wendel-Vos, 2017).

A limitation of our study is its short-term nature,[9] however, this is an exploratory analysis. Furthermore, unobserved individual differences may affect how individuals respond to incentives; this variation may affect the observations that could be made in a short-term study. Such differences may stem from preferences for exercise or pre-existing habits that we do not know of, as well as underlying biological reasons that may affect differences in seeking physical activity much like they can affect differences in food choices (Rangel, 2013). We also note that the pedometer used in this study is not high quality; fitness trackers can vary greatly in accuracy, especially taking into account the location where they are worn (Bachireddy et al., 2019; Bassett et al., 2017; Kim et al., 2018; Slade, Kochenderfer, Delp, & Collins, 2021; Yuan, Zhang, Liu, & Zhu, 2023). In general, pedometers only provide a small, potentially inaccurate measure of someone's physical or overall health profile, especially over a short time span. However, they serve as a convenient and easy to implement tool to evaluate short-term behavioral patterns (Bassett et al., 2017) that may prove to be a useful foundation for a longer-term study. Future work could explore different incentive structures in the form of nudges provided in phone apps that might also interact with social status in different contexts. For example, successful nudges could implement procedures where subjects can showcase their goal-achievement progress across social media outlets. Studies of this nature can measure the impact on the overall population and on different subgroups of individuals with varying levels of susceptibility to social status.

Our early associations call for a cautionary approach to the role of social status in physical activity intervention programs. Over two-thirds of worksites in the United States offer employees a workplace wellness program, for example; England's government implemented a pilot to motivate exercise using financial incentives (CDC, 2019) (CDC, 2019; Linnan et al. 2019; Department of Health, 2010). In addition, various interventions in which people earn money for partaking in exercise activities (i.e., Achievement app, Lympo app, or Sweatcoin), bet on the achievement of activity goals (i.e., StepBet app), or earn money that is donated to charities (i.e., Charity Miles and PK Rewards), have been introduced (Charitymiles, 2020; Evidation Health, 2020; Lympo, 2020; PK rewards, 2020; StepBet, 2020; Sweatcoin, 2020). Social status in field experiments may be a source of unobserved treatment variation that may need to be further studied and quantified.

CRediT authorship contribution statement

Natalia I. Valdez Gonzalez: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Visualization, Writing – original draft, Writing – review & editing. **Jennifer Y. Kee:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. **Marco A. Palma:** Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Writing – original draft, Writing – review & editing. **J. Ross Pruitt:** Funding acquisition, Resources, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A

See Tables A.1–A.6 and Figs. A.1 and A.2.

Appendix B. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.socec.2023.102155.

[9] An ideal time to collect data to allow for day-to-day variability is 3–7 days (Bassett, Toth, LaMunion, & Crouter, 2017).

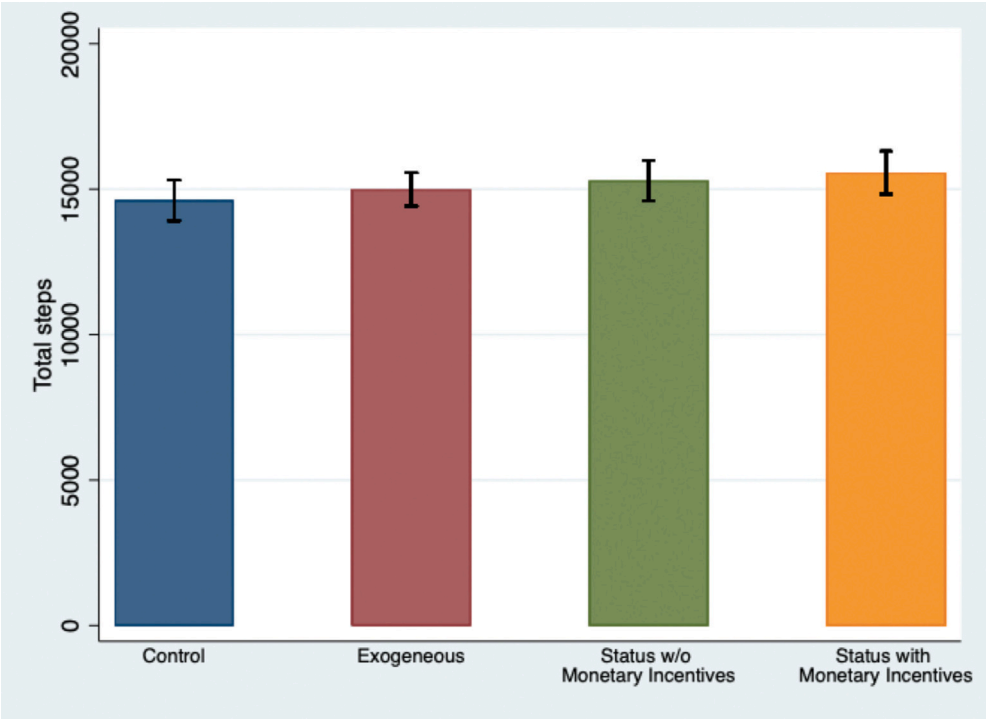

Fig. A.1. Total step count for Day 1 for all treatments.

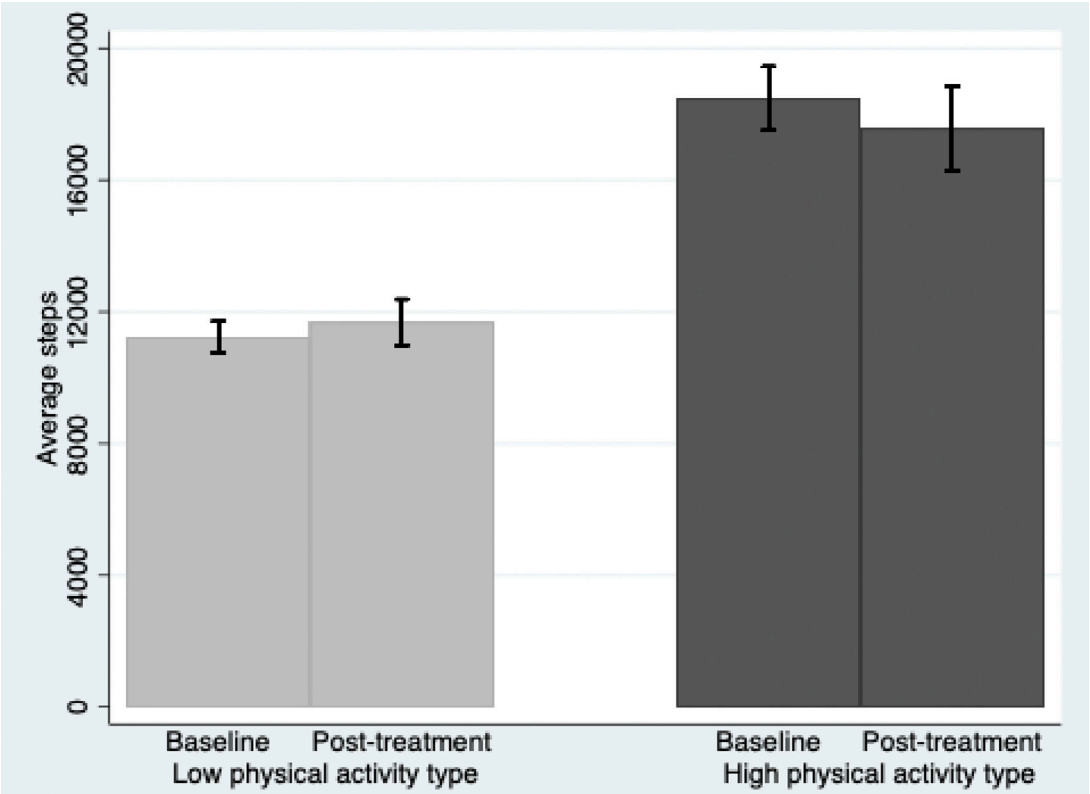

Fig. A.2. Step count across days by physical activity type for Control group.

Table A.1
Orthogonality (balance) test across treatments.

	Social status treatments				*p*-value
	Control	Exercise, No Monetary Incentives	Exercise, Monetary Incentives	Exogenous	
Age	25.690	23.338	24.338	23.667	0.276
Female	0.690	0.635	0.533	0.527	0.158
Household Size	2.500	2.535	2.486	2.644	0.930
White	0.345	0.293	0.347	0.250	0.541
Hispanic	0.190	0.200	0.213	0.237	0.916
Black	0.069	0.080	0.040	0.066	0.785
Native American	0.000	0.013	0.013	0.000	0.619
Asian	0.414	0.440	0.400	0.447	0.932
Year in School	3.772	3.813	3.667	3.280	0.172
Income, <$45k	0.448	0.440	0.365	0.480	0.547
Income, $45k - $49k	0.017	0.067	0.054	0.027	0.446
Income, $50k - $59k	0.086	0.053	0.108	0.040	0.365
Income, >$60k	0.293	0.360	0.378	0.307	0.673

Table A.2
Treatment assignments on Day 1 for whole sample.

Treatment	N
Control, no status	58
Social Status without Monetary Incentives	
Low	34
High	41
Social Status with Monetary Incentives	
Low	39
High	36
Exogenous Social Status	
Low	37
High	39

Table A.3
Summary statistics by treatments and status in Period 1.

Treatment and status	Mean	Median	Min	Max
Control	14,607	13,782	4,199	36,599
Social Status without Monetary Incentives, Low	11,585	11,114	7,294	22,160
Social Status without Monetary Incentives, High	18,482	17,046	8,726	43,341
Social Status with Monetary Incentives, Low	11,346	11,502	5,541	20,863
Social Status with Monetary Incentives, High	20,273	20,161	9,110	38,371
Exogenous Social Status, Low	15,179	14,528	7,519	27,363
Exogenous Social Status, High	14,816	14,059	3,614	37,134

Table A.4
Number of participants by session time and week.

	Week 1	Week 2	Week 3	Week 4	Week 5
9:30 am	5				
11:00 am	3	8	10	13	21
2:30 pm	8	16	21	19	19
4:00 pm	4	15	17	24	16
5:30 pm		12	13	20	20

Note: The first week featured a 9:30 am session that was replaced by a 5:30 pm session to increase participation opportunity.

Table A.5
Multiple hypotheses test across treatments and status.

		Coefficient	Multiplicity test: p-values			
			Unadjusted	Adjusted	Bonferroni	Holm
Control	No Monetary Incentives, Low	1218.63	0.25	0.66	1	1
Control	No Monetary Incentives, High	771.09	0.39	0.77	1	1
Control	Exogenous, Low	659.62	0.57	0.57	1	0.57
Control	Exogenous, High	805.15	0.45	0.70	1	0.9
Control	Monetary Incentives, Low	1566.59	0.10*	0.37	0.69	0.49
Control	Monetary Incentives, High	5011.81	0.00***	0.02**	0.03**	0.03**
No Monetary Incentives, Low	No Monetary Incentives, High	447.54	0.71	0.92	1	1
No Monetary Incentives, Low	Exogenous, Low	1878.25	0.15	0.63	1	1
No Monetary Incentives, Low	Exogenous, High	2023.79	0.11	0.56	1	1
No Monetary Incentives, Low	Monetary Incentives, Low	2785.22	0.01**	0.12	0.33	0.19
No Monetary Incentives, Low	Monetary Incentives, High	3793.18	0.02**	0.17	0.50	0.27
No Monetary Incentives, High	Exogenous, Low	1430.71	0.23	0.68	1	1
No Monetary Incentives, High	Exogenous, High	1576.25	0.19	0.72	1	1
No Monetary Incentives, High	Monetary Incentives, Low	2337.68	0.03**	0.21	0.73	0.36
No Monetary Incentives, High	Monetary Incentives, High	4240.72	0.01**	0.13	0.33	0.20
Exogenous, Low	Exogenous, High	145.54	0.91	0.91	1	0.91
Exogenous, Low	Monetary Incentives, Low	906.97	0.90	0.90	1	1
Exogenous, Low	Monetary Incentives, High	5671.43	0.03**	0.03**	0.07*	0.05**
Exogenous, High	Monetary Incentives, Low	761.43	0.54	0.93	1	1
Exogenous, High	Monetary Incentives, High	5816.96	0.00***	0.04**	0.09*	0.06*
Monetary Incentives, Low	Monetary Incentives, High	6578.40	0.00***	0.000***	0.01***	0.01***

Note: Based on List et al. (2019). * $p < 0.10$, ** $p < 0.05$, **** $p < 0.01$.

Table A.6
OLS regression estimates of social status treatment effects on change in steps.

	(1)	(2)	(3)	(4)
Status w/o Monetary Incentives	−818.5	−1975.2	−1295.0	−1416.6
	(725.1)	(1233.7)	(1708.8)	(1984.0)
Status with Monetary Incentives	−1563.3	810.0	1629.1	1565.4
	(1399.5)	(674.3)	(958.8)	(1090.4)
Exogenous	825.6	−96.9	528.6	277.5
	(998.6)	(1273.5)	(1789.5)	(2040.4)
High	−1916.2*	−1625.2**	−1887.9	−2033.5
	(1084.8)	(737.0)	(1328.5)	(3994.2)
Status w/o Incentives * High		2072.7	2115.1	2009.9
		(1621.9)	(2228.6)	(2316.6)
Status with Monetary Incentives * High		−4953.2**	−5150.3**	−5432.8**
		(2233.3)	(2384.8)	(2182.9)
Exogenous * High		1770.7	1473.6	1790.8
		(1525.7)	(2198.4)	(1790.8)
Constant	700.9	565.5	5057.8	5695.5
	(648.4)	(432.4)	(3678.9)	(3994.2)
Controls?	No	No	Yes	Yes
N	284	284	265	230
R^2	0.052	0.115	0.181	0.218

Note: The outcome variable is change in steps. Specifications (1) and (2) includes no controls while specifications (3) and (4) include them. Specification (3) does not include the high-income dummy variable as a control since approximately 15% of the sample opted to not disclose their income level; however, the magnitude and significance levels between specifications (3) and (4) reflect similar results. Errors are clustered at the session-level. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, **** $p < 0.01$.

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