Overcoming Time Inconsistency with a Matched Bet: Theory and Evidence from Exercising

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Discussion Paper No. 476

December 10, 2023

Collaborative Research Center Transregio 190 | www.rationality-and-competition.de
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Abstract

This paper introduces the matched-bet mechanism. The matched bet is an easily applicable and strictly budget-balanced mechanism that aims to help people overcome time-inconsistent behavior. I show theoretically that offering a matched bet helps both sophisticated and naive procrastinators to reduce time-inconsistent behavior. A field experiment on exercising confirms the theoretical predictions: offering a matched bet has a significant positive effect on gym attendance. Self-reported procrastinators are significantly more likely to take up the matched bet. Overall, the matched bet proves a promising device to help people not to procrastinate.

Keywords: Monetary Incentives, Market Design, Field Experiment, Health Behavior.

JEL classification: C93; D47; D90; I12.

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*I would like to thank my advisors Sander Onderstal and Arthur Schram for their many helpful comments and suggestions. I would also like to thank Yves Breitmoser, Pol Campos-Mercade, Marina Chugunova, Gary Charness, Matthew Ellman, Uri Gneezy, Ben Greiner, Paul Heidhues, Taisuke Imai, Timo Klein, David K. Levine, Michel Maréchal, Kirsten Rohde, Giorgia Romagnoli, Heather Royer, Klaus M. Schmidt, Joep Sonnemans, Randolph Sloof, Simon ter Meulen, Leonard Treuren, Egon Tripodi and Max van Lent. The paper has also greatly benefitted from seminar presentations at the University of Amsterdam, European University Institute and UC San Diego, WZB Berlin, University of Bologna, Ca' Foscary University of Venice, Heinrich Heine University Dusseldorf, LMU Munich and CERGE Prague as well as from conference presentations at IMEBESS, M-BEPS, TI Workshop on Behavioral Industrial Organization, the ESA world meeting, SABE-IAREP, TIBER, Nordic Conference on Behavioural and Experimental Economics, Advances with Field Experiments Conference, BehNet Workshop, EEA-ESEM, Conference on Economic Design and Verein f[Pleaseinsert\PrerenderUnicode{Ãij}intopreamble]r Socialpolitik conference. I am grateful to the University Sports Center Amsterdam for their willingness to cooperate in the field experiment, and in particular to Maurice Maas for his administrative support. Financial support from the Research Priority Area Behavioral Economics of the University of Amsterdam is gratefully acknowledged. Support by Deutsche Forschungsgemeinschaft through CRC TRR 190 (project number 280092119) is gratefully acknowledged. AEARCTR-0008740.

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1 Introduction

Many people struggle to follow through on their best intentions. They start with ambitious goals for improving their lifestyle but end up falling short of their exercising, studying and saving goals, or fail to lose weight and quit smoking. These behavioral problems can result in severe consequences both for the individual and for society, and have motivated a rich literature in economics aimed at better understanding time-inconsistent behavior.[1] In recent years, the focus of the literature has shifted towards testing behavioral interventions that could help people overcome time inconsistency issues.[2] Unfortunately, effective interventions tend to be costly, while low-cost interventions tend to be ineffective.

This paper tries to resolve the trade-off between costs and effectiveness and presents a new mechanism, the matched bet. The matched bet is an easily applicable and strictly budget-balanced mechanism that aims to help people overcome time-inconsistent behavior. In a simple model, I show that the matched-bet mechanism has desirable theoretical properties. In a field experiment on exercising, I show that the matched bet is also an effective mechanism in practice.

The matched bet works as follows: People are offered to participate in a matched bet with a given monetary bet stake. Bet participants are grouped with all other participants who are equally likely to reach a prespecified target. Bet participants obtain a reward equal to the bet stake if they reach the target. In exchange, they have to pay the average reward of their grouped partners.

To illustrate the rules of the matched bet, consider the following simple example: Assume that Anne, Bob and Claire choose to participate in a matched bet on exercising with a bet stake of \$10. Suppose they are grouped together, because they are equally likely to exercise. Consider three possible scenarios. In scenario 1, Anne exercises and both Bob and Claire do not exercise. The resulting bet payoffs are $\$10 - \$0 = \$10$ for Anne and $\$0 - \$5 = -\$5$ for Bob and Claire each. In scenario 2, both Anne and Bob exercise, and Claire does not. The bet payoffs are then $\$10 - \$5 = \$5$ for both Anne and Bob and $\$0 - \$10 = -\$10$ for Claire. In scenario 3, Anne, Bob and Claire all exercise, which results in bet payoffs of $\$10 - \$10 = \$0$ for each.

[1]See e.g. Strotz (1955); Laibson (1997); O'Donoghue and Rabin (1999).

[2]See e.g. Charness and Gneezy (2009) and Royer et al. (2015) on exercising, Bachireddy et al. (2019) and Aggarwal et al. (2023) on walking, Fryer Jr (2011) and Lusher (2017) on academic performance, Thaler and Benartzi (2004) and Ashraf et al. (2006) on saving, Burger and Lynham (2010) and Augurzky et al. (2018) on weight loss, and Giné et al. (2010) and Halpern et al. (2015) on smoking cessation.

The matched-bet mechanism has several attractive features: it is ex-post strictly budget-balanced, strategically straightforward and fair. Note that in all three scenarios, the bet payoffs sum up to zero; the reward paid to a bet participant is always exactly refinanced by the payments obtained from her grouped partners. As the matched-bet mechanism is ex-post strictly budget-balanced, a budget-constrained policy maker can offer a matched bet repeatedly to potentially achieve persistent behavioral change. Comparing scenarios 1 and 2, we observe that Bob increases his bet payoff by \$10 (from −\$5 to \$5) if he exercises. Similarly, comparing scenarios 2 and 3, we observe that Claire increases her bet payoff by \$10 (from −\$10 to \$0) if she exercises. The matched bet thus provides participants with an extra monetary incentive to reach the target. This extra incentive is always equal to the bet stake, and does not depend on the behavior of a participant's grouped partners, making the matched-bet mechanism strategically straightforward in that every bet participant has a dominant exercising strategy. Because participants are grouped only with other participants who are equally likely to reach the target, the expected participation costs for every participant are zero in equilibrium. This makes the matched bet a fair mechanism; it does not monetarily favor any participant over another.[3]

Time-inconsistent bet participants can use the matched-bet mechanism to provide themselves with an extra monetary incentive to counterbalance their present bias. Due to matching, they can do so at zero costs in expectation. Without matching, however, time-inconsistent people might refrain from taking up a bet. To illustrate, imagine Anne, Bob and Claire knew that they would be grouped also with Arnie and his bodybuilder friends. If Anne, Bob and Claire are prone to procrastinate exercising, they might then reject this unmatched bet to prevent losing too much money in expectation. In contrast, Arnie and his bodybuilder friends, who have no need for more exercise, would not take up a matched bet, but might take up an unmatched bet to win money. Matching is thus crucial to ensure that the 'right' people self-select into the bet. While there exist a few papers that use bets for behavioral change (Halpern et al., 2015; Lusher, 2017; Adjerid et al., 2021), this study is the first to analyze and test a bet mechanism in which participants are grouped based on how likely they reach a prespecified target.

[3]In particular, by construction, the matched bet does not take advantage of (partially) naive procrastinators' wrong beliefs and there is no cross-subsidization from naive to sophisticated individuals. Offering a matched bet does therefore not systematically harm (partially) naive procrastinators, in contrast to a common finding in the literature on contracts with present-biased individuals (see e.g. DellaVigna and Malmendier, 2004; DellaVigna and Malmendier, 2006; Eliaz and Spiegler, 2006; Heidhues and Kőszegi, 2010).

This paper answers whether the matched-bet mechanism is effective in helping people overcome time-inconsistent behavior. I provide an axiomatization of the matched-bet mechanism and show that it can be uniquely characterized by five desirable properties: *Voluntary participation*, *Ex-post strict budget balancedness*, *Neutrality*, *Symmetry* and *Fixed incentives*. I introduce a three-period model inspired by DellaVigna and Malmendier (2004) to analyze the effects of a matched bet on individual and social welfare. In period 0, agents decide whether to participate in a matched bet. In period 1, agents decide whether to exercise. If they do, they incur immediate costs. Bet participants are paid depending on their bet outcome. In period 2, agents who exercised obtain benefits. I assume agents' time preferences can be expressed by a quasi-hyperbolic discounting model (Phelps and Pollak, 1968; Laibson, 1997; O'Donoghue and Rabin, 1999). Agents who are present-biased undervalue future benefits and thus underexercise in the baseline. My model allows agents to have private and individual-specific (degrees of) time inconsistency, naiveté, exercising benefits and cost distributions.

I show that participating in a matched bet increases an agent's likelihood to exercise. The matched bet also features favorable self-selection into the bet. The more present-biased, the more an agent is willing to take up the matched bet. Time-consistent agents do not take up the matched bet. The rationale why present-biased agents do take up a matched bet depends on their degree of naiveté. Sophisticated procrastinators, i.e. present-biased agents who are aware of their time inconsistency, use the matched bet as a costless commitment device. In contrast, naive procrastinators, i.e. present-biased agents who are unaware of their time inconsistency, take up the matched bet because they (erroneously) expect to win money with it. Due to the matching, the matched bet perfectly aligns individual and social welfare. I derive two testable sufficient conditions, about the shape of the cost distribution functions and the size of the bet stake, for when the matched-bet mechanism unambiguously increases welfare. I further provide numerical results showing that offering a matched bet is predicted to be distinctly more welfare-enhancing than offering a subsidy, a commitment contract or an unmatched bet (Appendix B.1).

In a field experiment at a university gym, I test whether the matched bet is also a promising device in practice. I study 601 student gym members and randomize them into a treatment and control group. In the treatment group, subjects are offered to participate in a matched bet. Participation in the bet is voluntary. Bet participants are grouped with all other participants who attended the gym equally often in the four weeks preceding the intervention. Bet participants earn €5 from their grouped partners for each day they visit the gym (up to the 8th time) within the four-week intervention period. In exchange, participants have to pay the average earnings of their grouped partners. Subjects in the control group are not informed about the matched bet. I compare the gym attendance between the treatment and control group during and after a four-week intervention period.

The experimental results confirm the theoretical predictions. Offering a matched bet has a significant positive effect on gym attendance. Subjects who were offered to participate in the bet recorded on average 0.87 more gym visits than subjects in the control group. This implies a 38% (0.34 standard deviations) increase in gym attendance. The effect is larger both in absolute and relative terms for subjects who reported to have procrastinated exercising in the past. The bet take-up rate is 25%. In line with the theoretical prediction, I find that self-reported procrastination has a significant positive effect on bet take-up, confirming favorable self-selection also in practice. Further analysis suggests that the matched bet also increases welfare. Overall, the matched bet proves a promising mechanism to help people overcome time inconsistency issues, both in theory and in practice.

My paper contributes to the literature on monetary incentives for behavioral change. This literature has predominantly studied subsidies, also referred to as conditional cash transfers. With a subsidy, a policy maker pays participants if they reach a prespecified target. When applied to exercising, several field experiments at university or company gyms have found that subsidies increase gym attendance during the intervention period (see e.g. Charness and Gneezy, 2009; Pope and Harvey-Berino, 2013; Acland and Levy, 2015; Carrera et al., 2020; Arad et al., 2023).[4] The literature typically also finds higher gym attendance by incentivized compared to unincentivized subjects after the intervention period, which suggests that people might form a habit of exercising and that monetary incentives do not crowd out participants' intrinsic motivation to exercise. Positive post-intervention effects are limited in size and duration, however, and often decay after a quasi-exogenous negative shock on gym attendance due to holidays (Acland and Levy,

[4]Not surprisingly, participants attend the gym more often the more they get paid for attendance. Studies with only modest incentives yield only small increases in gym attendance (Carrera et al., 2018; Rohde and Verbeke, 2017; Milkman et al., 2021).

2015). This implies that it is not sufficient to pay people once over a short period of time to achieve persistent behavioral change. As subsidies impose high costs on the policy maker, continuously offering subsidies might prove too costly to solve time inconsistency issues. My paper proposes an effective and strictly budget-balanced alternative mechanism that could be offered on a repeated basis at very low costs and therefore does not rely on fickle habituation to achieve persistent behavioral change.

In the pursuit of a cost-effective way to solve time inconsistency issues, the literature has also investigated monetary commitment contracts. With such contracts, participants put money at stake, which they lose if they fail to reach a prespecified target.[5] Just like a matched bet, a budget-constrained policy maker can thus offer a commitment contract repeatedly. Evidence shows that offering monetary commitment contracts increases the desired behavior, but often only to a small margin. The reason is that typically only a minority of people is willing to participate (11% in Giné et al., 2010; 12 % in Royer et al., 2015; 14 % in Bai et al., 2021).[6] Laibson (2015) and Carrera et al. (2022) theoretically show that take-up rates are low because (1) naive procrastinators (erroneously) perceive that they do not need commitment and (2) commitment contracts can become quite costly due to the possible loss in flexibility or money. Even worse than low take-up rates, offering a commitment contract might decrease participants' welfare as partially naive procrastinators might participate in costly but ineffective commitment contracts (Heidhues and Kőszegi, 2009; John, 2020). Indeed, this theoretical prediction is supported by two recent experimental studies (John, 2020; Bai et al., 2021). These findings put into question whether monetary commitment contracts are a viable tool to help people overcome time inconsistency issues and point out the need for alternative low-cost monetary incentive schemes, such as the matched bet.

This paper is most closely related to the few studies that have investigated the effects of offering bets for behavioral change. With such bets, participants win money if they reach a pre-specified target and lose money if they fail to do so. In a field experiment on smoking cessation, Halpern et al. (2015) provide evidence for a bet's cost-effectiveness.

[5]Next to monetary commitment contracts, the literature has also studied non-monetary commitment contracts in which participants restrict their future choice sets (see. e.g. Ashraf et al., 2006; Milkman et al., 2014; Sadoff and Samek, 2019; Beshears et al., 2020; Sadoff et al., 2020).

[6]Commitment contracts that merely threaten to decrease a positive payoff to participants have higher participation rates (John et al., 2012; Kaur et al., 2015; Exley and Naecker, 2016; Schilbach, 2019; Dizon-Ross and Zucker, 2023). However, endowing individuals with "house money" that they may then put at stake is often impractical as it typically imposes extra costs on the policy maker.

They compare the effect of a high-stake bet to an equally high subsidy and to a control group and find that the bet increases abstinence rates only about two thirds as much as the subsidy, but costs about three times less. In the context of walking, Adjerid et al. (2021) have individuals choose between a bet and a less ambitious subsidy scheme. While the bet proves effective in increasing participants' daily step counts, they find unfavorable self-selection in that the individuals who benefit relatively more from participating in the bet are more likely to choose the subsidy scheme. Lusher (2017) analyzes the effects of a parimutuel betting market on academic performance of university students. In parimutuel betting, participants' bet stakes are placed in a bet pool, which is then shared by all winning participants. Lusher offers a bet with a modest bet stake and a binary target to improve one's GPA. He finds that participation in the bet increases the likelihood to increase one's GPA but has no effect on average GPA. While the three aforementioned papers already show the potential of using bets for behavioral change, my paper highlights that matching is a crucial component to make for a welfare-improving bet mechanism. On a more general level, this paper is among the first to demonstrate the promising avenue of a theory-driven approach to testing incentive schemes for behavioral change.[7]

The paper proceeds as follows: Section 2 theoretically analyzes the matched-bet mechanism. Section 3 describes the experimental design. Section 4 presents the experimental results. Finally, Section 5 concludes.

2 Theory

This section theoretically analyzes the effects of offering a matched bet to help people overcome time-inconsistent behavior in a simple model inspired by DellaVigna and Malmendier (2004). I demonstrate that the matched bet uniquely satisfies a combination of desirable properties and derive predictions that I subsequently test in the field experiment.

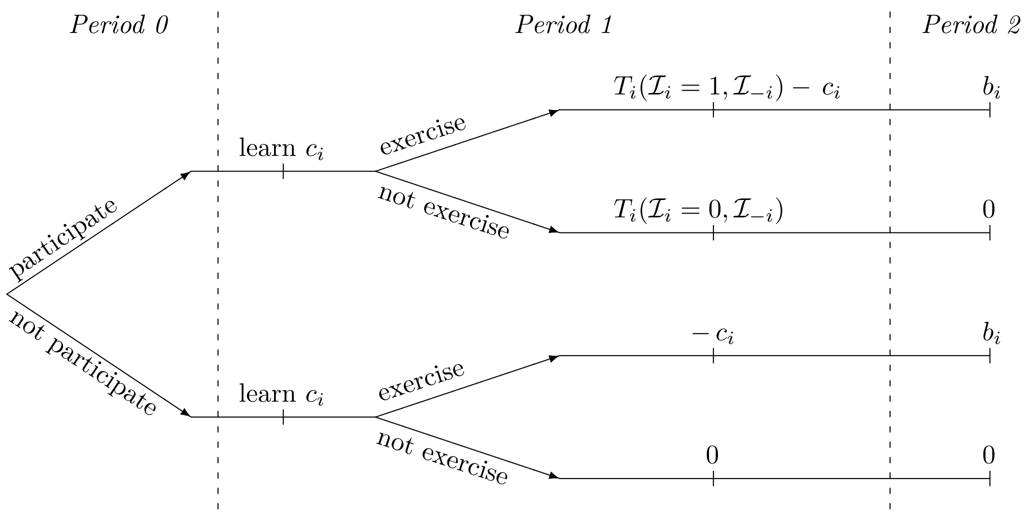
2.1 Model

Setting. Consider a setting with a set of N agents labeled $i = 1, ..., N$ and three periods. At period 0, agents know their own benefits of exercising $b_i > 0$ and their own distribution

[7] Two recent working papers theoretically analyze and empirically test dynamic subsidy schemes. Aggarwal et al. (2023) investigates threshold incentives for walking, while Woerner et al. (2021) studies streak incentives for meditating.

F_i which their own costs of exercising c_i are drawn from. I assume that, for all i, F_i has a strictly positive density f_i over $\mathbb{R}_{\geq 0}$. Still in period 0, agents are then offered an opportunity to participate in a matched bet with a fixed bet stake, and each agent i decides whether to participate ($\mathcal{P}_i = 1$) or not ($\mathcal{P}_i = 0$).[8] In period 1, agents first learn about their cost realization and then make a binary exercising decision. If an agent exercises ($\mathcal{I}_i = 1$), she incurs immediate costs c_i, but later obtains benefits b_i in period 2. If an agent does not exercise ($\mathcal{I}_i = 0$), both her costs and benefits are equal to zero. Furthermore, there are (possibly negative) monetary transfers $T_i(\mathcal{I}_i, \mathcal{I}_{-i})$ to bet participants in period 1. Figure 1 illustrates the timing of events for agent i.

Figure 1: Timing of Events



Agents. Agents are selfish, risk-neutral and may have time-inconsistent preferences. I assume agents' time preferences can be expressed by the canonical quasi-hyperbolic discounting model, also known as the β-δ model (Phelps and Pollak, 1968; Laibson, 1997; O'Donoghue and Rabin, 1999), which expresses the present value of discounted future utilities to agent i in period t as

$$U_{it} = u_{it} + \beta_i \sum_{s=t+1}^{T} \delta_i^{s-t} u_{is}. \tag{1}$$

Here, $\delta_i \leq 1$ denotes agent i's long-run discount factor and $\beta_i \leq 1$ agent i's short-run discount factor. Further, let $\hat{\beta}_i$ denote agent i's *perceived* short-run discount factor, i.e. agent i's belief in period 0 about her short-run discount factor in period 1. I allow agents

[8] Section B.3 analyzes a version of the matched bet in which agents can choose between a menu of bet stakes. The results are similar.

to underestimate their degree of time inconsistency, which implies $\beta_i \leq \hat{\beta}_i$.

Following O'Donoghue and Rabin (1999), three special types are worth mentioning: *rational* agents who are time-consistent ($\beta_i = \hat{\beta}_i = 1$), *sophisticated* agents who are time-inconsistent and aware of it ($\beta_i = \hat{\beta}_i < 1$), and *naive* agents who are time-inconsistent but completely unaware of it ($\beta_i < \hat{\beta}_i = 1$). While (partially) naive agents believe that their short-run discount factor will be higher in period 1 than it is in period 0, I assume that all agents (correctly) believe that the other agents' short-run discount factors are constant over time.[9]

Importantly, in terms of the informational setting, I assume that agents' underlying parameters β_i, $\hat{\beta}_i$, δ_i, b_i, F_i and c_i are private information but that agents can be ranked in period 0 according to their likelihood to exercise in period 1.[10]

2.2 Matched-Bet Mechanism

A matched bet with monetary bet stake $m > 0$ specifies the (possibly negative) monetary transfer T_i to agent i as follows

$$T_i = \left(\mathcal{I}_i m - \frac{1}{|S_i|} \sum_{j \in S_i} \mathcal{I}_j m \right) \mathcal{P}_i, \qquad (2)$$

[11]

where $S_i \equiv \{j \neq i | \mathcal{P}_j = 1, \mathbb{E}[\mathcal{I}_j] = \mathbb{E}[\mathcal{I}_i]\}$ denotes the set of agent i's grouped partners, i.e. the set of agents other than i who participate in the bet and who are equally likely to exercise as i in equilibrium. $|S_i|$ denotes the number of agent i's grouped partners.[12] Transfer T_i to a bet participant thus equals the bet stake multiplied by the difference of her own and her partners' average exercising frequencies. Bet participants are grouped with all other participants who, at period 0, have the same likelihood to exercise in period 1. [Make matching dependent on baseline frequency]

[9]This modeling assumption is in line with experimental evidence in Fedyk (2022), who finds that people anticipate present bias in others.

[10]One example where reality approaches this informational setting are gyms. Gyms typically record each member's gym attendance. The information about past gym attendance can be used to predict members' future attendance ranking quite accurately in spite of the fact that gyms are ignorant about the underlying preferences of their members.

[11]For simplicity and in accordance with the experiment, I assume that the offered bet stake is the same for every agent. The results do not change if agents with differing likelihoods to exercise are offered different bet stakes.

[12]I assume that the market is sufficiently thick to ensure that a bet participant always has at least one viable partner to be matched with, thus $|S_i| \geq 1 \; \forall \; i$.

The matched-bet mechanism possesses several desirable properties that distinguishes it from other incentive schemes.[13]

First, it satisfies *Voluntary participation*: $T_i = 0 \; \forall \; i : \mathcal{P}_i = 0$. The matched-bet mechanism allows agents to freely decide whether they participate or not. Non-participants are always ensured a transfer of zero, irrespective of their and other agents' exercising behavior. Voluntary participation ensures that no agent is forced to participate against her own will.

Second, it satisfies *Ex-post strict budget balancedness*: $\sum_i T_i = 0$. The matched bet is ex-post strictly budget-balanced because the reward paid to a bet participant is always exactly refinanced by the payments obtained from her grouped partners. The ex-post property makes the matched bet robust to common exercising frequency shocks. The strict budget balancedness implies that offering the matched bet does not require any funding.

Third, the matched-bet mechanism satisfies *Neutrality*: $\mathbb{E}[T_i] = \mathbb{E}[T_j] \; \forall \; i, j : \mathcal{P}_i = \mathcal{P}_j = 1$. It ensures that all bet participants are expected to earn the same bet payoff. Offering a matched bet does therefore not monetarily favor any agent over another. In particular, Neutrality prevents that naive agents are exploited. Neutrality requires that bet participants are only grouped with other participants that are equally likely to exercise. Together with strict budget balancedness neutrality implies that every participant breaks even in expectation.

Fourth, the matched-bet mechanism satisfies *Symmetry*: $T_i = T_j \; \forall \; i, j : \mathcal{P}_i = \mathcal{P}_j = 1, \mathbb{E}[\mathcal{I}_i] = \mathbb{E}[\mathcal{I}_j], \mathcal{I}_i = \mathcal{I}_j$. Bet participants who have the same likelihood to exercise in period 0 and take the same exercising decision in period 1 earn the same bet payoff. Symmetry ensures that differences in transfers are only due to expected and actual behavior, and not due to pure luck. Adding this property requires that bet participants are grouped with *all* other bet participants that are equally likely to exercise. It also rules out any lottery elements in the transfer function.

Fifth, the matched-bet mechanism provides *Fixed incentives*: $T_i(\mathcal{I}_i = 1) - T_i(\mathcal{I}_i = 0) \perp\!\!\!\perp \boldsymbol{\mathcal{I}_{-i}} \; \forall \; i : \mathcal{P}_i = 1$. Exercising increases a bet participant's transfer by an amount that is independent of the exercising behavior of other agents. Because of this, every bet participant has a dominant exercising strategy, which makes the matched bet strategically

[13] I define an incentive scheme as a mechanism that provides participants with a non-zero extra incentive for exercising, i.e. $\mathbb{E}[T_i(\mathcal{I}_i = 1)] - \mathbb{E}[T_i(\mathcal{I}_i = 0)] \neq 0 \; \forall \; i : \mathcal{P}_i = 1$.

straightforward. It also makes it easier for the policy maker to choose a suitable bet stake size.

Importantly, the matched-bet mechanism not only possesses the five desirable properties explained above, it is also the *only* incentive scheme that does so.

Theorem 1 (Properties of the Matched-Bet Mechanism)

The matched-bet mechanism is the only incentive scheme jointly satisfying voluntary participation, ex-post strict budget balancedness, neutrality, symmetry and fixed incentives.[14]

This uniqueness result provides a justification why, among the infinite set of incentive schemes, the matched-bet mechanism is particularly promising and is worth being investigated further.

2.3 Analysis

2.3.1 Behavior

Every agent faces two binary decisions: a bet participation decision in period 0 and an exercising decision in period 1. I solve using backward induction and first focus on the exercising decision, taking the earlier bet participation decision as given. The analysis employs a Perception-Perfect equilibrium concept (Cerrone, 2021) in which agents follow perception-perfect strategies (O'Donoghue and Rabin, 1999), i.e. in all periods they behave optimally given their current preferences and their perceptions about future behavior, and have correct beliefs about other agents' strategies in equilibrium.

An agent's exercising decision in period 1 depends on the agent's preferences in period 1. Exercising entails immediate costs c_i, and delayed benefits b_i that are discounted by $\beta_i\delta_i$. Without the matched bet, an agent exercises whenever costs are weakly lower than the discounted benefits, i.e. $c_i \leq \beta_i\delta_i b_i$.[15] A present-biased agent thus underexercises whenever $\beta_i\delta_i b_i < c_i < \delta_i b_i$.

For bet participants, the exercising decision additionally depends on the immediate transfer T_i. As $T_i(\mathcal{I}_i = 1) - T_i(\mathcal{I}_i = 0) = m \; \forall \; i : \mathcal{P}_i = 1$ (*Fixed incentives*), a bet

[14] All omitted proofs are in Appendix A.

[15] Throughout the paper, I assume, without loss of generality, that agents exercise when indifferent between exercising and not exercising and participate in the matched bet when indifferent between participating and not participating.

participant exercises if and only if

$$c_i \leq \beta_i \delta_i b_i + m. \tag{IC}$$

It is easy to see that bet participants have dominant exercising strategies as their exercising decisions do not depend on the behavior of other participants.

In period 0, when costs have not yet realized, an agent's likelihood to exercise equals $F_i(\beta_i \delta_i b_i + m)$ with the bet and $F_i(\beta_i \delta_i b_i)$ without the bet. Clearly, $F_i(\beta_i \delta_i b_i + m) > F_i(\beta_i \delta_i b_i)$ as f_i is strictly positive over $\mathbb{R}_{\geq 0}$ for all i, which leads to the following proposition

Proposition 1 (Bet Effect)

Participating in a matched bet increases an agent's likelihood to exercise.

The matched bet provides an extra incentive to exercise. It depends on the size of the bet stake m whether the extra incentive induces a bet participant to exercise efficiently $(m = (1 - \beta_i)\delta_i b_i)$, inefficiently rarely $(m < (1 - \beta_i)\delta_i b_i)$ or inefficiently often $(m > (1 - \beta_i)\delta_i b_i)$. Note that even though a bet participant still underexercises when participating in a matched bet with $m < (1 - \beta_i)\delta_i b_i$, she does so to a lesser extent than without the bet.

I now turn to the bet participation decision. In period 0, an agent makes a bet participation decision that depends on the agent's preferences in period 0, as well as her *perceived* own exercising strategy and her grouped partners' exercising strategies in period 1. Given an agent's preferences in period 0, exercising in period 1 entails future costs c_i discounted by $\beta_i \delta_i$ and benefits b_i discounted by $\beta_i \delta_i^2$. A bet participant also obtains transfer T_i discounted by $\beta_i \delta_i$.

Recall that an agent might have incorrect beliefs about her own exercising strategy (as $\beta_i \leq \hat{\beta}_i$), but is assumed to have accurate, i.e. consistent with equilibrium, beliefs about her grouped partners' exercising strategies. In period 0, agent i thus believes to exercise in period 1 if and only if $c_i \leq \hat{\beta}_i \delta_i b_i$ without and $c_i \leq \hat{\beta}_i \delta_i b_i + m$ with a matched bet. Further, agent i correctly believes that bet participant j exercises if and only if $c_j \leq \beta_j \delta_j b_j + m$. Put together, in period 0, an agent's perceived expected utility equals $\beta_i \delta_i \int_0^{\hat{\beta}_i \delta_i b_i} (\delta_i b_i - c_i) f_i(c_i) dc_i$ without the matched bet and $\beta_i \delta_i \int_0^{\hat{\beta}_i \delta_i b_i + m} (\delta_i b_i - c_i) f_i(c_i) dc_i + \beta_i \delta_i F_i(\hat{\beta}_i \delta_i b_i + m)m - \beta_i \delta_i \frac{1}{|S_i|} \sum_{j \in S_i} F_j(\beta_j \delta_j b_j + m)m$ with the matched bet. Since bet participants are grouped with all other participants who have the same likelihood to exercise,

$F_j(\beta_j\delta_j b_j+m) = F_i(\beta_i\delta_i b_i+m)\ \forall\ j \in S_i$, which simplifies a bet participant's perceived expected utility to $\beta_i\delta_i \int_0^{\hat{\beta}_i\delta_i b_i+m}(\delta_i b_i - c_i)f_i(c_i)dc_i + \beta_i\delta_i \left(F_i(\hat{\beta}_i\delta_i b_i+m) - F_i(\beta_i\delta_i b_i+m)\right)m$. Comparing perceived expected utilities without and with the matched bet, one obtains the bet participation constraint

$$\underbrace{\int_{\hat{\beta}_i\delta_i b_i}^{\hat{\beta}_i\delta_i b_i+m}(\delta_i b_i - c_i)f_i(c_i)dc_i}_{\text{Perceived Incentive Value}} + \underbrace{\left(F_i(\hat{\beta}_i\delta_i b_i+m) - F_i(\beta_i\delta_i b_i+m)\right)m}_{\text{Perceived Monetary Value}} \geq 0. \tag{PC}$$

The perceived incentive value describes the (possibly negative) non-monetary net benefits an agent expects to obtain from the increase in her likelihood to exercise when participating in the bet. The perceived monetary value describes the monetary amount an agent expects to win with the bet.

Time-consistent agents never take up a matched bet. Inserting $\beta_i = \hat{\beta}_i = 1$ into the participation constraint yields a negative incentive value and a monetary value of zero. Time-consistent agents already exercise efficiently without a matched bet. Taking up a matched bet would make them exercise inefficiently often. Because of matching, time-consistent agents also do not expect to win money with the bet. The rationale for why present-biased agents might take up a matched bet depends on their degree of naiveté $\hat{\beta}_i - \beta_i$. Sophisticated agents ($\beta_i = \hat{\beta}_i < 1$) are fully aware of their present bias and use the matched bet as a costless incentive device to exercise more efficiently. Like time-consistent agents, they do not expect to win money with the bet. In contrast, naive agents ($\beta_i < \hat{\beta}_i = 1$) are fully unaware of their present bias. They expect to exercise less efficiently with a matched bet but erroneously expect to win money with it. A combination of the reasons stated above holds true for partially naive agents ($\beta_i < \hat{\beta}_i < 1$).

Analyzing the comparative statics of the participation constraint yields the following proposition that describes the take-up of a matched bet.

Proposition 2 (Bet Participation)

Ceteris paribus, agents' willingness to participate in a matched bet increases in their degree of present bias.

The matched bet thus features favorable self-selection; those agents who need an extra incentive to exercise are also the ones more likely to take up the matched bet.[16] The

[16]Note that matching is crucial for favorable self-selection into the bet as shown in Appendix B.1.

effect of naiveté on bet participation is ambiguous and depends on the shape of the cost distribution functions. If f_i is decreasing (increasing) over the interval $[\hat{\beta}_i\delta_i b_i, \hat{\beta}_i\delta_i b_i + m]$, then agent i's willingness to participate decreases (increases) in her degree of naiveté.

2.3.2 Welfare

Having characterized agents' behavior I now turn to the welfare consequences of offering a matched bet. As agents' preferences may be time-inconsistent, welfare depends on which preferences capture an agent's true preferences. As is standard in the literature, I assume that welfare depends on an agent's long-run (time-consistent) preferences (O'Donoghue and Rabin, 2001; DellaVigna and Malmendier, 2004; Galperti, 2015).

As bet participants are expected to break even with the matched bet, the effect of participating in a matched bet on individual welfare is entirely driven by its incentive effect, $\delta_i \int_{\beta_i\delta_i b_i}^{\beta_i\delta_i b_i+m}(\delta_i b_i - c_i)f_i(c_i)dc_i$. Because of this, the matched bet perfectly aligns individual and social welfare, i.e. whenever an agent is better off in expectation by participating in a matched bet, she also exercises more efficiently, and vice versa. Note that other commonly used incentive schemes do not perfectly align individual and social welfare. For example, offering subsidies to time-consistent agents increases individual but decreases social welfare. In contrast, offering commitment contracts to partially naive agents might increase social but decrease individual welfare.

Proposition 3 (Welfare)

(i) If f_i is weakly decreasing over $\mathbb{R}_{\geq 0}$ for all i, the matched-bet mechanism weakly increases all agents' exercising efficiency and expected utility.

(ii) The matched-bet mechanism strictly increases the exercising efficiency and expected utility of agents for whom $0 < m \leq (1 - \beta_i)\delta_i b_i$.

The first part of the proposition provides a sufficient condition for when the matched bet leads to a Pareto improvement in terms of welfare. As sophisticated agents have correct beliefs about their exercising decisions, they only participate if the matched bet increases their exercising efficiency. In contrast, (partially) naive agents might potentially be willing to participate in a matched bet with a too high bet stake that causes them to overexercise to such an extent that the matched bet decreases their exercising efficiency.

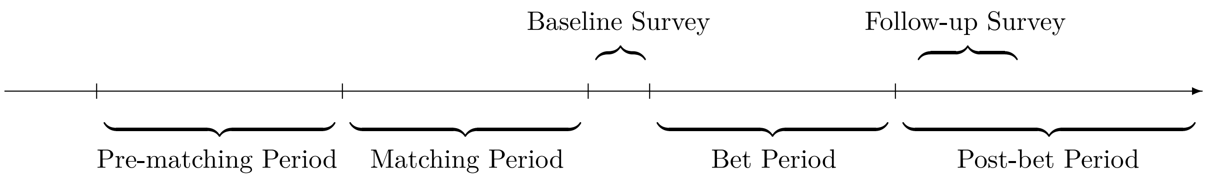
A weakly decreasing cost density function, however, implies that an agent's willingness to participate in a matched bet decreases in her degree of naiveté. The condition thus ensures that only agents who increase their exercising efficiency participate in a matched bet. As the matched bet perfectly aligns individual and social welfare, every bet participant is then weakly better off in expectation; no agent is harmed by being offered a matched bet. The second part of the proposition shows that a bet stake that is at most equal to an agent's optimal, i.e. efficiency-inducing, bet stake strictly increases the agent's exercising efficiency and welfare (irrespective of the shape of the cost density function). Every agent accepts such a bet stake and increases her exercising efficiency with it.

3 Experimental Design

3.1 Research Design

The experiment was conducted in collaboration with the university sports center (USC) of the University of Amsterdam. It compares gym attendance during and after a four-week intervention period (henceforth referred to as bet period) between a control group and a treatment group in which subjects are offered to participate in a matched bet. Bet participants are grouped according to their gym attendance during the four-week matching period. Figure 2 depicts the timeline of the experiment.

Figure 2: Timeline of Experiment



Notes: Bet participants were reminded of the start and the bet rules via e-mail on the first day of the bet period (20 November 2017). One day after the last day of the bet period they were reminded of the end.

The study combines data from two sources. It uses administrative data from the USC and survey data from the baseline and follow-up surveys. The administrative data contains information about each member's subscription and sports center attendance record. Members' visits are registered via finger scanners at the entry gates of all five USC gym locations. The attendance data thus provides precise and highly reliable information about where and when a member entered a USC gym. The second source of data stems from the baseline and follow-up surveys.

3.2 Baseline and Follow-up Survey

Eligible gym members were contacted via e-mail by the university sports center. They were asked to click on a link which forwarded them to the online baseline survey that they could complete within six days. A reminder e-mail was sent on the fourth day. The median person took about five minutes to complete the baseline survey. Completion of the baseline survey was incentivized by a one-month extension of the fitness membership. Appendix F gives the survey questions.

In the first part of the baseline survey, subjects self-report the extent to which they agree with a set of statements. Responses are given on a 7-point Likert-scale from 'strongly disagree' to 'strongly agree'. Statements addressed a subject's fitness level, motivation to exercise, satisfaction with exercising frequency, past and expected future procrastination of exercising sessions, willingness to take risks, competitiveness, healthy lifestyle and overall life happiness. Subjects were also asked about past and expected future exercising behavior. Questions asked about their average exercising duration at the USC and their exercising frequency outside the USC during the four-week matching period prior to the survey. Subjects also had to report on their exercising frequency goals and expectations about exercising at the USC in the coming four weeks. In addition, subjects answered demographic questions about gender, age, height, weight and weight goal.

Subsequently, subjects were randomized into two groups, control and treatment. Only subjects in the treatment group continued with the second part of the baseline survey, which introduced subjects to the matched bet and then offered them to participate in it. Participants were then asked about their exercising frequency expectations given their bet participation and the (possibly negative) monetary net payoff they expect from the bet.

Three days after the end of the bet period bet participants received another e-mail with a link to a one-page online follow-up survey that they could complete within 12 days.[17] The follow-up survey was a shorter, non-incentivized version of the first part

[17] Subjects who did not participate in the matched bet also received a link to a follow-up survey. As their response rate was only 21%, I do not use these data.

of the baseline survey except that bet participants were additionally asked how likely it is that they would take up a matched bet again. Directly after the one-page follow-up survey, bet participants were informed about their bet results and payment details.

3.3 Matched Bet Treatment

In the treatment group, subjects are *offered* to participate in a matched bet. Bet participants earn €5 from their grouped partners for each day they visit the university sports center (up to the 8th time) within the four-week bet period. In exchange, bet participants have to pay the average earnings of their grouped partners.

Bet participants were paid a constant reward of €5 for each visit up to a cap of 8 visits. The matched bet thus implements a stepwise incentive structure. This is in contrast with most other related papers where participants are either fully paid or not at all. The advantage of rewarding each visit is that participants continue to have marginal monetary incentives to exercise even if it has become unfeasible for them to reach the cap. The cap itself yields bet participants more control over their bet outcome. Participants can ensure to at least break-even by visiting the gym 8 times or more during the bet period. About two thirds of the subjects reported a goal of 8 or more gym visits. I chose a comparatively low reward of €5 per gym visit because Proposition 3.ii suggests that a welfare-maximizing policy maker should lean to a conservative bet stake.

Bet participants were anonymously grouped with participants who visited the sports center equally often in the four-week matching period. I chose this matching criterion because it predicts future attendance well while being easy to understand. In fact, past gym attendance is a better predictor of future gym attendance than subjects' own expectation about their future gym attendance.[18] More elaborate matching procedures might predict future attendance even better and thus make the matching more precise. However, the performance of a matched bet is robust to imperfect matching as shown in Appendix B.2. Also, for the matched-bet mechanism to work in practice, it is not important whether participants are actually grouped fairly; it matters more whether they perceive it as such. To increase participation rates, bet participants were grouped with all rather than a subset of their viable bet partners. Risk- and loss-averse people would prefer to be grouped with

[18]For subjects in the control group, regressing gym attendance during the bet period on gym attendance during the matching period yields $R^2 = 0.139$, while a corresponding regression on subjects' expected gym visits during the bet period only gives $R^2 = 0.104$.

more bet partners because the variance of the average earnings of one's grouped partners decreases in the number of partners.

Bet participants were told that their workout needed to last at least 30 minutes to have it count for the bet. This is only partly verifiable as members only need to scan their fingers at the entry gates but not at the exit gates of the university sports center; for safety reasons, it was not possible to require members to scan their fingers to exit the sports areas. Aside from duration issues, a member might also spend time in the sports area without exercising at all. The gym staff was told to look out for 'suspicious' behavior, e.g. members scanning their fingers and leaving immediately afterwards, or occupying themselves with clearly non-exercising related activities in the sports area. They did not report seeing any such behavior.

To enforce payments of bet participants who lost money, the accounts of participants who did not pay their bet losses on time were put on hold five and a half weeks after the end of the bet period. This prevented them from doing any sports at the university sports center until they had paid their bet losses.[19]

The matched bet was framed as a fitness challenge rather than a bet. The reason is that survey answers of the trial round in which the matched bet was framed as a bet suggested that a non-negligible number of subjects perceived the bet as gambling and rejected it for moral or religious reasons. In contrast, the survey answers of the main experiment suggest that subjects did not relate the matched bet to gambling.

3.4 Sample

I invited 1477 gym members who had a running student fitness membership at the university sports center (USC) during the matching and bet period and who attended the gym on at most four days during the four-week matching period to participate in the experiment. To participate in the study, subjects had to complete the baseline survey. 629 subjects completed the baseline survey out of which 601 subjects were eligible for the analysis (206 subjects in the control group and 395 subjects in the treatment group).[20]

[19]Despite this, 8 out of 40 bet losers did not pay. In total, the payment default equaled €118. This suggests that a stronger enforcement mechanism is needed to prevent payment default. Alternatively, one could request bet participants to pay an amount upfront (as e.g. successfully implemented by Lusher, 2017).

[20]I excluded 28 subjects as they erroneously received incorrect information about their gym attendance during the matching period in the baseline survey.

Subjects were on average 23 years old. There were slightly more women (59%) than men in the sample. Subjects recorded on average 1.8 gym visits at the USC during the four-week matching period. For this period, they self-reported on average 4.9 exercising sessions outside the USC. Subjects aimed to record on average 8.9 gym visits at the USC during the four-week bet period, and expected to actually record 6.7 visits.[21] 62% of the subjects reported to have procrastinated exercising sessions during the matching period and 34% expected to procrastinate exercising sessions during the bet period. Even though 75% of the subjects stated that they were motivated to exercise, only 35% of the subjects were satisfied with their exercising frequency at the university gym.

Table D1 depicts the summary statistics. As one would expect from randomization, subjects in the control and treatment group are not systematically different from each other.[22]

4 Experimental Results

4.1 Main Effects

This section analyzes the main treatment effects. I first graphically show the effect of a matched bet on gym attendance and then provide regression results. In total, 99 out of 395 subjects (25%) that were offered the matched bet chose to participate. Figure 3 depicts the average gym visits per week for different groups over time for the pre-matching period (week -8 to -4), matching period (week -4 to week -1) and bet period (week 1 to week 4). Week 0 is the survey week.

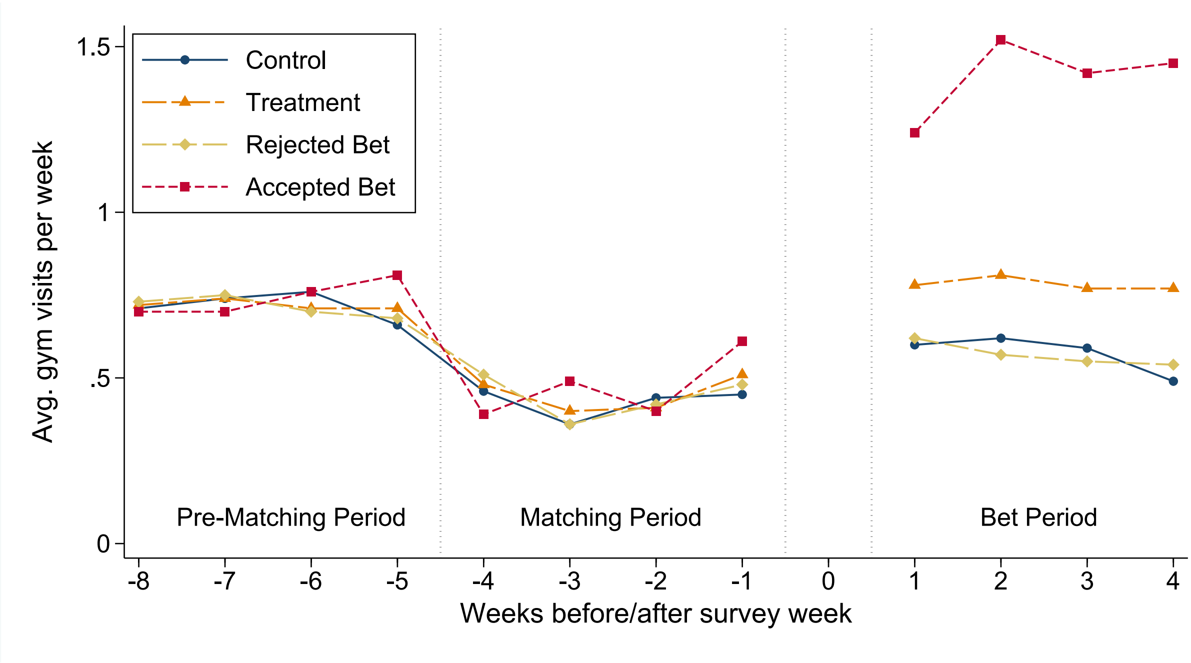
As expected by randomization, average gym attendance of the treatment and control group is very similar during the pre-matching and matching periods.[23] During the bet

[21]Subjects in the control group turned out to record only 2.7 gym visits during the bet period. They thus greatly overestimate their future gym attendance, in line with the literature (Garon et al., 2015). Next to overestimation, there is also evidence for overplacement in the data. Even though bet payoffs sum up to zero by construction, bet participants expected to win on average €7.93. 70% of the bet participants expected to win money, 21% to break-even, and only 9% to lose money with the bet. Interestingly, participants' expected bet payoffs do not significantly predict their actual bet payoffs (regression of bet payoffs on expected bet payoffs, $p = 0.727$).

[22]Only 1 out of 20 variables, gym visits goal during the bet period, is significantly different at the 5%-significance level. As the average gym visits goal is higher for the control group, and as gym visits goal is positively correlated with actual gym visits during the bet period, the treatment effect estimate will, if at all, be downward biased.

[23]Recall that subjects learned about the upcoming matched bet only in the survey week. The lower average gym attendance during the matching period is because I restricted the sample to gym members who visited the gym on at most four days during the matching period, but did not put any restrictions

Figure 3: Average Weekly Gym Visits over Time by Groups



Notes: The figure shows the average weekly gym visits over time by different groups. It shows averages for the control group (continuous blue line) and treatment group (long-short-dashed orange line). Splitting up the treatment group shows average visits over time for subjects who rejected the bet (long-dashed golden line) and who accepted the bet (short-dashed red line). Weeks -8 to -4 constitute the pre-matching period, weeks -4 to -1 constitute the matching period, week 0 constitutes the survey week, and weeks 1 to 4 constitute the bet period.

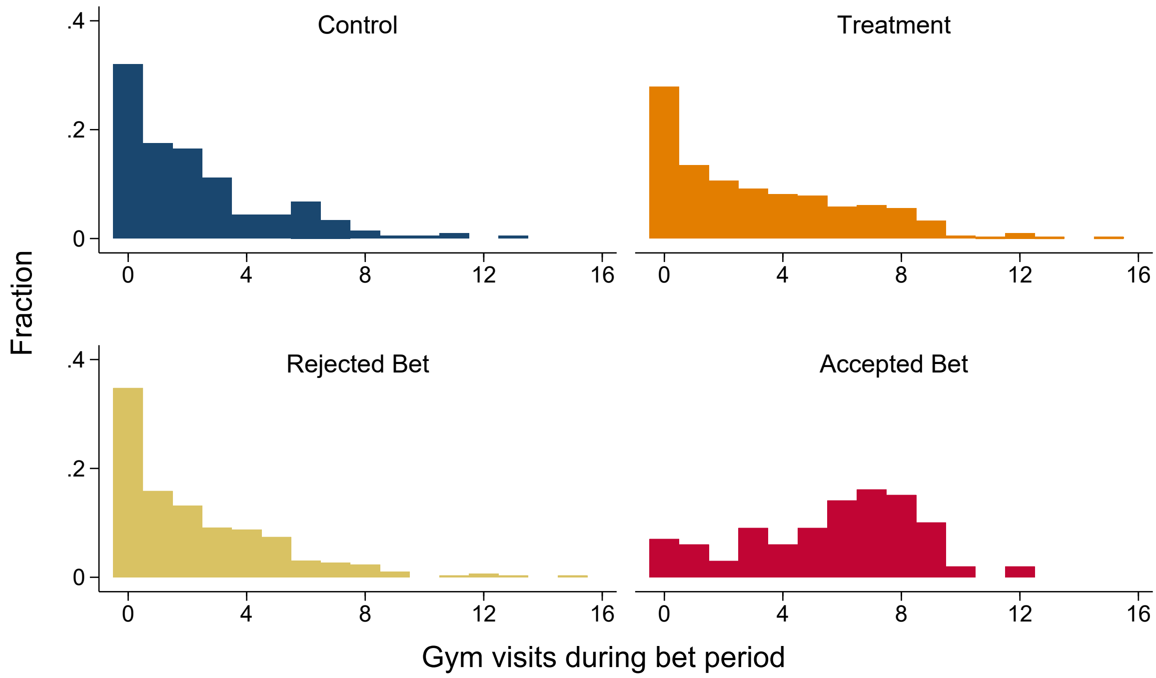
period subjects in the bet treatment visited the gym more often than subjects in the control treatment over all four weeks of the bet period. The difference increases slightly over time from 0.18 weekly visits in the first week to 0.28 in the last week of the bet period. Splitting up subjects in the treatment group into bet participants and bet rejecters, we observe that both groups visit the gym similarly often during the pre-matching and matching periods. During the bet period bet participants continuously visit the gym much more often than bet rejecters, whose weekly average gym attendance is similar to that of the control group.

Figure 4 shows the distributions of gym visits for various groups during the bet period. The top row depicts the distributions for the control and treatment group (offered bet). The bottom row splits up the treatment group and shows the distributions for subjects who rejected and who accepted the matched bet.

We observe a similar gym attendance distribution of the control and treatment group. Both empirical distributions are shaped like an exponential distribution with zero-atten-

on gym attendance before and after the matching period.

Figure 4: Distributions of Gym Visits during Bet Period by Groups



Notes: The figure presents the distributions of gym visits during the bet period by different groups. It shows the distribution for the control group (top left) and treatment group (top right). Splitting up the treatment group shows the distributions for subjects who rejected the bet (bottom left) and who accepted the bet (bottom right).

dance subjects being overrepresented. The distribution of the treatment group first-order dominates the one of the control group and a Kolmogorov-Smirnov test shows that the two distributions are not equal ($p = 0.002$). The frequency distribution of bet participants looks distinctly different from the distributions of the control group and bet rejecters. The distribution has a mode of 7 visits. Even though the matched bet monetarily incentivized gym visits up to the 8th visit, about 14% of the bet participants registered more than 8 gym visits during the bet period.

Table 1 shows results of regressing the number of gym visits on the treatment variable. Columns 1 and 2 show results without and with controls. Offering a matched bet increases gym attendance by 0.87 visits during the bet period (column 1).[24] The effect is highly significant ($p < 0.001$). With an average gym attendance of 2.26 of the control group, this translates into a 38% increase in gym attendance. The treatment effect equals 0.34

[24]To test the effect of the matched bet, one needs to compare all participants who were offered the bet to the control group. A simple comparison between bet participants and non-participants would be biased due to self-selection.

standard deviations. The effect size is robust to including control variables; here the treatment effect is estimated at 0.92 extra gym visits (column 2).[25]

Table 1: Treatment Effect of Offering Bet

	Gym visits in BP		1+ gym visits in BP (0/1)	
	(1)	(2)	(3)	(4)
Mean of control group	2.257	2.257	0.680	0.680
Treated (0/1)	0.867***	0.924***	0.042	0.039
	(0.235)	(0.206)	(0.040)	(0.035)
Controls		✓		✓
Observations	601	601	601	601
(Pseudo-) R^2	0.020	0.276	0.002	0.220

Notes: The table shows OLS estimates in (1) and (2) and marginal effects of probit regressions in (3) and (4). The dependent variable in (1) and (2) is the number of gym visits during the (four-week) bet period. The dependent variable in (3) and (4) indicates whether a subject recorded at least one gym visit during the bet period. The treatment variable indicates whether a subject was offered to participate in the matched bet. The control variables are age, gender, BMI, subscription length, the numbers of gym visits during the (four-week) matching and pre-matching periods, and the self-reported expected number of gym visits during the bet period. Robust standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Column 3 in Table 1 shows the treatment effect on recording at least one gym visit during the bet period. Offering the matched bet does not significantly increase the proportion of subjects that record at least one gym visit during the bet period ($p = 0.290$). This finding is robust to including some control variables (column 4). The matched bet thus shows no significant effect at the extensive margin. This finding is in contrast to Royer et al. (2015) and Carrera et al. (2020) who find significant effects at the extensive margin of existing gym members when a subsidy is used to incentivize exercising. One explanation for these different findings could be that a subsidy 'forces' monetary incentives on unmotivated subjects who would reject imposing monetary incentives on themselves through a bet.

The analysis so far has focused on the effect of *offering* the matched bet on gym attendance, which is crucially influenced by the take-up rate. The remainder of this subsection presents the effect of *taking up* the matched bet, which corrects for the take-up

[25]The treatment effect is about double the size for self-reported procrastinators compared to non-procrastinators, suggesting that the matched bet predominantly changed behavior of the 'right' individuals. This and other heterogeneous treatment effects are discussed in more detail in Appendix C.

rate and thus directly estimates the behavioral change due to the monetary incentives. This analysis relies on the assumption that offering the bet has no direct effect on gym attendance except to cause some subjects to actually take up the bet, a condition typically referred to as the exclusion restriction. If the exclusion restriction holds, one can use the random treatment assignment as an instrument for bet take-up to estimate the treatment effects on the treated, depicted in Table D2.

Taking up a matched bet increases gym attendance by 3.46 visits during the bet period. The effect is highly significant ($p < 0.001$) and robust to including some control variables. With an average gym attendance of 2.26 of the control group, this translates into an increase in gym attendance by 153% resp. 1.36 standard deviations.[26] This gives the following result, which confirms Proposition 1.

Result 1 *Participating in a matched bet increases gym attendance.*

The magnitude of the increase in weekly gym attendance (0.87) due to taking up the bet is in line with the literature: Charness and Gneezy (2009) and Acland and Levy (2015) find larger effects of about 1.5 extra weekly visits during their intervention period with higher monetary incentives, while Rohde and Verbeke (2017) and Carrera et al. (2018) find lower effects of about 0.2 extra weekly visits with lower monetary incentives than provided with the matched bet in this experiment.

The experiment was not designed to focus on the long-run effects of offering a matched bet as matched bet rounds could be offered repeatedly due to its strict budget balancedness property. Despite this, the data allows to estimate post-intervention effects for up to 20 weeks after the end of the bet period as depicted in Figure D1. Over the course of the 20-week post-bet period, subjects in the treatment group recorded 1.11 (10% resp. 0.10 standard deviations) more gym visits than subjects in the control group (12.10 vs. 10.99). The difference is not significant (regression of gym visits during 20-week post-bet period on treatment, $p = 0.269$).[27] Per week, the point estimate for the post-bet period is about

[26] This increase does not seem to come at the cost of shorter gym sessions or fewer exercising sessions outside the USC gym. Bet participants reported an almost identical (Wilcoxon signed-rank test, $p = 0.976$) average duration of their gym visits before (62.8 minutes) and during the bet period (63.0 minutes). They also reported a similar ($p = 0.209$) number of exercising sessions outside the USC before (3.2 sessions) and during the bet period (2.9 sessions).

[27] Subjects in the treatment group continued to visit the gym significantly more often than subjects in the control group in the first week after the end of the bet period ($p = 0.024$). From the second week onward, the weekly treatment effects – though mostly positive – are statistically insignificant. This could

one fourth of the treatment effect estimated for the bet period. This ratio is similar in magnitude compared to the average ratios found in related papers (cf. Charness and Gneezy, 2009; Royer et al., 2015; Acland and Levy, 2015 & März, 2019).

4.2 Bet Participation

Theory predicts that the matched bet features favorable self-selection as agents' willingness to participate in a matched bet increases in their degree of present bias (Propostion 2). In order to test whether the matched bet features favorable self-selection not only in theory but also in practice, this section investigates whether present-biased subjects were indeed more likely to participate in the matched bet. As I cannot directly observe a subject's present bias, I use self-reported past procrastination of exercising sessions as proxy. Similarly, I proxy a subject's perceived present bias by her expected future procrastination.

Recall that 99 out of 395 subjects (25%) that were offered the matched bet chose to participate. Columns 5 to 7 of Table D1 compare characteristics of bet rejecters and bet participants. In line with the theoretical prediction, we observe that procrastination of exercising sessions during the matching period is significantly positively correlated with bet take-up ($p = 0.012$).[28] This non-parametric result is supported by regression analysis. Table 2 shows marginal effects of probit regressions of bet participation on standardized past and expected future procrastination of exercising sessions.

Self-reported past procrastination significantly increases bet take-up by about 6 percentage points per one standard deviation increase. This result is robust to including past gym attendance data and demographic variables, as well as risk and competition preferences.[29] The effect is sizable; ceteris paribus, a subject at the upper end is more than 2.5 times as likely to participate in the matched bet as a subject at the lower end of

be partly explained by the two-week Christmas break starting one week after the end of the bet period, during which gym attendance is overall low. The quasi-exogenous negative attendance shock might have broken some of the just newly formed exercising habit. This finding is in line with the literature (Acland and Levy, 2015).

[28] Also, age and expected gym visits during the bet period are significantly positively correlated with bet take-up, while exercising sessions outside the university gym during the matching period is significantly negatively correlated. There is no significant gender difference in the bet take-up rate.

[29] Table 2 treats the 7-point Likert-scale measures of past and expected future procrastination as well as risk and competitive preferences as continuous variables. Table D3 depicts that the effect of past procrastination on bet participation is also robust to using an alternative specification that binarizes the Likert-scale variables.

Table 2: Effect of Time Preferences on Bet Participation

	(1)	(2)	(3)	(4)
Mean take-up rate	0.251	0.251	0.251	0.251
Procrastination in MP (std.)	0.057**	0.061**	0.065**	0.063**
	(0.026)	(0.027)	(0.028)	(0.028)
Expected procrastination in BP (std.)	0.001	0.005	−0.000	0.004
	(0.026)	(0.026)	(0.026)	(0.026)
Past gym attendance		✓	✓	✓
Demographics			✓	✓
Risk & Competition Preferences				✓
Observations	395	395	395	395
Pseudo-R^2	0.015	0.029	0.048	0.057

Notes: The table shows marginal effects of probit regressions. The dependent variable indicates whether a subject participated in the matched bet. MP = matching period, BP = bet period. Past gym attendance includes gym attendance in the pre-matching period and categorical gym attendance in the matching period. Demographics include gender, age, BMI and subscription duration. Robust standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$ * $p < 0.1$

the procrastination scale. The data thus provides evidence for favorable self-selection.

Result 2 *Present bias positively affects the likelihood to take up a matched bet.*

In contrast to past procrastination, expected future procrastination has no effect on bet participation. This finding suggests that, ceteris paribus, sophisticated and naive procrastinators are about equally likely to take-up the matched bet. Note that theory predicts this outcome for uniform cost distribution functions.

4.3 Welfare

The results so far have shown that the matched bet increases participants' gym attendance and that the 'right' people tend to select into the bet. From these positive findings alone, however, it is not yet evident that the matched bet also increased average welfare. It could potentially be the case that the extra monetary incentive made many bet participants visit the gym too often. This section therefore investigates the consequences of offering a matched bet on average welfare.[30]

[30]It is noteworthy that if individuals have quasilinear preferences with respect to money, *average* individual welfare coincides with *average* social welfare, irrespective of the accuracy of matching. The

While one cannot directly observe welfare, Proposition 3 provides two sufficient testable conditions for when the matched bet is predicted to unambiguously improve welfare. The first condition is weakly decreasing cost density functions. In this case, theory predicts that only people who are better off and exercise more efficiently with the bet participate in it. Recall the earlier finding that sophistication about one's present bias does not affect the likelihood of bet participation, pointing towards an on average flat cost density function resp. a homogeneous uniform cost distribution function. Next to this indirect test, my data allows to also directly test the condition under the assumptions that the cost distribution functions are homogeneous and the extra incentive provided by the bet is uncorrelated to participants' expected baseline exercising frequencies.[31] If so, then weakly decreasing cost density functions imply that the effect of taking up a matched bet is weakly decreasing in a subject's expected baseline frequency.

I test this implication in the following way. I first predict each subject's baseline frequency by using the estimates of a regression – using only the control group – of gym visits during the bet period on gym visits during the matching and pre-matching period as well as subjects' own expected gym visits during the bet period. I then estimate the effect of taking up the matched bet depending on a subject's predicted baseline frequency with an instrumental variable approach. I find that the estimated treatment effect on the treated depends negatively, albeit insignificantly so, on the baseline frequency (see Table D4), suggesting that the cost density functions are indeed weakly decreasing in the relevant areas. It implies that offering the matched bet likely did not harm (partially) naive subjects, and thus increased average welfare.

The second sufficient condition relates to the size of the bet stake. Irrespective of the shape of the cost density function, the matched bet is predicted to unambiguously improve welfare for all subjects for whom the bet stake is at most equal to their optimal, i.e. efficiency-inducing, bet stake. Under the assumptions that bet subjects have correct

reason is that an individual's welfare is simply social welfare plus her bet transfer. As bet payoffs sum up to exactly zero by construction, the effect of bet transfers on individuals' welfare cancels out in the aggregate.

[31] The latter assumption deserves a short discussion. Recall that all bet participants, irrespective of their expected baseline frequencies, are rewarded with €5 for each gym visit (up to the cutoff of eight visits). As a subject's likelihood to reach the cutoff supposedly increases in her expected baseline frequency, there could potentially exist a non-negligible negative correlation between the average extra incentive provided by the bet and subjects' expected baseline frequencies, questioning the assumption's validity. The data, however, suggests that this issue is arguably of limited size as only 4% of bet participants' visits were visits above the cutoff.

beliefs about their exercising benefits and their cost distribution functions, we can use their self-reported exercising frequency goal for gym attendance during the bet period – elicited before the bet was introduced – as a proxy for subjects' efficient exercising frequencies.

Doing so, we find that bet participants visited the gym less often than they initially aimed for. Bet participants recorded on average 5.64 visits during the bet period. However, prior to learning about the matched bet, they aimed to visit the gym on 9.11 days. Only 18% of bet participants recorded more visits than they initially aimed for. Overall, it thus seems that the matched bet did not induce bet participants to overexercise, but instead helped them decrease the extent of underexercising, and thereby increased average welfare. This conclusion is further supported by survey results as bet participants reported to be significantly more satisfied with their exercising frequency at the USC and procrastinated exercising sessions less during the bet period than before (see Table D5).[32]

Result 3 *The matched bet increases average welfare.*

5 Conclusion

This paper introduces, theoretically analyzes, and experimentally tests the matched-bet mechanism. The matched bet is an easily applicable, strictly budget-balanced and strategically straightforward mechanism that aims to help people overcome time-inconsistent behavior.

In a theoretical model inspired by DellaVigna and Malmendier (2004), I first show that the matched bet uniquely satisfies a set of five desirable properties: *Voluntary participation*, *Ex-post strict budget balancedness*, *Neutrality*, *Symmetry* and *Fixed incentives*. I then show that the matched-bet mechanism helps both sophisticated and (partially) naive procrastinators to reduce time-inconsistent behavior without distorting the behavior of time-consistent agents. Finally, I provide testable sufficient conditions for when the matched bet is unambiguously welfare-improving.

In a field experiment at a university gym, I show that the matched bet also proves a promising device in practice. Subjects who were offered to participate in the matched bet

[32] There was no effect on participants' self-reported fitness, lifestyle and overall happiness. Given the short span of the intervention, these null results might not be surprising; other papers with a longer time horizon have found positive effects on fitness and lifestyle (see e.g. Charness and Gneezy, 2009).

recorded on average 38% more gym visits (an increase of 0.34 standard deviations) during the bet period than subjects in the control group. Self-reported procrastinators were significantly more likely to take up the matched bet, confirming favorable self-selection into the bet. Further analysis suggests that the matched bet increased participants' individual and social welfare. Overall, the matched-bet mechanism is a promising mechanism to help people overcome time-inconsistent behavior, both in theory and in practice. The matched bet is both low-cost and effective, unlike existing incentive schemes such as subsidies and commitment contracts.

Future research could investigate whether the matched-bet mechanism can induce persistent behavioral change through repeated bet rounds. As the matched bet is strictly budget-balanced, offering repeated bet rounds does not run into financing issues. There also seems to be a demand for repeated bet rounds as the great majority of bet participants in the experiment indicated that they would likely take up a matched bet again.[33] Offering the matched bet on a regular basis, however, introduces an obstacle, the so called *ratchet effect*. Once potential participants know about an upcoming bet round, they might be inclined to 'trick' the matching system by deliberately exercising rarely during the matching period. In this way they could ensure to be grouped with partners with a lower likelihood to exercise, thereby increasing their expected bet payoff. To mitigate such behavior, the deliberately foregone exercising benefit during the matching period needs to outweigh the expected monetary gain due to an easier matching group, which could be accomplished by a low bet stake or a comparatively long matching period.

The matched bet could also be applied in areas other than exercising in which monetary incentives haven proven to effectively change people's behavior. Compared to alternative incentive schemes, the matched bet is promising if a large proportion of the targeted population is present-biased and accurate matching is possible. If individual's inefficient behavior is not predominantly caused by time-inconsistency but is instead due to positive externalities not taken into account by the individuals, subsidies or subsidized bets ought to work better than matched bets. In the context of externalities, participation rates in the matched bet are expected to be low as only overconfident people might be willing to take up a matched bet. The second criterion, accurate matching, is supposed to be

[33] According to the responses in the follow-up survey, at least 73% of bet participants would likely take up a matched bet again. Not surprisingly, interest in future bet rounds is highly and positively correlated with a bet participant's increase in gym attendance during the bet period (Pearson corr. = 0.42).

crucial for favorable self-selection. It is likely met if the policy maker knows individuals' past record and past record is predictive of future record. Given the two requirements, academic performance (matching on past grades), weight loss (matching on BMI) and smoking cessation (matching on cotinine levels) are promising new areas of application.

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Online Appendix

A Proofs

Proof of Theorem 1 (Matched-Bet Mechanism)

I first show that the matched-bet mechanism satisfies the five properties.

- *Voluntary participation*: $T_i = \left(\mathcal{I}_i m - \frac{1}{|S_i|}\sum_{j\in S_i}\mathcal{I}_j m\right)\mathcal{P}_i = 0 \;\forall\; i : \mathcal{P}_i = 0$.

- *Ex-post strict budget balancedness*: The matched bet is ex-post strictly budget-balanced as $\sum_i T_i = \sum_i \mathcal{P}_i \mathcal{I}_i m - \sum_i \mathcal{P}_i \frac{1}{|S_i|}\sum_{j\in S_i}\mathcal{I}_j m = \sum_i \mathcal{P}_i \mathcal{I}_i m - \sum_j \mathcal{P}_j \mathcal{I}_j m = 0$.

- *Neutrality*: The expected transfer to any arbitrary bet participant i equals $\mathbb{E}[T_i] = \mathbb{E}[\mathcal{I}_i]m - \frac{1}{|S_i|}\sum_{j\in S_i}\mathbb{E}[\mathcal{I}_j]m = 0$ as $S_i \equiv \{j \neq i | \mathcal{P}_j = 1, \mathbb{E}[\mathcal{I}_j] = \mathbb{E}[\mathcal{I}_i]\}$.

- *Symmetry*: $S_i \equiv \{j \neq i | \mathcal{P}_j = 1, \mathbb{E}[\mathcal{I}_j] = \mathbb{E}[\mathcal{I}_i]\}$ implies that $|S_i| = |S_j|$ if $\mathcal{P}_j = \mathcal{P}_j = 1, \mathbb{E}[\mathcal{I}_j] = \mathbb{E}[\mathcal{I}_i]$. As $T_i = \mathcal{I}_i m - \frac{1}{|S_i|}\sum_{j\in S_i}\mathcal{I}_j m = \mathcal{I}_i m - \frac{1}{|S_i|}\sum_{k\neq j\in S_i}\mathcal{I}_k m - \frac{1}{|S_i|}\mathcal{I}_j m$ and $T_j = \mathcal{I}_j m - \frac{1}{|S_j|}\sum_{i\in S_j}\mathcal{I}_i m = \mathcal{I}_j m - \frac{1}{|S_j|}\sum_{k\neq i\in S_j}\mathcal{I}_k m - \frac{1}{|S_j|}\mathcal{I}_i m$, it follows that $T_i = T_j \;\forall\; i, j : \mathcal{P}_i = \mathcal{P}_j = 1, \mathbb{E}[\mathcal{I}_i] = \mathbb{E}[\mathcal{I}_j], \mathcal{I}_i = \mathcal{I}_j$.

- *Fixed incentives*: $T_i(\mathcal{I}_i = 1) - T_i(\mathcal{I}_i = 0) = (m - \frac{1}{|S_i|}\sum_{j\in S_i}\mathcal{I}_j m) - (-\frac{1}{|S_i|}\sum_{j\in S_i}\mathcal{I}_j m) = m \perp\!\!\!\perp \boldsymbol{\mathcal{I}_{-i}} \;\forall\; i : \mathcal{P}_i = 1$.

I now show that the five properties identify the matched-bet mechanism. We can describe any arbitrary incentive scheme by its monetary transfer $T_i(\mathcal{I}_i, \boldsymbol{\mathcal{I}_{-i}}, x_i)$ to participant i where $\boldsymbol{\mathcal{I}_{-i}}$ denotes the vector of exercising decisions of all agents except i and x_i the part of T_i that is independent of $\mathcal{I}_i$ and $\boldsymbol{\mathcal{I}_{-i}}$. As the matched bet satisfies *Fixed incentives*, the marginal effect of exercising on an agent's transfer equals a constant, which can be denoted by m without loss of generality, and is independent of other agents' behavior. Therefore, the transfer function must be of the following form: $T_i = \mathcal{I}_i m - h_i(\boldsymbol{\mathcal{I}_{-i}}, x_i)$ with function h_i that does not depend on $\mathcal{I}_i$. Now, *Ex-post strict budget balancedness* and *Neutrality* together imply that $\mathbb{E}[T_i] = 0 \;\forall\; i : \mathcal{P}_i = 1$. Therefore, $\mathbb{E}[\mathcal{I}_i m] = \mathbb{E}[h_i(\boldsymbol{\mathcal{I}_{-i}}, x_i)] \;\forall\; i : \mathcal{P}_i = 1$. As, by assumption, agents' likelihoods to exercise are not commonly known except for their relative ranking, agent j's exercising behavior may only influence T_i if $\mathbb{E}[\mathcal{I}_j] = \mathbb{E}[\mathcal{I}_i]$. Further, it must hold that $\mathbb{E}[x_i] = 0 \;\forall\; i : \mathcal{P}_i = 1$. It follows that

$T_i = \mathcal{I}_i m - \sum_{j \in S'_i} \alpha_j \mathcal{I}_j m + x_i \; \forall \; i : \mathcal{P}_i = 1$ with $\sum_{j \in S'_i} \alpha_j = 1$ and $S'_i \subseteq S_i$. Due to *Symmetry*, it follows that $x_i = x_j, \sum_{j \in S'_i} \alpha_j \mathcal{I}_j m = \sum_{i \in S'_j} \alpha_i \mathcal{I}_i m \; \forall \; i, j : \mathcal{P}_i = \mathcal{P}_j = 1, \mathbb{E}[\mathcal{I}_i] = \mathbb{E}[\mathcal{I}_j], \mathcal{I}_i = \mathcal{I}_j$. Therefore, for all bet participants it must be the case that $x_i = 0$, $S'_i = S_i$, $\alpha_j = \frac{1}{|S_i|} \, \forall \, j \in S_i$. Taken together, transfer to bet participant i thus equals $T_i = \mathcal{I}_i m - \frac{1}{|S_i|} \sum_{j \in S_i} \mathcal{I}_j m$. Due to *Voluntary participation*, non-participants always obtain a transfer of zero. The transfer to agent i thus equals $T_i = \left(\mathcal{I}_i m - \frac{1}{|S_i|} \sum_{j \in S_i} \mathcal{I}_j m\right) \mathcal{P}_i$.

Lastly, I show that dropping one of the five properties makes it impossible to uniquely characterize the matched-bet mechanism. A matched bet with forced participation satisfies all properties except *Voluntary Participation*. A subsidized bet with $T_i = \mathcal{I}_i m - \frac{1}{|S_i|} \sum_{j \in S_i} \mathcal{I}_j m + x$ where $x > 0$ satisfies all properties except *Ex-post strict budget balancedness*. An unmatched bet with $T_i = \mathcal{I}_i m - \frac{1}{|S''_i|} \sum_{j \in S''_i} \mathcal{I}_j m$ where $S''_i \equiv \{j \neq i | \mathcal{P}_j = 1\}$ satisfies all properties except *Neutrality*. A bet in which bet participants are grouped with a strict subset of participants that are equally likely to exercise, i.e. $T_i = \mathcal{I}_i m - \frac{1}{|S'''_i|} \sum_{j \in S} \mathcal{I}_j m$ where $S'''_i \subset S_i$ and $j \in S'''_i \iff i \in S'''_j$ satisfies all properties except *Symmetry*. A matched bet pool with $T_i = \frac{|S_i|+1}{\mathcal{I}_i + \sum_{j \in S_i} \mathcal{I}_j} \mathcal{I}_i m - m$ satisfies all properties except *Fixed incentives*. □

Proof of Proposition 2 ← Denote the maximal m for which agent i takes up the bet by $\overline{m}_i^P$. Rearranging the participation constraint (PC) yields

$$m \leq \overline{m}_i^P = (1 - \hat{\beta}_i)\delta_i b_i \frac{F_i(\hat{\beta}_i \delta_i b_i + m) - F_i(\hat{\beta}_i \delta_i b_i)}{F_i(\beta_i \delta_i b_i + m)} + \frac{\int_{\hat{\beta}_i \delta_i b_i}^{\hat{\beta}_i \delta_i b_i + m} F_i(c_i) dc_i}{F_i(\beta_i \delta_i b_i + m)}. \tag{3}$$

As $F_i(\beta_i \delta_i b_i + m)$ strictly increases in β_i (as f_i is strictly positive over $\mathbb{R}_{\geq 0}$), both terms strictly decrease in β_i. Therefore, $\overline{m}_i^P$ strictly decreases in β_i. $\frac{\int_{\delta_i b_i}^{\delta_i b_i + m} F_i(c_i) dc_i}{F_i(\delta_i b_i + m)} < m$, thus $\overline{m}_i^P < m$ for $\beta_i = \hat{\beta}_i = 1$. As a consequence, for any $m > 0$, there is a threshold for β_i where $\overline{m}_i^P$ drops below m. Ceteris paribus, agents' willingness to participate in a matched bet thus increases in their degree of present bias. □

Proof of Proposition 3 ←

(i) Agent i's individual welfare in period 0 equals $\delta_i \int_0^{\beta_i \delta_i b_i + m} (\delta_i b_i - c_i) f_i(c_i) dc_i + \mathbb{E}[T_i]$ with and $\delta_i \int_0^{\beta_i \delta_i b_i} (\delta_i b_i - c_i) f_i(c_i) dc_i$ without the bet. $\mathbb{E}[T_i] = 0$ by construction of the matched bet. This implies that individual and social welfare are perfectly aligned; an agent who is weakly better off by taking up the bet also weakly increases her exercising efficiency, and vice versa. An agent is weakly better off by taking up the bet if her welfare with the bet is weakly higher than her welfare without the bet, i.e. $\delta_i \int_{\beta_i\delta_i b_i}^{\beta_i\delta_i b_i+m}(\delta_i b_i - c_i)f_i(c_i)dc_i \geq 0$. Denote the maximal m for which agent i is better off by taking up the bet by $\overline{m}_i^W$. By rearranging, we obtain

$$m \leq \overline{m}_i^W = (1-\beta_i)\delta_i b_i \frac{F_i(\beta_i\delta_i b_i + m) - F_i(\beta_i\delta_i b_i)}{F_i(\beta_i\delta_i b_i + m)} + \frac{\int_{\beta_i\delta_i b_i}^{\beta_i\delta_i b_i+m} F_i(c_i)dc_i}{F_i(\beta_i\delta_i b_i + m)} \tag{4}$$

All agents are weakly better off by being offered a matched bet if agents only take up a bet if the bet makes them better off in expectation, thus if $\overline{m}_i^P \leq \overline{m}_i^W \ \forall\ i$ (cf. Proof of Proposition 2). Note that $\overline{m}_i^P = \overline{m}_i^W$ for sophisticated agents ($\beta_i = \hat{\beta}_i$). If f_i is weakly decreasing over $\mathbb{R}_{\geq 0}$, then

$$\frac{\partial \overline{m}_i^P}{\partial \hat{\beta}_i} = (1-\hat{\beta}_i)\delta_i^2 b_i^2 \frac{f_i(\hat{\beta}_i\delta_i b_i + m) - f_i(\hat{\beta}_i\delta_i b_i)}{F_i(\beta_i\delta_i b_i + m)} \leq 0$$

For $\frac{\partial \overline{m}_i^P}{\partial \hat{\beta}_i} \leq 0$ and $\beta_i \leq \hat{\beta}_i$, $\overline{m}_i^P \leq \overline{m}_i^W$ thus holds for all agents. Therefore, offering a matched bet makes all agents weakly better off (and weakly increases their exercising efficiency) if f_i is weakly decreasing over $\mathbb{R}_{\geq 0}\ \forall\ i$. □

(ii) As $\mathbb{E}[T_i] = 0$, an agent is strictly better off if she participates in the bet and strictly increases her exercising efficiency. By rearranging the participation constraint PC, one obtains that agent i participates in the bet iff

$$(1-\hat{\beta}_i)\delta_i b_i[F_i(\hat{\beta}_i\delta_i b_i + m) - F_i(\hat{\beta}_i\delta_i b_i)] + \int_{\hat{\beta}_i\delta_i b_i}^{\hat{\beta}_i\delta_i b_i+m} F_i(c_i)dc_i - mF_i(\beta_i\delta_i b_i + m) \geq 0.$$

For $m \leq (\hat{\beta}_i - \beta_i)\delta_i b_i$, $F_i(\hat{\beta}_i\delta_i b_i) \geq F_i(\beta_i\delta_i b_i + m)$. Therefore, $\int_{\hat{\beta}_i\delta_i b_i}^{\hat{\beta}_i\delta_i b_i+m} F_i(c_i)dc_i > mF_i(\hat{\beta}_i\delta_i b_i) \geq mF_i(\beta_i\delta_i b_i + m)$, which implies that the participation constraint is always fulfilled.

For $(\hat{\beta}_i - \beta_i)\delta_i b_i < m_i \leq (1-\beta_i)\delta_i b_i$, $F_i(\hat{\beta}_i\delta_i b_i) < F_i(\beta_i\delta_i b_i + m)$. Note that $\int_{\hat{\beta}_i\delta_i b_i}^{\hat{\beta}_i\delta_i b_i+m} F_i(c_i)dc_i > [m - (\hat{\beta}_i - \beta_i)\delta_i b_i]F_i(\hat{\beta}_i\delta_i b_i) + (\hat{\beta}_i - \beta_i)\delta_i b_i F_i(\beta_i\delta_i b_i + m)$ and $F_i(\hat{\beta}_i\delta_i b_i + m) \geq F_i(\beta_i\delta_i b_i + m)$. Substituting gives $(1-\hat{\beta}_i)\delta_i b_i[F_i(\hat{\beta}_i\delta_i b_i + m) - F_i(\hat{\beta}_i\delta_i b_i)] + \int_{\hat{\beta}_i\delta_i b_i}^{\hat{\beta}_i\delta_i b_i+m} F_i(c_i)dc_i - mF_i(\beta_i\delta_i b_i + m) > [(1-\beta_i)\delta_i b_i - m][F_i(\beta_i\delta_i b_i + m) - F_i(\hat{\beta}_i\delta_i b_i)] \geq 0$, so that the participation constraint is again always fulfilled.

By rearranging (4), one obtains that an agent is strictly better off iff

$$(1-\beta_i)\delta_i b_i[F_i(\beta_i\delta_i b_i+m)-F_i(\beta_i\delta_i b_i)]+\int_{\beta_i\delta_i b_i}^{\beta_i\delta_i b_i+m} F_i(c_i)dc_i - mF_i(\beta_i\delta_i b_i+m) > 0.$$

As $\int_{\beta_i\delta_i b_i}^{\beta_i\delta_i b_i+m} F_i(c_i)dc_i > mF_i(\beta_i\delta_i b_i)$, it holds that $(1-\beta_i)\delta_i b_i[F_i(\beta_i\delta_i b_i+m) - F_i(\beta_i\delta_i b_i)]+\int_{\beta_i\delta_i b_i}^{\beta_i\delta_i b_i+m} F_i(c_i)dc_i - mF_i(\beta_i\delta_i b_i+m) > [(1-\beta_i)\delta_i b_i - m][F_i(\beta_i\delta_i b_i+m) - F_i(\beta_i\delta_i b_i)] \geq 0$ for $m \leq (1-\beta_i)\delta_i b_i$. Therefore, every agent for whom $m \leq (1-\beta_i)\delta_i b_i$ participates in the bet and is strictly better off compared to the baseline. □

B Theoretical Extensions

This section discusses three extensions to the theoretical analysis. First, it compares the performance of the matched-bet mechanism to existing incentive schemes. Second, it shows that the matched-bet mechanism is robust to imperfect matching. And third, it investigates the welfare effects of offering multiple bet stakes.

B.1 Relative Performance of the Matched-Bet Mechanism

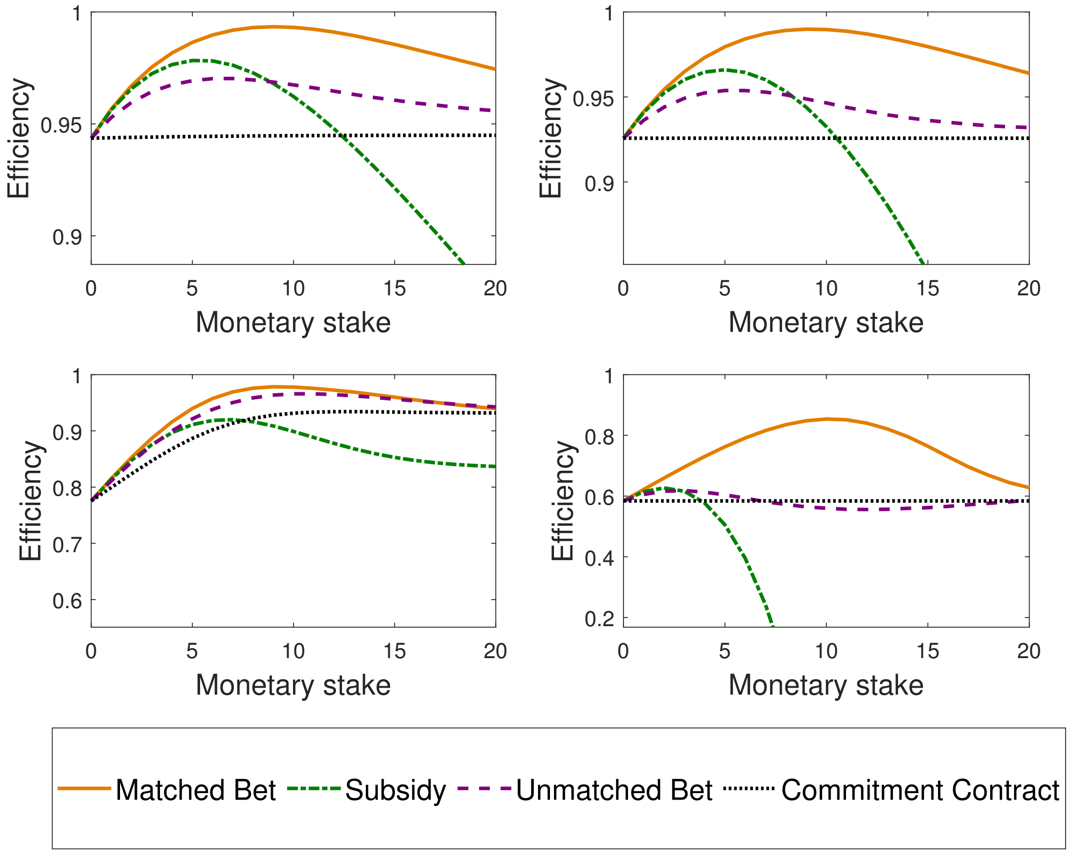
This section shows that the matched-bet mechanism yields higher efficiency than a subsidy, monetary commitment contract and unmatched bet. With a subsidy, a policy maker pays a participant a monetary reward if she reaches a prespecified target. In contrast, with a commitment contract, a participant has to pay a monetary fine to the policy maker if she fails to reach the target. An unmatched bet works similarly to the matched bet. They differ in that an unmatched bet groups bet participants with all other participants, and thus not just participants that are equally likely to reach the target. Formally (cf. (2)), the monetary transfers to agent i in a subsidy, monetary commitment contract and unmatched bet are specified by $T_i^{Su} = (\mathcal{I}_i m - 0)\,\mathcal{P}_i$, $T_i^{Co} = (\mathcal{I}_i m - m)\,\mathcal{P}_i$, and $T_i^{Un} = \left(\mathcal{I}_i m - \frac{1}{|S_i''|}\sum_{j\in S_i''}\mathcal{I}_j m\right)\mathcal{P}_i$ with set $S_i'' \equiv \{j \neq i | \mathcal{P}_j = 1\}$, and $|S_i''|$ denoting the number of agents in S_i''.

Figure B1 compares the efficiency of the matched-bet mechanism to a subsidy, unmatched bet and commitment contract for various monetary stakes. A mechanism's efficiency denotes the social welfare achieved by offering this mechanism divided by the first-best social welfare. For a comprehensive comparison, the figure depicts performance for homogeneous unimodal cost distributions that differ in averages and shapes. Left (right) graphs depict efficiency for distributions with relatively low (high) average costs. Upper (lower) graphs use distributions with a strictly decreasing (non-monotonous) density over $\mathbb{R}_{\geq 0}$. I rely on numerical solutions as results are not analytically tractable.[34]

We observe that the matched-bet mechanism comes close to the first best for a medium-sized monetary stake. In this case, many present-biased agents are willing to participate and the extra incentive brings them close to exercising efficiently. The take-up rate is also high with a low bet stake but a low stake changes participants' behavior only by a small

[34]The calibration of time preferences is based on the empirical literature (see e.g. Augenblick et al., 2015; Augenblick and Rabin, 2019). The results, however, are robust to the chosen parameters.

Figure B1: Efficiency of Mechanisms



Notes: The figure compares efficiency of the matched bet, subsidy, unmatched bet and commitment contract by size of the monetary stake m. Variables are calibrated in the following way: benefits $b_i \sim \text{U}[10, 30]$, short-run discount factor $\beta_i \sim \min\{\text{U}[\frac{1}{3}, \frac{4}{3}], 1\}$, perceived short-run discount factor $\hat{\beta}_i \sim \text{U}[\beta_i, 1]$, long-run discount factor $\delta_i = 1$. Costs are $c_i \sim \text{Exp}(15)$ in the upper left graph, $c_i \sim \text{Exp}(30)$ in the upper right graph, $c_i \sim \text{Gamma}(15, 1)$ in the lower left graph and $c_i \sim \text{Gamma}(15, 2)$ in the lower right graph.

amount. In contrast, a high bet stake leads to a low take-up rate.

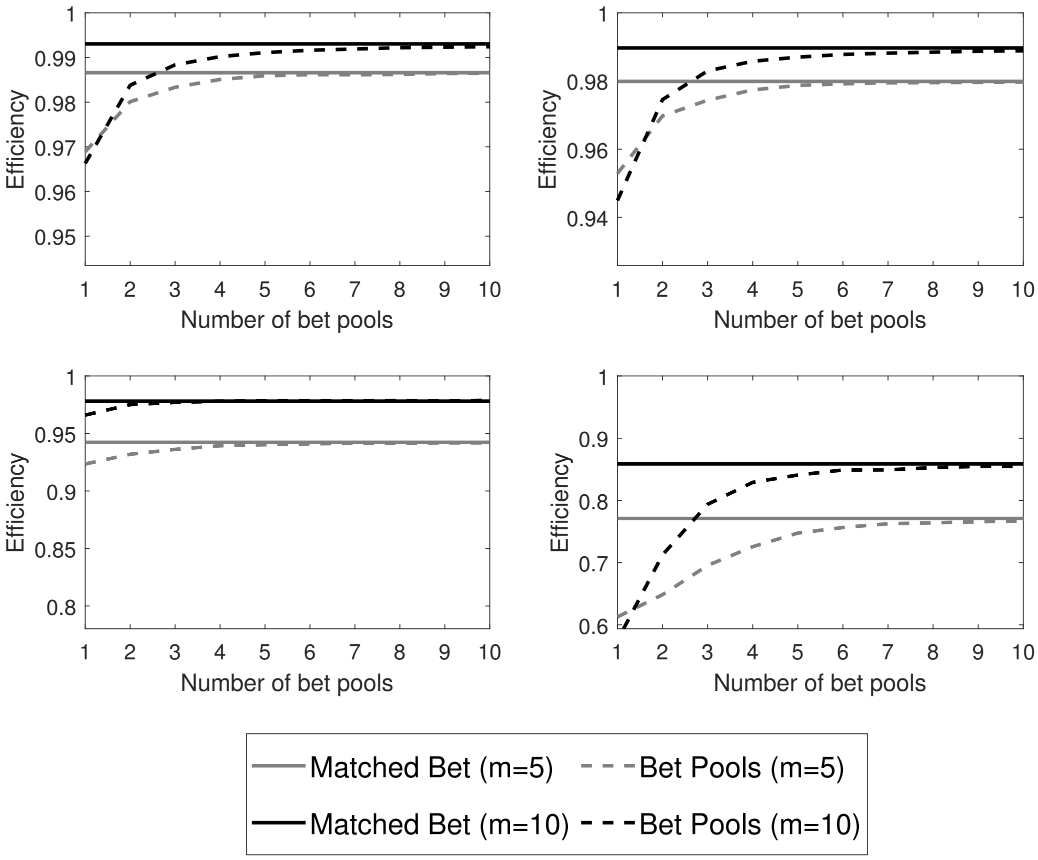
The figure also shows that the matched-bet mechanism fares well in comparison to the other mechanisms. When keeping monetary stakes the same across mechanisms, the matched-bet mechanism yields higher efficiency than a subsidy, unmatched bet and commitment contract over almost all monetary stakes irrespective of the cost distribution. The reason is that only the matched bet features favorable self-selection. With a subsidy, every agent participates. This implies that offering a subsidy to time-consistent agents makes them exercise less efficiently. This issue exacerbates in the size of the monetary stake. For a high stake, a subsidy might then even decrease average efficiency compared to the baseline. While too many agents participate with a subsidy, too few agents participate with a commitment contract, severely limiting its average effect. With an unmatched bet, agents with a high likelihood to exercise benefit from participation at the expense of participants with lower likelihoods. Because of this, often the wrong types participate in an unmatched bet, which results in a lower average efficiency of offering an unmatched compared to a matched bet.

B.2 Robustness to Imperfect Matching

In my theoretical analysis of the matched-bet mechanism, I assume perfect matching, i.e. bet participants are grouped with other participants that have the same likelihood to exercise. In reality, perfect matching is generally not possible. This raises the question how robust the matched-bet mechanism is to imperfect matching. Figure B2 shows efficiency dependent on the number of bet pools using the same calibration as in Section B.1. Given a number of bet pools n, bet participants are grouped with other participants whose ranks in terms of likelihood to exercise in the population of N agents fall in the same interval of $(0, \frac{N}{n}], (\frac{N}{n}, \frac{2N}{n}], ..., (\frac{(n-1)N}{n}, N]$ as their own. Note that an unmatched bet is equivalent to one bet pool, while a matched bet is equivalent to an infinite number of bet pools.

The figure shows that efficiency increases monotonically in the number of bet pools. With one bet pool, i.e. an unmatched bet, efficiency is considerably lower than with a matched bet, as already shown in the previous section. For a moderate number of bet pools, however, efficiency with an imperfectly matched bet already closely approaches efficiency with a matched bet. This finding is irrespective of average costs, the shape of the density function and the size of the bet stake. The figure thus illustrates that the matched bet is robust to imperfect matching.

Figure B2: Robustness of Matched Bet towards Imperfect Matching



Notes: The figure compares efficiency of the matched bet to an imperfectly matched bet with various numbers of bet pools. Variables are calibrated in the following way: benefits $b_i \sim \mathrm{U}[10, 30]$, short-run discount factor $\beta_i \sim \min\{\mathrm{U}[\frac{1}{3}, \frac{4}{3}], 1\}$, perceived short-run discount factor $\hat{\beta}_i \sim \mathrm{U}[\beta_i, 1]$, long-run discount factor $\delta_i = 1$, $m = 5$ (gray) and $m = 10$ (black). Costs are $c_i \sim \mathrm{Exp}(15)$ in the upper left graph, $c_i \sim \mathrm{Exp}(30)$ in the upper right graph, $c_i \sim \mathrm{Gamma}(15, 1)$ in the lower left graph and $c_i \sim \mathrm{Gamma}(15, 2)$ in the lower right graph.

B.3 Multiple Bet Stakes

The main text analyzes a version of the matched-bet mechanism in which agents are offered a single bet stake. Because of this, agents only have to decide whether to participate in the matched bet. In principle, however, it would also be possible to let agents choose their bet stakes themselves. The matched-bet mechanism then requires that bet participants are grouped with all other participants who prefer the same bet stake and have the same likelihood to exercise.

An agent chooses the bet stake m_i^* that she expects to maximize her utility. Formally, an agent's maximization problem becomes

$$\max_{m_i} \beta_i \delta_i \left[\int_0^{\hat{\beta}_i \delta_i b_i + m_i} (\delta_i b_i - c_i) f_i(c_i) dc_i + \int_{\beta_i \delta_i b_i + m_i}^{\hat{\beta}_i \delta_i b_i + m_i} m_i f_i(c_i) dc_i \right].$$

Agents choose a bet stake m_i^*, which can be implicitly defined by

$$m_i^* = (1 - \hat{\beta}_i)\delta_i b_i \frac{f_i(\hat{\beta}_i \delta_i b_i + m_i^*)}{f_i(\beta_i \delta_i b_i + m_i^*)} + \frac{F_i(\hat{\beta}_i \delta_i b_i + m_i^*) - F_i(\beta_i \delta_i b_i + m_i^*)}{f_i(\beta_i \delta_i b_i + m_i^*)}. \quad \text{(B1)}$$ [35]

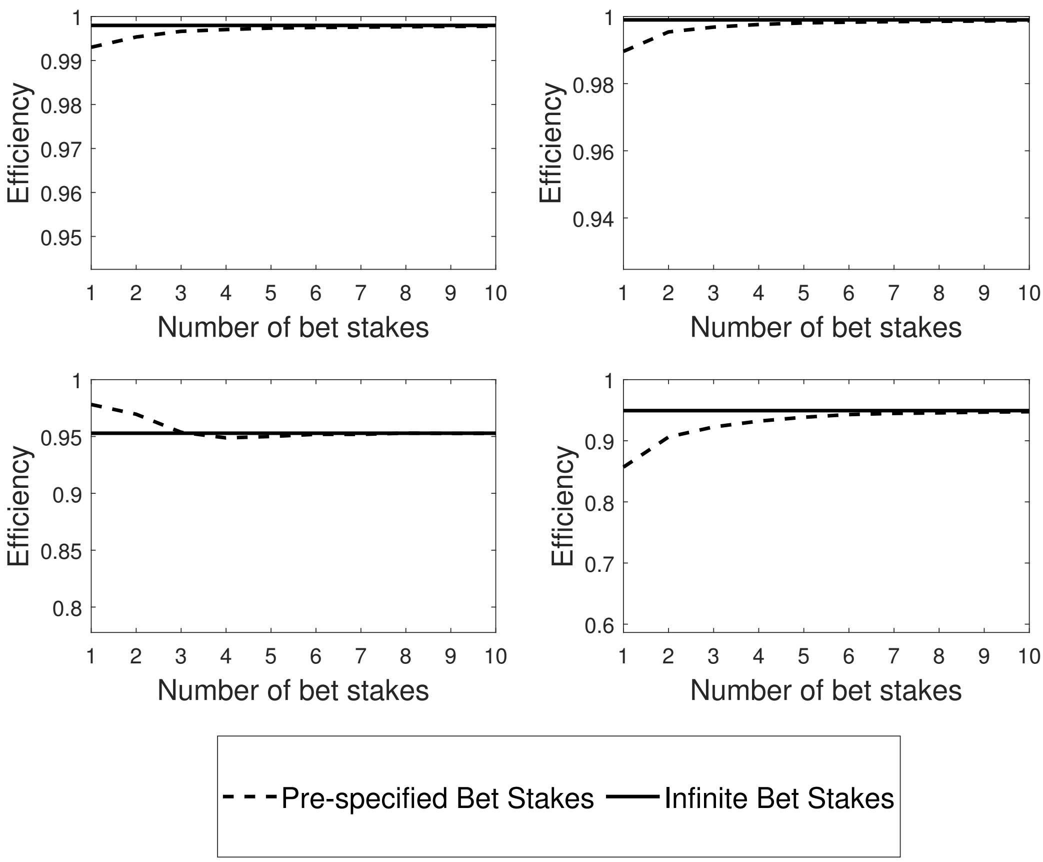
For agents who have correct about beliefs about their own present bias ($\beta_i = \hat{\beta}_i$) the equation above simplifies to $m_i^* = (1 - \beta_i)\delta_i b_i$. For these agents, the chosen bet stake coincides with the optimal, i.e. efficiency-inducing, bet stake; sophisticated procrastinators choose a strictly positive bet stake while time-consistent agents do not take up a matched bet (resp. choose a bet stake of zero). For partially naive procrastinators the chosen bet stake depends on the shape of the cost distribution function. If f_i is weakly decreasing (increasing) over the interval $[\beta_i \delta_i b_i + m_i^*, \hat{\beta}_i \delta_i b_i + m_i^*]$, partially naive procrastinators choose a suboptimally low (high) bet stake.

The welfare comparison between matched bets with fixed and choosable bet stakes is ambiguous. While allowing agents to choose their bet stakes is weakly better for sophisticated procrastinators, offering a single bet stake might be better for (partially) naive procrastinators. In both versions time-consistent agents do not take up the matched bet. Figure B3 depicts simulation results that show how overall efficiency depends on the number of offered bet stakes, using the same calibration as in Sections B.1 and B.2. Given a number of bet stakes n and a maximal bet stake M, bet participants are offered a bet

[35] Note that m_i^* coincides with the optimal incentive that a profit-maximizing firm would offer an agent in exchange for a lump-sum fee (DellaVigna and Malmendier, 2004).

stake menu of $[\frac{1}{n+1}M, ..., \frac{n}{n+1}M]$.

Figure B3: Offering a Menu of Bet Stakes



Notes: The figure compares efficiency of the matched bet depending on the number of offered bet stakes. Variables are calibrated in the following way: benefits $b_i \sim$ U[10, 30], short-run discount factor $\beta_i \sim \min\{\text{U}[\frac{1}{3}, \frac{4}{3}], 1\}$, perceived short-run discount factor $\hat{\beta}_i \sim \text{U}[\beta_i, 1]$, long-run discount factor $\delta_i = 1$, maximal bet stake $M = 20$. Costs are $c_i \sim \text{Exp}(15)$ in the upper left graph, $c_i \sim \text{Exp}(30)$ in the upper right graph, $c_i \sim \text{Gamma}(15, 1)$ in the lower left graph and $c_i \sim \text{Gamma}(15, 2)$ in the lower right graph.

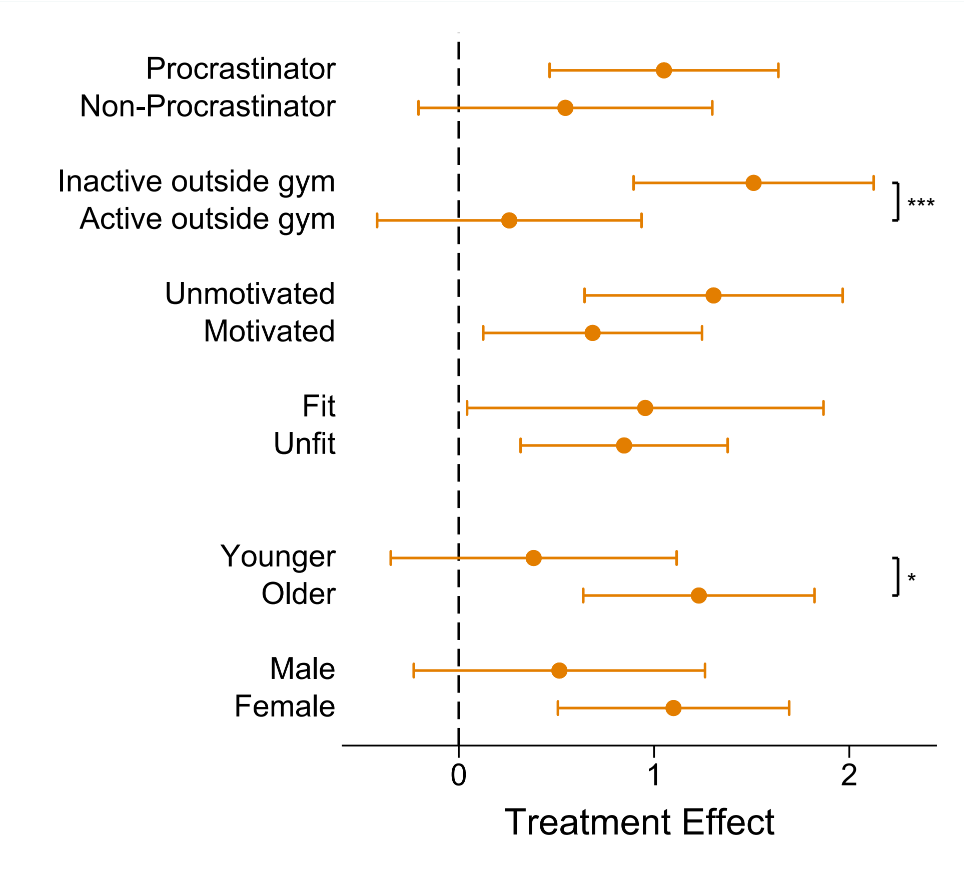
We observe that it depends on the specification whether a matched bet with a single bet stake (as analyzed both in theory and practice in the main text) or a matched bet in which agents freely choose their bet stakes yields higher overall efficiency. Either way, the differences in efficiency are minor. We also observe that allowing agents to freely choose their bet stakes can be approximated by offering a menu of merely a few different bet stakes.

In terms of practical applications, it is often not feasible to let individuals choose between many bet stakes as grouping participants by their chosen bet stakes and their likelihood to exercise requires a large number of bet participants. Furthermore, choosing a bet stake is difficult if one lacks experience with monetary incentives for changing one's own behavior. In the trial round, bet participants could choose between a bet stake of €3 and €5 (see Appendix E). Theory predicts that participants with a larger present bias will opt for a higher bet stake. Participants' selection did not seem to be driven by present bias, however, but seemed to be affected more by the participant's inclination to bet and compete.

C Heterogeneous Treatment Effects

Offering a matched bet increases gym attendance in the aggregate. This section analyzes potential heterogeneity in the treatment effect by splitting up the treatment and control group in various ways. Figure C1 shows the effects of offering the matched bet on gym attendance along four behavioral and two demographic dimensions.

Figure C1: Heterogeneous Treatment Effects



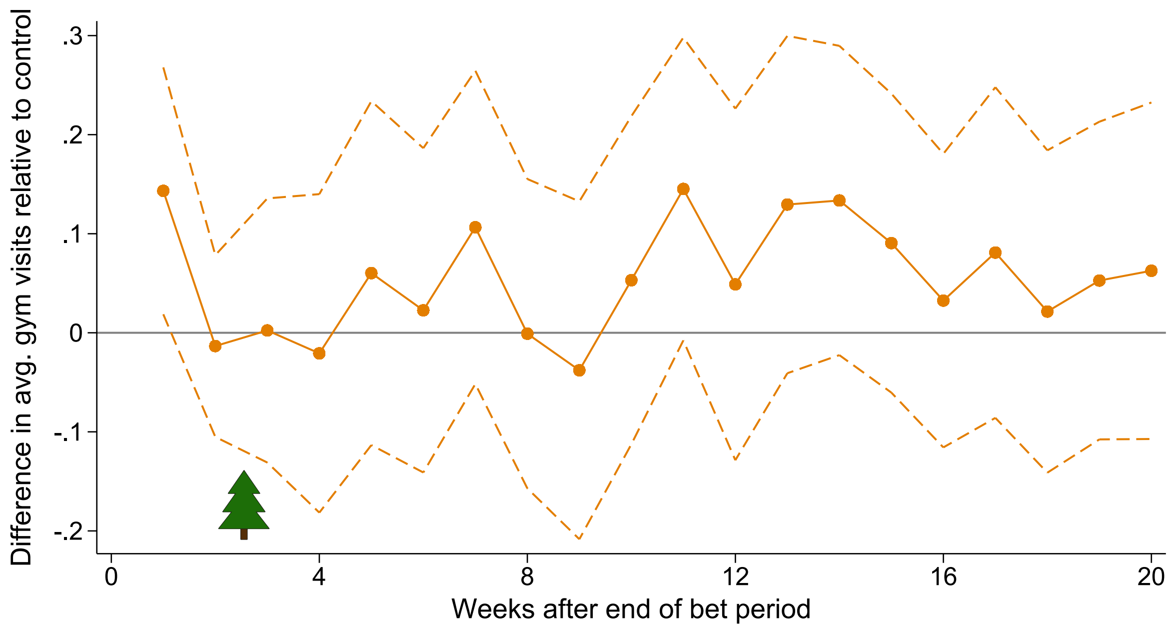
Notes: The figure shows differences in the effect of offering the matched bet on gym attendance during the four-week bet period by splitting up the subject pool into self-reported procrastinators vs. non-procrastinators, subjects who reported less vs. equal or more exercising sessions than the median outside the university gym during the matching period, self-reported unmotivated vs. motivated subjects, self-reported unfit vs. fit subjects, male vs. female subjects, and into subjects who have below vs. equal or above median age. Subjects were characterized as procrastinators, being motivated resp. fit if they answered 'slightly agree', 'agree' or 'strongly agree' to the respective Likert-scale statements about their past procrastination behavior, motivation to exercise resp. fitness level. Error bars indicate ninety-five percent confidence intervals. *** $p < 0.01$, ** $p < 0.05$ * $p < 0.1$

We observe that the treatment effect is about double the size for self-reported procrastinators compared to non-procrastinators, which can be explained by the higher bet take-up rate of procrastinators (30% vs. 16%; test of proportions, $p = 0.002$). However, regressing gym attendance during the bet period on treatment, self-reported procrastination and their respective interaction term reveals that the treatment effects are not statistically significantly different from each other ($p = 0.297$). In contrast, the treatment effect is significantly larger for subjects who reported fewer than the median number of exercising sessions outside the university gym during the matching period than for subjects who reported a number equal or above the median ($p = 0.007$). While subjects below the median are marginally more likely to take up the matched bet (29% vs. 21%; $p = 0.098$), those that accept also increase their gym attendance significantly more than subjects above the median ($p = 0.030$). An explanation for this finding is that participants who do not regularly exercise outside the university gym find it easier to increase their gym attendance as additional gym visits do not interfere with their other sports activities. We further observe that the treatment effect is larger, albeit insignificantly so, for unmotivated compared to motivated subjects ($p = 0.159$). As the take-up rates for unmotivated and motivated subjects are very similar, the larger treatment effect for unmotivated subjects suggests that unmotivated bet participants tend to react more strongly to the monetary incentive, which might act as a substitute for their lack of intrinsic motivation. There is no notable difference in the treatment effects for self-reported unfit and fit subjects ($p = 0.839$).

Figure C1 also depicts the effect of offering a matched bet on gym attendance along two demographic dimensions, age and gender. There is a marginally significantly larger treatment effect for subjects that are equal or older than the median in the sample (age 23 or older) compared to subjects that are below the median ($p = 0.077$). There is no significant difference in the treatment effect by gender ($p = 0.227$).

D Additional Figures and Tables

Figure D1: Long-Run Treatment Effects



Notes: The figure shows the difference in average weekly gym visits over time after the end of the bet period of the treatment relative to the control group. The dashed lines represent ninety-five percent confidence intervals using robust standard errors. The Christmas tree denotes the two-week Christmas break at the University of Amsterdam in the second and third week after the end of the bet period.

Table D1: Summary Statistics

	(1) Overall	(2) Control	(3) Treatment	(4) p-value (2) vs. (3)	(5) Bet Rejecters	(6) Bet Participants	(7) p-value (5) vs. (6)
Female	0.59	0.55	0.61	0.182	0.61	0.60	0.831
Age	23.45	23.66	23.34	0.294	23.15	23.90	0.047
BMI	22.58	22.84	22.45	0.145	22.44	22.47	0.935
Duration of gym contract	11.09	11.13	11.07	0.774	11.19	10.70	0.081
Gym visits in pre-MP	2.88	2.87	2.88	0.984	2.85	2.96	0.737
Gym visits in MP	1.77	1.70	1.80	0.439	1.77	1.90	0.434
Avg. duration of exercise	60.78	61.54	60.38	0.533	59.88	61.89	0.416
Exercise outside USC in MP	4.91	5.27	4.72	0.260	5.16	3.39	0.005
Exp. gym visits in BP	6.69	7.08	6.49	0.078	6.26	7.15	0.042
Exp. gym visits in BP for €5	8.47	8.60	8.41	0.689	8.11	9.27	0.068
Gym visits goal in BP	8.87	9.33	8.63	0.049	8.46	9.11	0.160
Procrastination in MP (1-7)	4.60	4.67	4.56	0.274	4.43	4.95	0.012
Expects to procr. in BP (1-7)	3.60	3.60	3.60	0.990	3.53	3.80	0.177
Motivation (1-7)	5.07	4.94	5.14	0.140	5.17	5.04	0.362
Competitive (1-7)	5.09	5.24	5.01	0.101	4.94	5.22	0.110
Willing to take risks (1-7)	4.86	4.83	4.87	0.991	4.80	5.08	0.056
Fit (1-7)	5.09	5.05	5.11	0.851	5.11	5.10	0.886
Satisfaction with exercise (1-7)	3.51	3.44	3.54	0.395	3.56	3.48	0.575
Happy (1-7)	5.50	5.58	5.45	0.093	5.52	5.25	0.067
Healthy lifestyle (1-7)	4.51	4.59	4.47	0.383	4.46	4.49	0.871
Exp. gym visits in BP with bet						8.90	
Exp. bet earnings in €						7.93	
Observations	601	206	395		296	99	

Notes: Column 1 is the overall mean, columns 2 and 3 are the means of the control resp. treatment group. Columns 5 and 6 are the means of bet rejecters resp. bet participants. Columns 4 resp. 7 give the p-value of the differences in means between control and treatment resp. bet rejecters and participants from t-tests, Mann-Whitney-U-tests or tests of proportions. pre-MP = pre-matching period, MP = matching period, BP = bet period.

Table D2: Treatment Effect of Accepting Bet (IV)

	Gym visits in BP		1+ gym visits in BP (0/1)	
	(1)	(2)	(3)	(4)
Mean of control group	2.257	2.257	0.680	0.680
Accepted Bet (0/1)	3.458***	3.613***	0.167	0.118
	(0.891)	(0.753)	(0.156)	(0.139)
Controls		✓		✓
Observations	601	601	601	601
R^2	0.181	0.409	0.041	0.260

Notes: The table shows two-stage least squares estimates. The dependent variable in (1) and (2) is the number of gym visits during the four-week bet period. The dependent variable in (3) and (4) indicates whether a subject recorded at least one gym visit during the bet period. The treatment variable indicates whether a subject participated in the matched bet. Its estimation uses the random treatment assignment as an instrument for bet take-up. The control variables are age, gender, BMI, subscription length, the numbers of gym visits during the four-week matching and pre-matching periods, and the self-reported expected number of gym visits during the bet period. Robust standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table D3: Effect of Time Preferences on Bet Participation – Binary Classification

	(1)	(2)	(3)	(4)
Mean take-up rate	0.251	0.251	0.251	0.251
Procrastinated in MP (0/1)	0.129***	0.133***	0.136***	0.136***
	(0.046)	(0.045)	(0.045)	(0.044)
Expects to procrastinate in BP (0/1)	0.032	0.045	0.044	0.044
	(0.049)	(0.049)	(0.049)	(0.049)
Past gym attendance		✓	✓	✓
Demographics			✓	✓
Risk & Competition Preferences				✓
Observations	395	395	395	395
Pseudo-R^2	0.024	0.040	0.058	0.062

Notes: The table shows marginal effects of probit regressions. The dependent variable indicates whether a subject participated in the matched bet. MP = matching period, BP = bet period. Past gym attendance includes gym attendance in the pre-matching period and categorical gym attendance in the matching period. Demographics include gender, age, BMI and subscription duration. The variables past and expected future procrastination as well as risk and competitive preferences, which were measured on a 7-point Likert-scale, are binarized and coded as 1 if a subject stated 'slightly agree', 'agree' or 'strongly agree', and 0 otherwise. Robust standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$ * $p < 0.1$

Table D4: Heterogeneous Treatment Effect of Accepting Bet (IV)

	Gym visits in BP	
	(1)	(2)
Accepted Bet (0/1)		4.644***
		(1.274)
Accepted Bet X Predicted gym visits in BP		−0.430
		(0.527)
Predicted gym visits without bet in BP		1.000***
		(0.101)
Gym visits in MP	0.449***	
	(0.105)	
Gym visits in pre-MP	0.309***	
	(0.067)	
Expected gym visits in BP	0.143***	
	(0.038)	
Constant	−0.404	0.000
	(0.250)	(0.197)
Observations	206	601
R^2	0.331	0.400

Notes: The table shows OLS (column 1) and two-stage least squares (column 2) estimates. The dependent variable is the number of gym visits during the four-week bet period. The regressors in column 1 are the numbers of gym visits during the four-week matching and pre-matching periods, and the self-reported expected number of gym visits during the bet period. The estimates are used to construct the variable "Predicted gym visits without bet in BP" that is used in column 2. The treatment variable in column 2 indicates whether a subject participated in the matched bet. Its estimation uses the random treatment assignment as an instrument for bet take-up. The treatment variable is interacted with the predicted gym visits without a bet in the bet period. MP = matching period, BP = bet period. Robust standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table D5: Self-reported Welfare Effects of Bet Participation

	Random attrition		Manski Bounds		
	Baseline	Δ	Baseline	Lower Δ	Upper Δ
Satisfaction with exercise (std.)	−0.047	0.446	−0.014	0.217	0.580
	(0.106)	[0.002]	(0.105)		
Procrastination in prior 4 weeks (std.)	0.214	−0.499	0.193	−0.631	−0.332
	(0.096)	[0.000]	(0.091)		
Fit (std.)	0.045	−0.187	0.010	−0.437	0.000
	(0.108)	[0.256]	(0.103)		
Healthy lifestyle (std.)	0.027	0.155	−0.010	−0.018	0.312
	(0.099)	[0.093]	(0.100)		
Happy (std.)	−0.161	−0.018	−0.200	−0.300	0.150
	(0.115)	[0.920]	(0.110)		
Observations	90	90	99	99	99

Notes: The standardized variables indicate satisfaction with one's exercising frequency at the university sports center, procrastination of exercising sessions at the university sports center in the prior four weeks, fitness, healthy lifestyle, and happiness. Δ denotes the difference between the follow-up and baseline survey. Manski bounds give the lower and upper bound of the difference. The lower bound assigns a 1, the upper bound a 7 to all missing variables in the follow-up survey. Standard errors are in parentheses, p-values from Wilcoxon sign-rank tests are in brackets.

E Trial Round

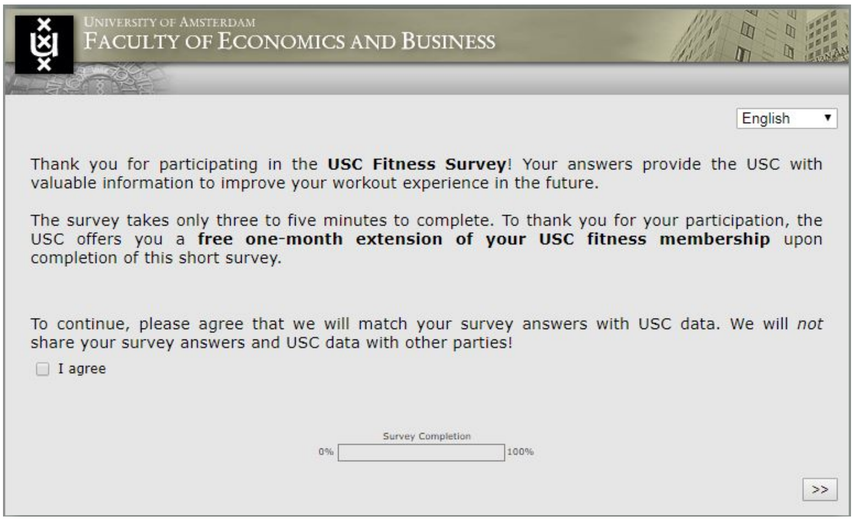
I conducted a trial round of the matched bet experiment with a similar design in May/June 2017. The trial round had a bet take-up rate of only 10%. I used survey answers of subjects of the trial round to make participation in the main experiment more appealing. The trial round differed from the main round as follows. The trial round also included non-student gym members and members who attended the gym on more than four days during the matching period. Bet participants could choose between a bet stake of €3 and €5 and were rewarded with this amount up to a cap of 10 visits during the four-week bet period. The trial round also grouped participants according to their past gym attendance. Unlike in the main experiment, in which bet participants are grouped with all other participants who recorded the same gym visits during the matching period, bet participants in the trial round were grouped with only one partner. In the trial round, participants were required to check out at exit gates to make the gym visit count for the bet. Also, the matched bet was framed as a bet rather than a challenge (as in the main experiment). The differences between the main experiment and the trial round are summarized in Table E1.

Table E1: Differences between Experiment and Trial Round

	Experiment	Trial Round
Sample	Only student members	All members
	Only non-frequent gym visitors	All members
Bet stake	€5 bet stake	Choice of €3 and €5 bet stake
Cap	Cap of 8 visits	Cap of 10 visits
Matching	Several partners	One partner
Exit gates	No exit gates	Exit gates
Framing	Challenge	Bet
Timing	Beginning of Winter	Beginning of Summer

F Survey Questions

Figure F1: Baseline Survey Questions



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English

Thank you for participating in the **USC Fitness Survey**! Your answers provide the USC with valuable information to improve your workout experience in the future.

The survey takes only three to five minutes to complete. To thank you for your participation, the USC offers you a **free one-month extension of your USC fitness membership** upon completion of this short survey.

To continue, please agree that we will match your survey answers with USC data. We will *not* share your survey answers and USC data with other parties!

☐ I agree

Survey Completion
0% 100%

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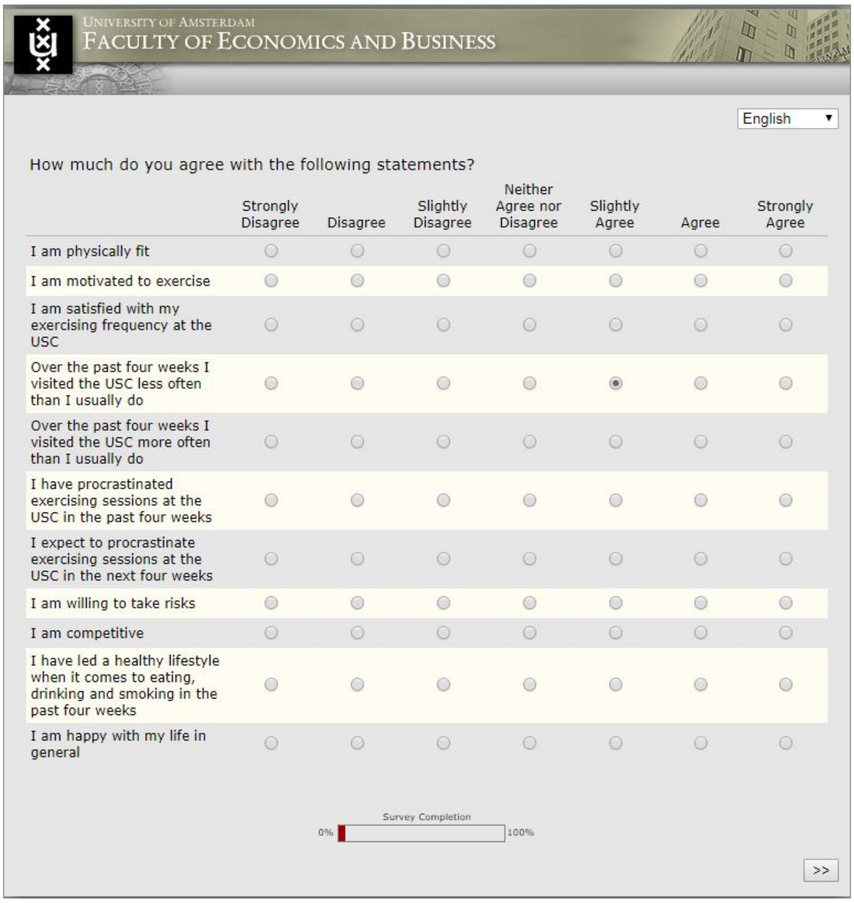

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English

How much do you agree with the following statements?

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
I am physically fit	○	○	○	○	○	○	○
I am motivated to exercise	○	○	○	○	○	○	○
I am satisfied with my exercising frequency at the USC	○	○	○	○	○	○	○
Over the past four weeks I visited the USC less often than I usually do	○	○	○	○	◉	○	○
Over the past four weeks I visited the USC more often than I usually do	○	○	○	○	○	○	○
I have procrastinated exercising sessions at the USC in the past four weeks	○	○	○	○	○	○	○
I expect to procrastinate exercising sessions at the USC in the next four weeks	○	○	○	○	○	○	○
I am willing to take risks	○	○	○	○	○	○	○
I am competitive	○	○	○	○	○	○	○
I have led a healthy lifestyle when it comes to eating, drinking and smoking in the past four weeks	○	○	○	○	○	○	○
I am happy with my life in general	○	○	○	○	○	○	○

Survey Completion
0% 100%

>>

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English

We would now like to ask a few questions about when and where you exercise. We define exercising as any sport activity that lasts at least 30 minutes.

- Throughout this survey, when asked about exercising at the USC, please only count exercising sessions at the following USC sports centers: Universum, Amstelcampus, PCH, ASC and ClubWest.
- Count exercising sessions at all other locations (including USC Body&Mind and USC Tennis) as exercising outside of the USC.

According to the USC database, you have exercised at the USC on days in the past four weeks (October 16th to November 12th).

How long was your average exercising session at the USC in the past four weeks (in minutes)?

-->

On how many days have you exercised outside of the USC in the past four weeks?

0 4 8 12 16 20 24 28

-->

Now, think about the next four weeks (November 20th to December 17th). Given all your other activities and obligations, on how many days would you like to exercise at the USC in the next four weeks?

0 4 8 12 16 20 24 28

-->

On how many days do you expect to exercise at the USC in the next four weeks?

0 4 8 12 16 20 24 28

-->

Imagine you were paid 5€ for each day (up to the 8th time) you exercised at the USC in the next four weeks. On how many days would you expect to exercise at the USC in the next four weeks?

0 4 8 12 16 20 24 28

-->

Survey Completion

0% 100%

>>

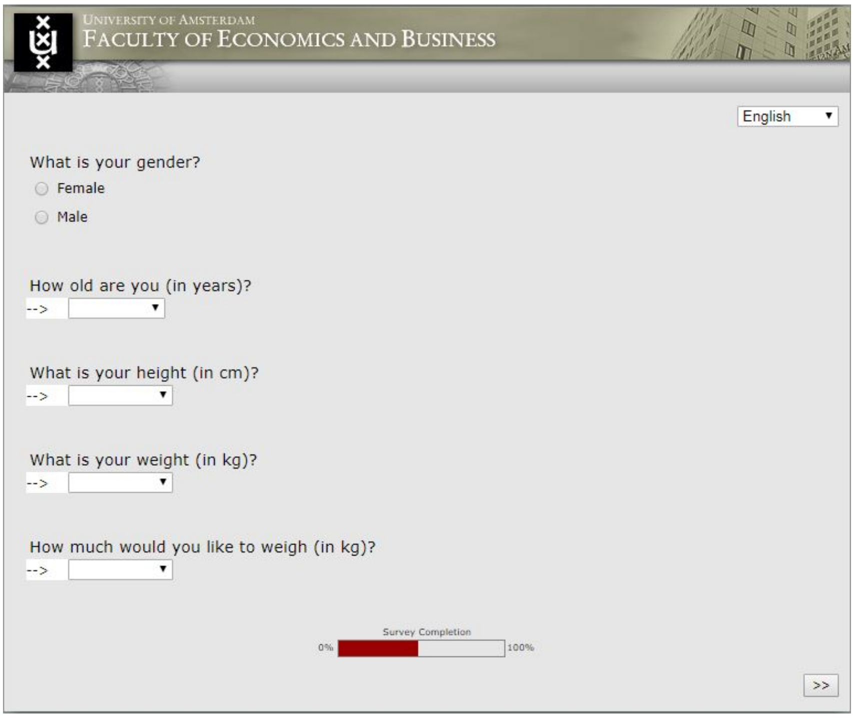
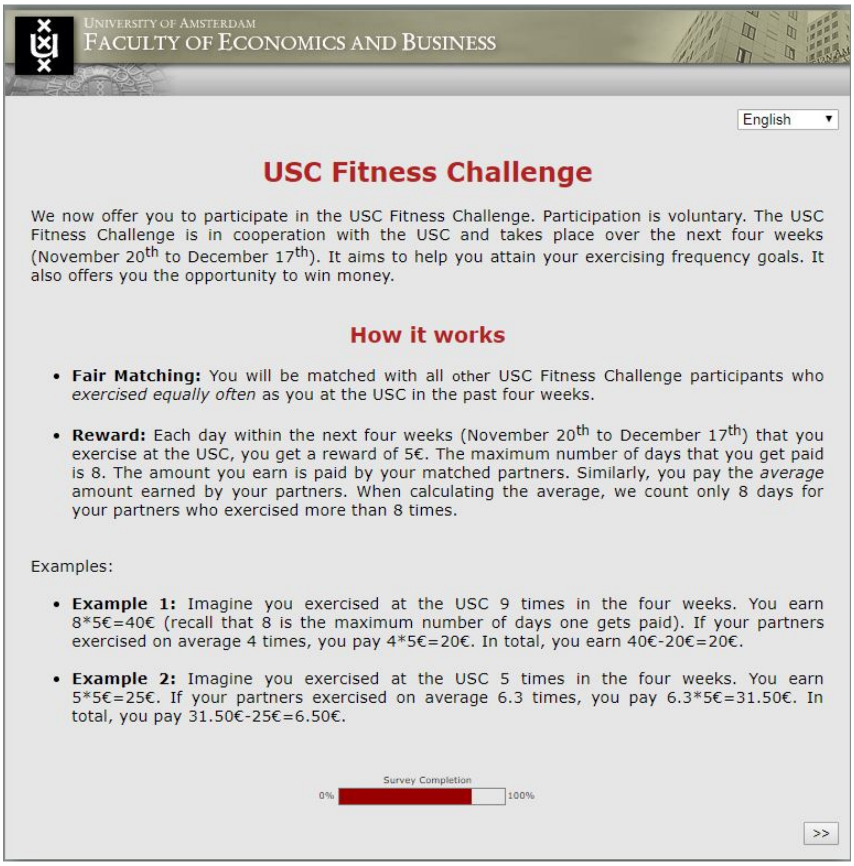


Figure F2: Baseline Survey Control Group

Figure F3: Baseline Survey Bet Treatment



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USC Fitness Challenge

We now offer you to participate in the USC Fitness Challenge. Participation is voluntary. The USC Fitness Challenge is in cooperation with the USC and takes place over the next four weeks (November 20th to December 17th). It aims to help you attain your exercising frequency goals. It also offers you the opportunity to win money.

How it works

- **Fair Matching:** You will be matched with all other USC Fitness Challenge participants who *exercised equally often* as you at the USC in the past four weeks.
- **Reward:** Each day within the next four weeks (November 20th to December 17th) that you exercise at the USC, you get a reward of 5€. The maximum number of days that you get paid is 8. The amount you earn is paid by your matched partners. Similarly, you pay the *average* amount earned by your partners. When calculating the average, we count only 8 days for your partners who exercised more than 8 times.

Examples:

- **Example 1:** Imagine you exercised at the USC 9 times in the four weeks. You earn 8*5€=40€ (recall that 8 is the maximum number of days one gets paid). If your partners exercised on average 4 times, you pay 4*5€=20€. In total, you earn 40€-20€=20€.
- **Example 2:** Imagine you exercised at the USC 5 times in the four weeks. You earn 5*5€=25€. If your partners exercised on average 6.3 times, you pay 6.3*5€=31.50€. In total, you pay 31.50€-25€=6.50€.

Survey Completion
0% 100%

>>

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Why participate?

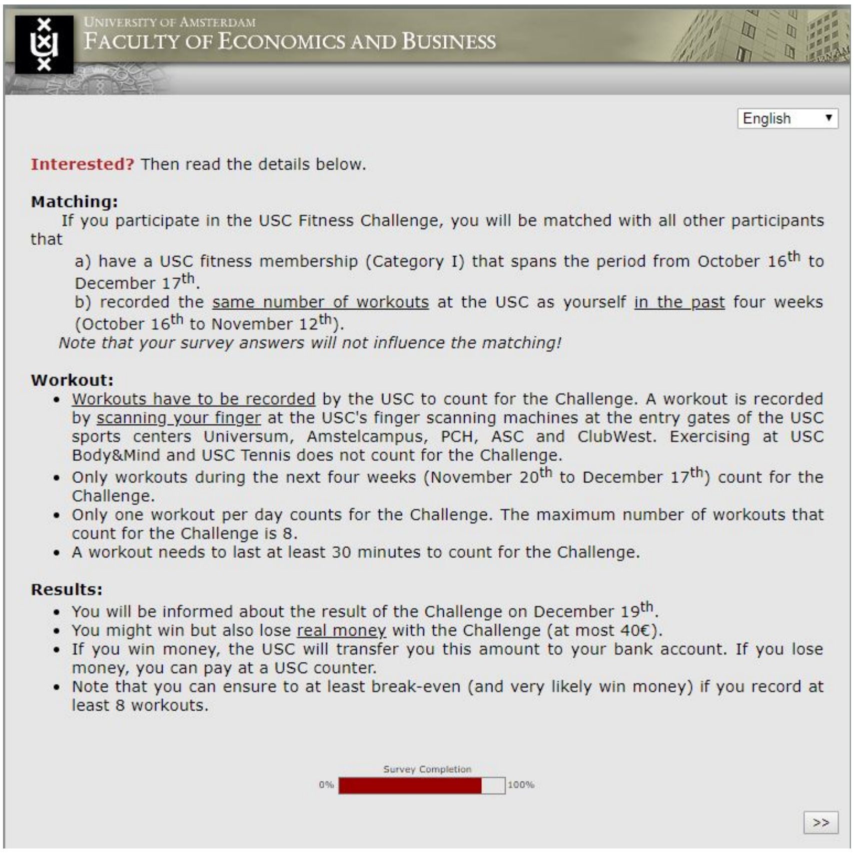
Motivating
Do you have problems sticking to your exercising goals? *Boost your motivation* with the USC Fitness Challenge! The reward for each workout might give you the extra motivation you need to leave the couch and go to the gym.

Rewarding
Get fit and be paid for it! The USC Fitness Challenge offers you a fair chance to *win money* while getting in shape.

Kickstarting
Well begun is half done! The USC Fitness Challenge offers you a unique opportunity to kickstart your exercising habit. One month of regular training is often enough for a person to *form an exercising habit*. Challenge yourself now and you may benefit from it also in the months to come.

Survey Completion
0% 100%

>>



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Interested? Then read the details below.

Matching:
If you participate in the USC Fitness Challenge, you will be matched with all other participants that

a) have a USC fitness membership (Category I) that spans the period from October 16th to December 17th.
b) recorded the same number of workouts at the USC as yourself in the past four weeks (October 16th to November 12th).

Note that your survey answers will not influence the matching!

Workout:

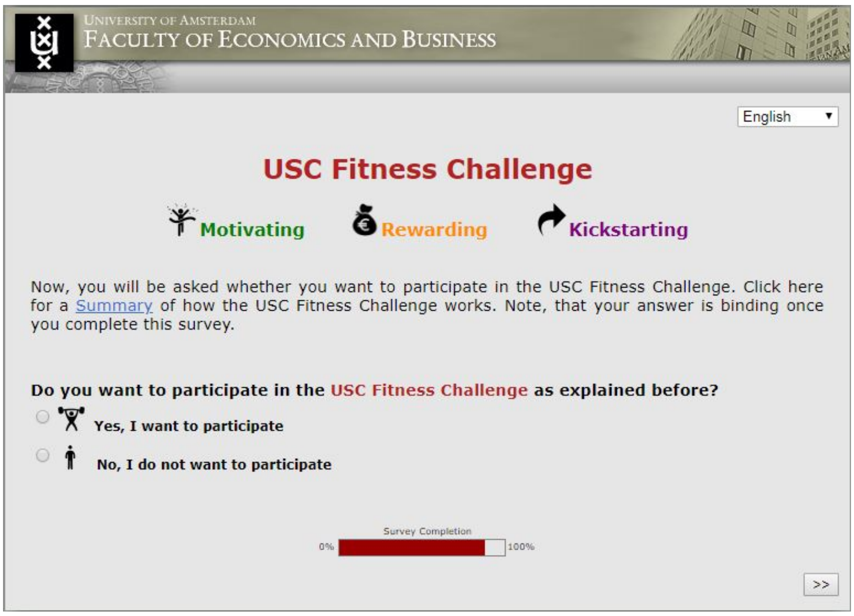
- Workouts have to be recorded by the USC to count for the Challenge. A workout is recorded by scanning your finger at the USC's finger scanning machines at the entry gates of the USC sports centers Universum, Amstelcampus, PCH, ASC and ClubWest. Exercising at USC Body&Mind and USC Tennis does not count for the Challenge.
- Only workouts during the next four weeks (November 20th to December 17th) count for the Challenge.
- Only one workout per day counts for the Challenge. The maximum number of workouts that count for the Challenge is 8.
- A workout needs to last at least 30 minutes to count for the Challenge.

Results:

- You will be informed about the result of the Challenge on December 19th.
- You might win but also lose real money with the Challenge (at most 40€).
- If you win money, the USC will transfer you this amount to your bank account. If you lose money, you can pay at a USC counter.
- Note that you can ensure to at least break-even (and very likely win money) if you record at least 8 workouts.

Survey Completion
0% 100%

>>



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USC Fitness Challenge

Motivating Rewarding Kickstarting

Now, you will be asked whether you want to participate in the USC Fitness Challenge. Click here for a Summary of how the USC Fitness Challenge works. Note, that your answer is binding once you complete this survey.

Do you want to participate in the USC Fitness Challenge as explained before?

- Yes, I want to participate
- No, I do not want to participate

Survey Completion
0% 100%

>>

Figure F4: Baseline Survey Bet Participants

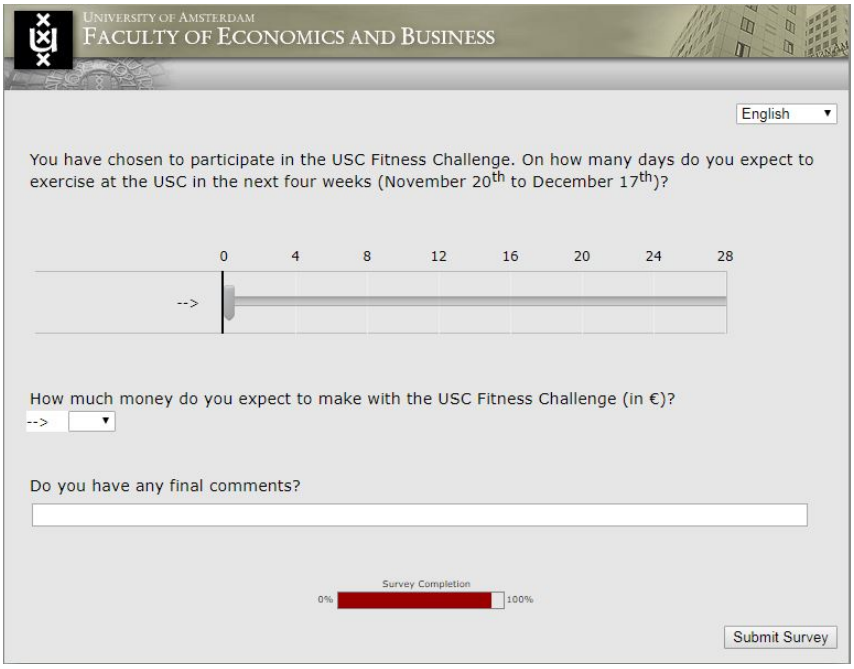


Figure F5: Baseline Survey Bet Rejecters

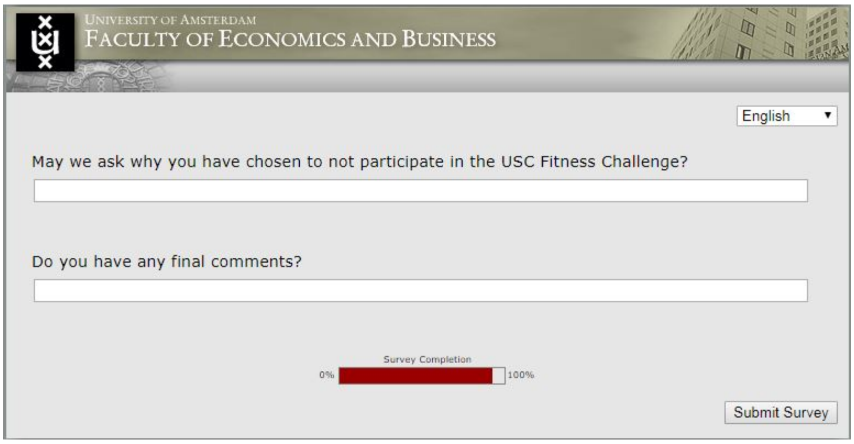
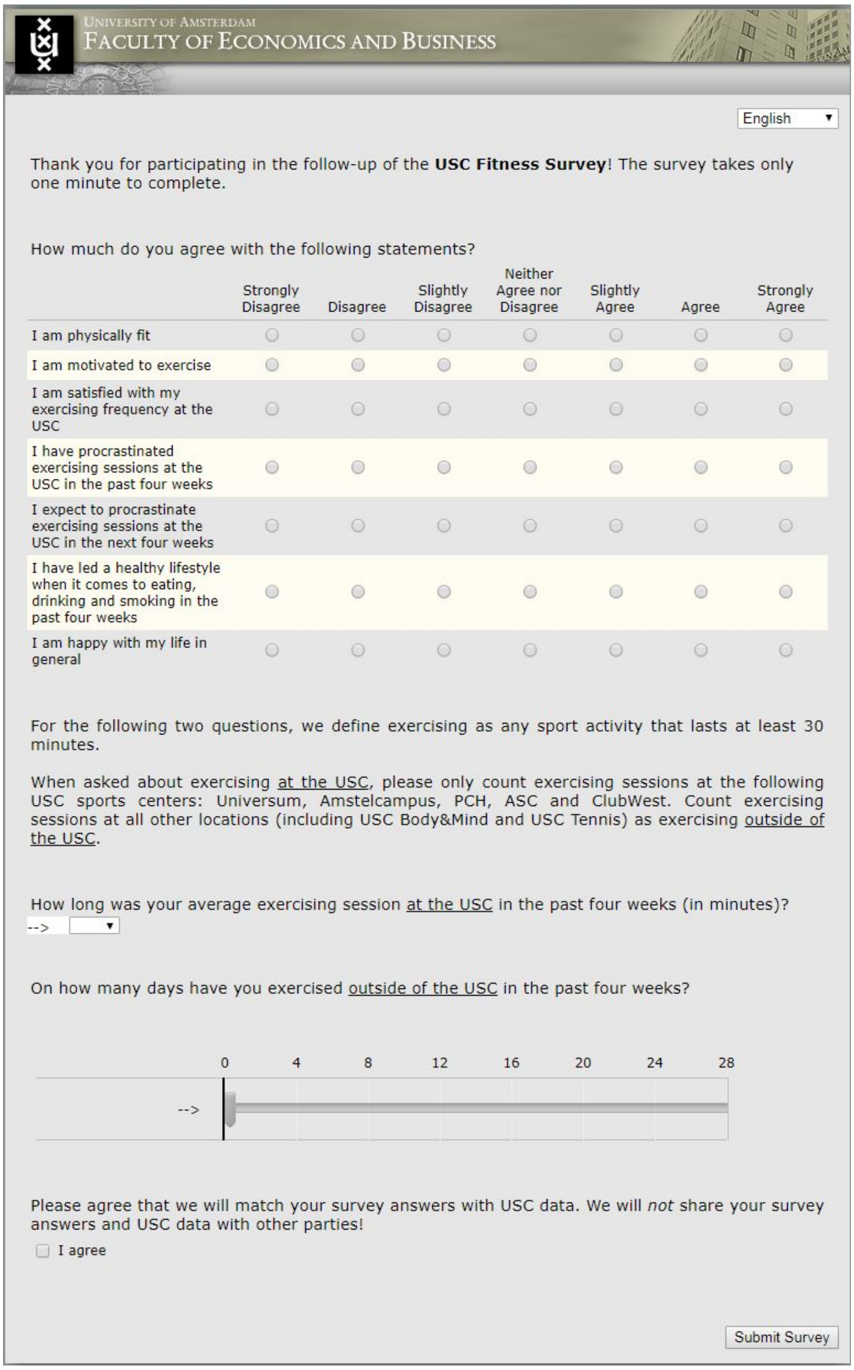


Figure F6: Follow-up Survey Questions Control Group & Bet Rejecters



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Thank you for participating in the follow-up of the **USC Fitness Survey**! The survey takes only one minute to complete.

How much do you agree with the following statements?

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
I am physically fit	○	○	○	○	○	○	○
I am motivated to exercise	○	○	○	○	○	○	○
I am satisfied with my exercising frequency at the USC	○	○	○	○	○	○	○
I have procrastinated exercising sessions at the USC in the past four weeks	○	○	○	○	○	○	○
I expect to procrastinate exercising sessions at the USC in the next four weeks	○	○	○	○	○	○	○
I have led a healthy lifestyle when it comes to eating, drinking and smoking in the past four weeks	○	○	○	○	○	○	○
I am happy with my life in general	○	○	○	○	○	○	○

For the following two questions, we define exercising as any sport activity that lasts at least 30 minutes.

When asked about exercising at the USC, please only count exercising sessions at the following USC sports centers: Universum, Amstelcampus, PCH, ASC and ClubWest. Count exercising sessions at all other locations (including USC Body&Mind and USC Tennis) as exercising outside of the USC.

How long was your average exercising session at the USC in the past four weeks (in minutes)?

-->

On how many days have you exercised outside of the USC in the past four weeks?

0 4 8 12 16 20 24 28

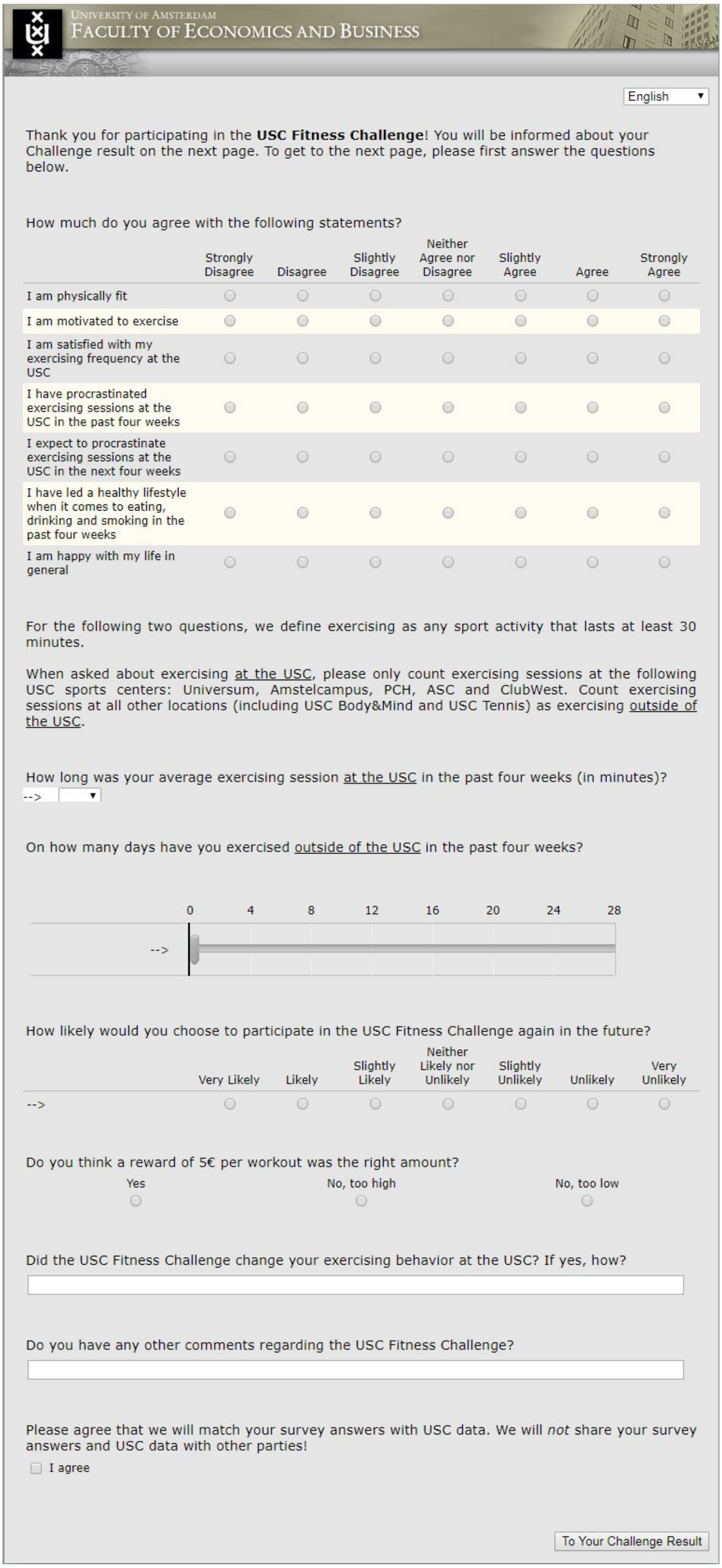
-->

Please agree that we will match your survey answers with USC data. We will *not* share your survey answers and USC data with other parties!

☐ I agree

Submit Survey

Figure F7: Follow-up Survey Questions Bet Participants



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Thank you for participating in the **USC Fitness Challenge**! You will be informed about your Challenge result on the next page. To get to the next page, please first answer the questions below.

How much do you agree with the following statements?

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
I am physically fit	○	○	○	○	○	○	○
I am motivated to exercise	○	○	○	○	○	○	○
I am satisfied with my exercising frequency at the USC	○	○	○	○	○	○	○
I have procrastinated exercising sessions at the USC in the past four weeks	○	○	○	○	○	○	○
I expect to procrastinate exercising sessions at the USC in the next four weeks	○	○	○	○	○	○	○
I have led a healthy lifestyle when it comes to eating, drinking and smoking in the past four weeks	○	○	○	○	○	○	○
I am happy with my life in general	○	○	○	○	○	○	○

For the following two questions, we define exercising as any sport activity that lasts at least 30 minutes.

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How long was your average exercising session at the USC in the past four weeks (in minutes)?

-->

On how many days have you exercised outside of the USC in the past four weeks?

0 4 8 12 16 20 24 28

-->

How likely would you choose to participate in the USC Fitness Challenge again in the future?

	Very Likely	Likely	Slightly Likely	Neither Likely nor Unlikely	Slightly Unlikely	Unlikely	Very Unlikely
-->	○	○	○	○	○	○	○

Do you think a reward of 5€ per workout was the right amount?

Yes	No, too high	No, too low
○	○	○

Did the USC Fitness Challenge change your exercising behavior at the USC? If yes, how?

Do you have any other comments regarding the USC Fitness Challenge?

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☐ I agree

To Your Challenge Result

Figure F8: Rules of Matched Bet

USC Fitness Challenge

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- Note that you can ensure to at least break-even (and very likely win money) if you record at least 8 workouts.

If you have any questions, please send an e-mail to a.r.s.woerner@uva.nl