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

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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 reduce time-inconsistent behavior. I conduct a field experiment to test the matched-bet mechanism in a natural area of application: exercising. My experimental results confirm 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 exercise more. I discuss how a matched bet could also be implemented in other areas such as academic performance, weight loss and smoking cessation.

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1 Introduction

Many people struggle to follow through with their plans. They fall 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 to model 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 expected to be 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 \$6. Suppose they are grouped together, because they are expected to exercise equally likely. Consider three possible scenarios. In scenario 1, Anne exercises and both Bob and Claire do not exercise. The resulting bet payoffs are $\$6 - \$0 = \$6$ for Anne and $\$0 - \$3 = -\$3$ for Bob and Claire each. In scenario 2, both Anne and Bob exercise, and Claire does not. The bet payoffs are then $\$6 - \$3 = \$3$ for both Anne and Bob and $\$0 - \$6 = -\$6$ for Claire. In scenario 3, Anne, Bob and Claire all exercise, which results in bet payoffs of $\$6 - \$6 = \$0$ for each.

Note that in all three scenarios, the bet payoffs sum up to zero. This is a property of the matched-bet mechanism: the reward paid to a bet participant is exactly refinanced by the payments obtained from her grouped partners. The matched-bet mechanism is

[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, 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. (2015) on weight loss, and Giné et al. (2010) and Halpern et al. (2015) on smoking cessation.

thus ex-post strictly budget-balanced. For this reason, a budget-constrained policy maker can offer a matched bet repeatedly to achieve persistent behavioral change. Comparing scenarios 1 and 2, we observe that Bob increases his bet payoff by \$6 (from −\$3 to \$3) if he exercises. Similarly, comparing scenarios 2 and 3, we observe that Claire increases her bet payoff by \$6 (from −\$6 to \$0) if she exercises. The matched bet thus provides participants with an extra monetary incentive to reach the target. Note that this extra incentive is always equal to the bet stake, and does not depend on the behavior of a participant's grouped partners.

Time-inconsistent bet participants can use the extra monetary incentive to counterbalance their present bias. They can do so at zero cost in expectation, because the matching ensures that they are grouped with participants who are expected to be equally likely to reach the prespecified target. Without matching, 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), this paper is the first to analyze and test a bet mechanism in which participants are grouped based on how likely they are expected to reach a prespecified target.

This paper tries to answer whether the matched-bet mechanism is effective in helping people overcome time-inconsistent behavior. 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 invest in an investment good such as exercising, studying or saving. If so, they incur immediate costs. Bet participants are paid depending on their bet outcome. In period 2, agents who invested 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). My model allows agents to have private and individual-specific degrees of time inconsistency, naiveté, benefits and costs.

Agents who are time-inconsistent undervalue future benefits and thus underinvest in the baseline. I show that it is sufficient to know agents' expected baseline investment frequencies to offer a Pareto improving matched bet. My theoretical analysis predicts that participating in a matched bet increases an agent's expected investment frequency. I show that the matched bet features favorable self-selection into the bet. The more present-biased an agent is, the more likely she is to take up the matched bet. Time-consistent agents do not take up the matched bet. The rationale why time-inconsistent people do take up a matched bet depends on their degree of naiveté. Sophisticated procrastinators, i.e. time-inconsistent agents who are aware of their time inconsistency, use the matched bet as a costless commitment device. In contrast, naive procrastinators, i.e. time-inconsistent agents who are unaware of their time inconsistency, take up the matched bet because they (erroneously) expect to win money with it. Agents with a high degree of time inconsistency benefit most from the matched-bet mechanism. As the matched bet perfectly aligns individual and social welfare, the matched-bet mechanism also increases investment efficiency. Comparing the matched bet to an unmatched bet, a subsidy and a commitment contract, I use numerical examples to show that the matched bet yields the highest efficiency.

In a field experiment at a university gym, I test whether the matched bet is also a promising device in practice. I study 601 gym members who completed a short online survey and randomize them into a treatment and control group. I compare the gym attendance between the treatment and control group during and after a four-week intervention period in November and December 2017. 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.

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 people who reported to have procrastinated exercising in the past. The bet take-up rate is 25%. I find that self-reported procrastination and low past exercising frequency outside the university gym have a significant positive effect on bet take-up. This suggests that people who benefit the most from taking up a matched bet are also the most likely to participate. Overall, the matched bet proves a promising mechanism to help people overcome time inconsistency issues, both in theory and in practice.

The paper proceeds as follows: Section 2 discusses the related literature. Section 3 theoretically analyzes the matched-bet mechanism. Section 4 describes the experimental design. Section 5 presents the experimental results. Section 6 discusses practical challenges and points out other areas in which the matched bet could be applied. Finally, Section 7 concludes.

2 Related Literature

This section discusses the related literature, with a focus on monetary incentive schemes for behavioral change. The literature on monetary incentives 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. Subsidies have been implemented in various areas such as exercising, studying, weight loss and smoking cessation. Most papers find that subsidies increase participants' desired behavior. Evidence suggests that the effect size positively depends on how well participants can control reaching the target (Gneezy et al., 2011).

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; Acland and Levy, 2015; Cappelen et al., 2017; Pope and Harvey-Berino, 2013). Perhaps 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., 2017; Rohde and Verbeke, 2017). The literature also finds an increase in gym attendance after the intervention period, which suggests that people form a habit of exercising. It thus seems that the monetary incentives do not crowd out participants' intrinsic motivation to exercise. The 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, 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, repeated rounds of subsidies might prove too costly to solve time inconsistency issues.

In the pursuit of a cost-effective way to solve time inconsistency issues, the literature has also looked at commitment contracts (see Bryan et al., 2010 for a review). With commitment contracts, participants either restrict their future choice set or put their own money at stake, which they lose if they fail to reach a prespecified target. Just like a matched bet, a budget-constrained policy maker can thus offer a commitment contract repeatedly. Evidence shows that offering commitment contracts increases the desired behavior, but often only to a small margin. Typically, only a minority of people is willing to take up a commitment contract. In particular, pure monetary commitment contracts have low take-up rates (Giné et al., 2010; Royer et al., 2015). The literature finds higher take-up rates when the commitment contract restricts participants' future choice sets (Ashraf et al., 2006; Milkman et al., 2013; Beshears et al., 2015) or merely threatens to decrease a positive payoff to participants (John et al., 2012; Kaur et al., 2015). Laibson (2015) argues that the low take-up rate is due to two reasons. First, naive procrastinators (erroneously) perceive that they do not need commitment. Second, commitment contracts can become quite costly due to the possible loss in flexibility or money. Sadoff and Samek (2018) argue that naive procrastinators might learn about the value of commitment over time. They provide evidence that externally imposed experience with commitment contracts increases voluntary take-up later on.

Behavioral interventions that neither restrict participants' future choice sets nor provide monetary incentives often fail to change subjects' behavior. For instance, neither helping people with planning exercising sessions (Carrera et al., 2018b), nor informing people about how often their peers exercise (Beatty and Katare, 2018) increased gym attendance.

A few papers have investigated the effects of offering bets on changing people's behavior. Halpern et al. (2015) compare the effect of a one-sided bet on smoking cessation to a subsidy and control. They find that both the subsidy and bet significantly increase abstinence rates, though the subsidy does so to a larger extent. My paper is most closely related to Lusher (2017), who 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 implements a bet without matching. He offers a bet with a modest bet stake and a binary target to increase one's GPA. He finds that participation in the bet increases the likelihood to increase one's GPA. Especially low-achieving students benefit from the bet; they are also the most likely to participate.

3 Theory

This section theoretically analyzes the effects of offering a matched bet to help people overcome time-inconsistent behavior in a model inspired by DellaVigna and Malmendier (2004). The section serves two purposes. First, it demonstrates that a matched bet has desirable theoretical properties, making it a device worth studying in practice. Second, the theoretical results propose specific hypotheses that are subsequently tested in a field experiment.

3.1 Model

Consider a setting with a set of N agents labeled $i = 1, ..., N$. Agents decide whether to invest in an investment good. More specifically, agents make a binary investment decision $\mathcal{I}_i = \{0, 1\}$ where $\mathcal{I}_i = 1$ if agent i invests and $\mathcal{I}_i = 0$ if agent i does not invest.

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

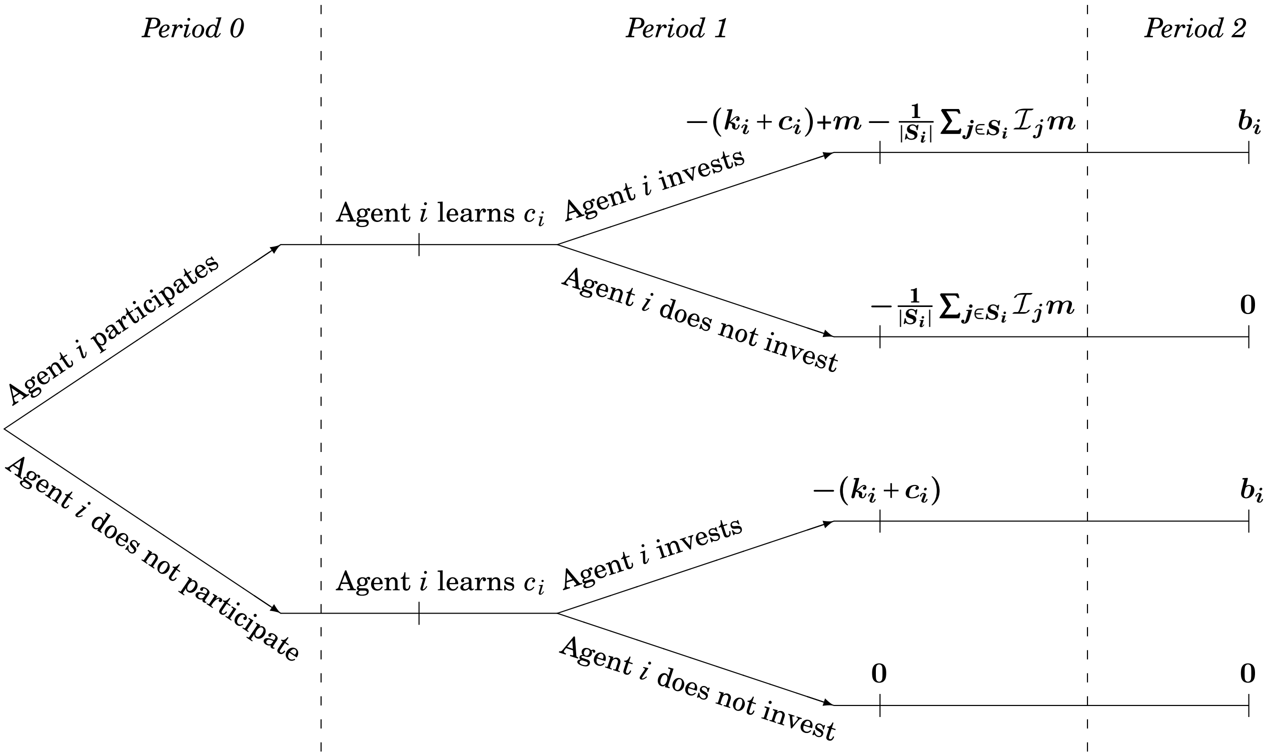
$$T_i = \mathcal{I}_i m - \frac{1}{|S_i|} \sum_{j \in S_i} \mathcal{I}_j m, \tag{1}$$

where S_i denotes the set of i's grouped partners (excluding herself) and $|S_i|$ denotes the number of i's grouped partners. Transfer T_i thus equals the difference of a bet participant's own and her partners' average investment frequencies, multiplied by the bet stake.

Timing of Events. I assume a three-period model. In period 0, agents are offered an opportunity to participate in a matched bet with monetary bet stake m, and each agent i decides whether to participate ($\mathcal{P}_i = 1$) or not ($\mathcal{P}_i = 0$). In period 1, agents learn about their opportunity costs c_i and then make a binary investment decision $\mathcal{I}_i = \{0, 1\}$. If an agent invests ($\mathcal{I}_i = 1$), the agent incurs immediate effort costs k_i and opportunity costs c_i, but later obtains (expected) benefits b_i in period 2. If an agent does not invest ($\mathcal{I}_i = 0$), $k_i = c_i = b_i = 0$. Furthermore, there are (possibly negative) monetary transfers T_i to bet participants in period 1 depending on their bet outcome. Figure 1 illustrates the timing of events for agent i.

Agents. Agents face an investment decision with immediate investment costs $k_i + c_i$ and delayed benefits $b_i > 0$. Examples of such investment decisions concern exercising,

Figure 1: Timing of Events



studying, saving, eating healthily and having medical check-ups. Benefits b_i and costs $k_i + c_i$ may vary between agents. The costs of investing consist of deterministic effort costs k_i and stochastic opportunity costs c_i. At period 0, agents know their own non-monetary benefits b_i, their own effort costs k_i and the common distribution $F(\cdot)$ from which their own opportunity costs c_i are drawn from. The distribution $F(\cdot)$ has $F(0) = 0$ and $F(\overline{c}) = 1$. The corresponding density function $f(\cdot)$ is weakly decreasing on $[0, \overline{c}]$. At the start of period 1, agents learn about their own opportunity costs c_i.

Agents are risk-neutral and may have time-inconsistent preferences. I assume agents' time preferences can be expressed by a quasi-hyperbolic discounting model, also known as the β-δ model (Phelps and Pollak, 1968; Laibson, 1997; O'Donoghue and Rabin, 1999). It follows that an agent's direct utilities in period 0 and period 1 are given by

$$U_i^0 = \beta_i \delta_i [(\delta_i b_i - k_i - c_i)\mathcal{I}_i + \mathcal{P}_i T_i] \tag{2}$$

and

$$U_i^1 = (\beta_i \delta_i b_i - k_i - c_i)\mathcal{I}_i + \mathcal{P}_i T_i, \tag{3}$$

where $\delta_i \leq 1$ denotes agent i's long-run discount factor, and $\beta_i \leq 1$ indicates agent i's short-run discount factor. Further, $\hat{\beta}_i$ indicates 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. An agent's present bias is defined as $1-\beta_i$, and an agent's perceived present bias is defined as $1-\hat{\beta}_i$. I allow agents to underestimate their degree of time inconsistency, which implies $\beta_i \leq \hat{\beta}_i$. The difference between an agent's true and perceived present bias describes an agent's degree of naiveté $\hat{\beta}_i - \beta_i$. An agent's perceived direct utility in period 0 equals

$$\hat{U}_i^0 = \beta_i \delta_i \left[(\delta_i b_i - k_i - c_i)\hat{\mathcal{I}}_i + \mathcal{P}_i \hat{T}_i \right], \tag{4}$$

where $\hat{\mathcal{I}}_i$ captures the agent's belief in period 0 about her investment decision in period 1. Similarly, $\hat{T}_i$ captures the agent's belief in period 0 about the resulting monetary transfer to her in period 1.

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 present bias will be lower in period 1 than it is in period 0, I assume that all agents (correctly) believe that the other agents' present biases are constant over time.[3]

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 an agent's welfare depends on her long-run (time-consistent) preferences (O'Donoghue and Rabin, 2001; DellaVigna and Malmendier, 2004; Galperti, 2015). Note that an agent's long-run preferences coincide, up to the multiplicative constant β_i, with the agent's preferences in period 0. An agent's individual welfare in period 0 is thus given by

$$U_i^W = \delta_i \left[(\delta_i b_i - k_i - c_i)\mathcal{I}_i + \mathcal{P}_i T_i \right]. \tag{5}$$

leading to the following definition of efficient investment.

Definition 1 *Let $\mathcal{I}_i(c_i)$ be agent i's investment strategy. Agent i is said to invest efficiently if $\mathcal{I}_i(c_i) = 1$ if and only if $c_i \leq \delta_i b_i - k_i$.*

An agent who invests efficiently obtains $\mathbb{E}[U_{i,eff}^W]$. To rule out trivial cases, I assume $k_i < \delta_i b_i < k_i + \overline{c}$ for all agents. These conditions ensure that investing is not always nor never efficient. To guarantee accurate matching, I further assume $k_i < \beta_i \delta_i b_i$ for all agents. This condition ensures that all agents invest with strictly positive probability in

[3] This modeling assumption is in line with experimental evidence in Fedyk (2017) who finds that people anticipate present bias in others.

the baseline case.

Matching. Bet participants are grouped with all other participants who have the same expected baseline investment frequency. In the baseline, an agent invests if and only if $c_i \leq \beta_i \delta_i b_i - k_i$, so that an agent's expected baseline investment frequency equals $F(\beta_i \delta_i b_i - k_i)$. Recall that S_i denotes the set of i's grouped partners and $|S_i|$ denotes the number of grouped partners. In a matched bet, the set S_i includes all bet participants who have the same expected baseline investment frequency as participant i excluding herself, thus

$$S_i \equiv \{j \neq i | \mathcal{P}_j = 1, F(\beta_j \delta_j b_j - k_j) = F(\beta_i \delta_i b_i - k_i)\}. \tag{6}$$

I assume $|S_i| \geq 1 \, \forall \, i : \mathcal{P}_i = 1$. This implies that the market is sufficiently thick to ensure that a bet participant always has at least one viable partner to be matched with. The matching assumes that an agent's expected baseline investment frequency can be identified, possibly because there is sufficient information about her past investment behavior.[4] An agent's underlying parameters β_i, $\hat{\beta}_i$, δ_i, b_i, k_i and $F(\cdot)$, however, are assumed to be private information. 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 a member's future attendance quite accurately in spite of the fact that gyms are ignorant about the underlying preferences of their members.[5]

3.2 Analysis

Budget. Before I analyze agents' behavior, note that the reward paid to a bet participant is always exactly refinanced by the payments obtained from her grouped partners. Summing up all transfers to agents (1) yields

$$\sum_i \mathcal{P}_i T_i = \sum_i \mathcal{P}_i \mathcal{I}_i m - \sum_i \mathcal{P}_i \frac{1}{|S_i|} \sum_{j \in S_i} \mathcal{I}_j m = \sum_i \mathcal{P}_i \mathcal{I}_i m - \sum_j \mathcal{P}_j \mathcal{I}_j m = 0.$$

which leads to the following proposition.

Proposition 1 (Budget Balancedness) *A matched bet is ex-post strictly budget-balanced.*

[4] Section A.2 shows that the performance of the matched-bet mechanism is robust to imperfect matching.

[5] Not surprisingly, additional information about underlying parameters might improve the matched-bet mechanism's performance. Section A.4 shows that the matched-bet mechanism can achieve the first best if also β_i, δ_i and b_i can be identified.

The strict budget balancedness allows a budget-constrained policy maker to offer matched bets over extended periods of time, which might be necessary to induce long-run behavioral change. The ex-post property makes the matched bet robust to common outcome shocks.

I now turn to the analysis of agents' behavior. Every agent faces two binary decisions: a bet participation decision in period 0 and an investment decision in period 1. The analysis employs a Perfect Bayesian Nash equilibrium concept. I thus solve backwards and first focus on the investment decision, taking the earlier bet participation decision as given. Throughout the paper, I assume, without loss of generality, that agents who are indifferent between participating or not participating, or between investing or not investing, participate and invest, respectively.

Investment Decision. An agent's investment decision in period 1 depends on the agent's preferences in period 1. Substituting (1) into (3) and rearranging, we obtain the maximization problem

$$\max_{\mathcal{I}_i \in \{0,1\}} (\beta_i \delta_i b_i - k_i - c_i + \mathcal{P}_i m)\mathcal{I}_i - \mathcal{P}_i \frac{1}{|S_i|} \sum_{j \in S_i} \mathcal{I}_j m. \tag{7}$$

Note that the second term in the above expression does not depend on agent i's investment strategy. An agent thus maximizes her utility by investing if and only if

$$c_i \leq \beta_i \delta_i b_i - k_i + \mathcal{P}_i m. \tag{8}$$

In other words, an agent invests in period 1 if and only if her realized opportunity costs are sufficiently low. In period 0, when opportunity costs have not yet realized, an agent's expected investment frequency thus equals $F(\beta_i \delta_i b_i - k_i + \mathcal{P}_i m)$. This leads to

Proposition 2 (Bet Effect)

(i) Without a matched bet, present-biased agents underinvest.

(ii) Participating in a matched bet increases an agent's expected investment frequency.

(iii) An agent who participates in a matched bet has a dominant investment strategy.

(iv) An agent who participates in a matched bet invests efficiently if $m = (1-\beta_i)\delta_i b_i$*, underinvests if* $m < (1-\beta_i)\delta_i b_i$ *and overinvests if* $m > (1-\beta_i)\delta_i b_i$*.*

Proof (i) It follows from Definition 1 that efficient investment involves a frequency of $F(\delta_i b_i - k_i)$. Because $F(\beta_i\delta_i b_i - k_i) < F(\delta_i b_i - k_i)$ for all agents with $\beta_i < 1$, all present-biased agents underinvest without a matched bet. The inefficiency increases in the agent's present bias. (ii) Taking up a matched bet increases an agent's investment frequency as $F(\beta_i\delta_i b_i - k_i + m) > F(\beta_i\delta_i b_i - k_i)$. (iii) A bet participant's investment strategy equals $\mathcal{I}_i(c_i) = 1$ if and only if $c_i \le \beta_i\delta_i b_i - k_i + m$. Clearly, the strategy does not depend on the behavior of other participants. Bet participants thus have a dominant investment strategy. An agent's belief about other agent's behavior is only relevant for the bet participation but not for the investment decision. (iv) A bet participant invests efficiently if and only if her expected investment frequency equals her expected efficient frequency, i.e. if and only if $F(\beta_i\delta_i b_i - k_i + m) = F(\delta_i b_i - k_i)$. The condition is satisfied only if $m = (1-\beta_i)\delta_i b_i$. If $m < (1-\beta_i)\delta_i b_i$, $F(\beta_i\delta_i b_i - k_i + m) < F(\delta_i b_i - k_i)$, so that an agent underinvests. In contrast, if $m > (1-\beta_i)\delta_i b_i$, $F(\beta_i\delta_i b_i - k_i + m) > F(\delta_i b_i - k_i)$, so that an agent overinvests. ■

Note that even though an agent still underinvests 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.

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* investment strategy in period 1. Given opportunity costs c_i, an agent's perceived utility in period 0 equals

$$\begin{aligned} &\beta_i\delta_i\left[(\delta_i b_i - k_i - c_i + \mathcal{P}_i m)\hat{\mathcal{I}}_i - \mathcal{P}_i\frac{1}{|S_i|}\sum_{j\in S_i}\mathcal{I}_j m\right] \\ \textit{with}\;\; &\hat{\mathcal{I}}_i(c_i) = 1 \iff c_i \le \hat{\beta}_i\delta_i b_i - k_i + \mathcal{P}_i m, \\ &\mathcal{I}_j(c_j) = 1 \iff c_j \le \beta_j\delta_j b_j - k_j + m \quad \forall\, j \in S_i. \end{aligned} \tag{9}$$

Recall that an agent might have incorrect beliefs about her own investment strategy (as $\beta_i \le \hat{\beta}_i$), but is assumed to have accurate beliefs about her grouped partners' investment strategies. As opportunity costs have not yet materialized in period 0, agents maximize their perceived expected utility $\mathbb{E}[\hat{U}_i^0]$ as follows

$$\max_{\mathcal{P}_i\in\{0,1\}} \beta_i\delta_i\left[\int_0^{\hat{\beta}_i\delta_i b_i - k_i + \mathcal{P}_i m}(\delta_i b_i - k_i - c_i + \mathcal{P}_i m) f(c_i) dc_i - \mathcal{P}_i\frac{1}{|S_i|}\sum_{j\in S_i}\int_0^{\beta_j\delta_j b_j - k_j + m} m f(c_j) dc_j\right].$$

Recall that since bet participants are grouped with all other participants who have the same expected baseline investment frequency, $S_i \equiv \{j \neq i | \mathcal{P}_j = 1, F(\beta_j \delta_j b_j - k_j) = F(\beta_i \delta_i b_i - k_i)\}$. Thus, $\beta_j \delta_j b_j - k_j + m = \beta_i \delta_i b_i - k_i + m \; \forall \; j \in S_i$, which simplifies the agent's maximization problem to

$$\max_{\mathcal{P}_i \in \{0,1\}} \beta_i \delta_i \left[\int_0^{\hat{\beta}_i \delta_i b_i - k_i + \mathcal{P}_i m} (\delta_i b_i - k_i - c_i) f(c_i) dc_i + \mathcal{P}_i \int_{\beta_i \delta_i b_i - k_i + m}^{\hat{\beta}_i \delta_i b_i - k_i + m} m f(c_i) dc_i \right]. \quad (10)$$

The first term of the expression above quantifies the perceived non-monetary payoff from investing while the second term quantifies the perceived monetary payoff from participating in the matched bet. As an agent's bet participation decision is binary, we can rewrite the agent's maximization problem as the bet participation constraint $\mathbb{E}[\hat{U}^0_{i,\mathcal{P}_i=1}] - \mathbb{E}[\hat{U}^0_{i,\mathcal{P}_i=0}] \geq 0$, which is given by

$$\underbrace{\int_{\hat{\beta}_i \delta_i b_i - k_i}^{\hat{\beta}_i \delta_i b_i - k_i + m} (\delta_i b_i - k_i - c_i) f(c_i) dc_i}_{\text{Incentive Value}} + \underbrace{\int_{\beta_i \delta_i b_i - k_i + m}^{\hat{\beta}_i \delta_i b_i - k_i + m} m f(c_i) dc_i}_{\text{Monetary Value}} \geq 0. \quad \text{(PC)}$$

The first term on the left-hand side describes the (possibly negative) value an agent expects to obtain from the extra monetary incentive to invest when participating in the bet. Without the bet, an agent expects to invest only if $c \leq \hat{\beta}_i \delta_i b_i - k_i$. With a matched bet, an agent expects to invest also if $\hat{\beta}_i \delta_i b_i - k_i < c_i \leq \hat{\beta}_i \delta_i b_i - k_i + m$. The second term describes the monetary value, i.e. the discounted monetary amount an agent expects to win with the bet. The rationale for why agents might take up the bet depends on their degree of naiveté $\hat{\beta}_i - \beta_i$. Sophisticated agents ($\beta_i = \hat{\beta}_i < 1$) do not expect to win money with the bet. If they take up the bet, they do so because they value the extra incentive to invest. Sophisticated agents acknowledge their time inconsistency and use the matched bet as a costless incentive device to invest more efficiently. In contrast, naive agents ($\beta_i < \hat{\beta}_i = 1$) do not recognize a bet's incentive value and even expect to invest less efficiently with a bet. They erroneously expect to invest efficiently without a matched bet and expect to overinvest with a matched bet. Inserting $\hat{\beta}_i = 1$ into the participation constraint shows that the incentive value is always negative for naive agents as $\int_{\delta_i b_i - k_i}^{\delta_i b_i - k_i + m} (\delta_i b_i - k_i - c_i) f(c_i) dc_i < 0$. Even though naive agents expect to invest less efficiently with a matched bet, they might take up the bet because they erroneously expect to win a sufficient amount of money. A combination of the reasons stated above holds true for partially naive agents ($\beta_i < \hat{\beta}_i < 1$). Naiveté thus yields two opposing effects. It decreases the perceived incentive value but increases the perceived monetary value.

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

Proposition 3 (Bet Take-up)

(i) There exists an $\overline{m}_i$ such that an agent participates in the matched bet if and only if $m \leq \overline{m}_i$.

(ii) There exists a $\overline{\beta}_i$ such that an agent participates in the matched bet if and only if $\beta_i \leq \overline{\beta}_i$.

(iii) There exists a $\overline{\hat{\beta}}_i$ such that an agent participates in the matched bet if and only if $\hat{\beta}_i \leq \overline{\hat{\beta}}_i$.

Proof See Appendix B

The smaller the bet stake, the more agents take up the matched bet. The more present-biased and the more sophisticated an agent is, the more likely she is to take up the matched bet. The participation constraint is never fulfilled for time-consistent agents. Inserting $\beta_i = \hat{\beta}_i = 1$ into (PC) yields a negative incentive value and a monetary value of zero. This implies

Corollary 1 *Time-consistent agents do not take up a matched bet.*

Proof See Appendix B

Time-consistent agents invest efficiently without a matched bet. With a matched bet, they would overinvest. Time-consistent agents therefore negatively value the bet's commitment aspect. As they expect to break even with a matched bet, they reject it. The matched bet thus features favorable self-selection. Time-inconsistent agents might participate in the bet while time-consistent agents do not participate.[6]

Welfare. I now consider the effects of offering a matched bet on individual and social welfare. Substituting (1) into (5) yields an agent's utility in period 0 given opportunity costs c_i:

$$\begin{aligned} &\delta_i \left[(\delta_i b_i - k_i - c_i + \mathcal{P}_i m)\mathcal{I}_i - \mathcal{P}_i \frac{1}{|S_i|} \sum_{j \in S_i} \mathcal{I}_j m \right] \\ \text{with} \quad &\mathcal{I}_i(c_i) = 1 \iff c_i \leq \beta_i \delta_i b_i - k_i + \mathcal{P}_i m, \\ &\mathcal{I}_j(c_j) = 1 \iff c_j \leq \beta_j \delta_j b_j - k_j + m \quad \forall\, j \in S_i. \end{aligned} \tag{11}$$

[6] Note that matching is crucial for favorable self-selection into the bet as shown in Section A.1.

Taking expectations as opportunity costs have not yet materialized in period 0 yields

$$\delta_i \left[\int_0^{\beta_i\delta_i b_i - k_i + \mathcal{P}_i m} (\delta_i b_i - k_i - c_i + \mathcal{P}_i m) f(c_i) dc_i - \mathcal{P}_i \frac{1}{|S_i|} \sum_{j \in S_i} \int_0^{\beta_j \delta_j b_j - k_j + m} m f(c_j) dc_j \right],$$

which can be simplified to

$$\mathbb{E}[U_i^W] = \delta_i \left[\int_0^{\beta_i\delta_i b_i - k_i + \mathcal{P}_i m} (\delta_i b_i - k_i - c_i) f(c_i) dc_i \right] \tag{12}$$

as $\beta_j\delta_j b_j - k_j + m = \beta_i\delta_i b_i - k_i + m \; \forall \; j \in S_i$. Because of matching, bet participants are expected to break even with the bet. The size of the bet stake thus only influences an agent's investment efficiency. One obtains an agent's individual welfare by combining (12) with the participation constraint (PC) leading to the following proposition that shows that offering a matched bet does not harm any agent.

Proposition 4 (Individual Welfare)

(i) The matched-bet mechanism makes all agents weakly better off in expectation compared to the baseline.

(ii) The matched-bet mechanism makes all agents for whom $m \leq (2 - \hat{\beta}_i - \beta_i)\delta_i b_i$ strictly better off in expectation.

Proof See Appendix B

Only agents who are better off in expectation with a matched bet participate in it. The Pareto improvement trivially holds for sophisticated agents because their perceived utility equals their true utility. It also holds for naive agents who maximize their perceived rather than their true utility. One could imagine naive agents to participate in a matched bet with a bet stake that is much too high, erroneously expecting to earn money with the bet, and thereby overinvesting. It turns out that this is not the case. Whenever an agent would be worse off taking up the bet, she does not take it up.

The second part of the above proposition provides a sufficient condition for when agents are strictly better off with a matched bet. Sophisticated agents are for sure better off if $m \leq 2(1 - \beta_i)\delta_i b_i$, i.e. if the bet stake is at most double the optimal bet stake of $m = (1 - \beta_i)\delta_i b_i$. Naive agents are for sure better off if the bet stake is at most equal to the optimal bet stake.

I now derive the effect of the matched bet on efficiency. Even though agents' welfare and investment efficiency are closely related, they are not equivalent. An agent might participate in a mechanism that makes her better off but induces her to invest less efficiently, for example, if the mechanisms subsidizes investment of time-consistent agents, which induces them to overinvest (see Section A.1). On the other hand, an agent might invest more efficiently but still be worse off with a bet. This might occur for naive agents who take up a commitment contract with a suboptimally high monetary stake. With a matched bet, however, individual and social welfare are perfectly aligned.

Proposition 5 (Social Welfare)

(i) All agents who take up a matched bet increase their efficiency compared to the baseline.

(ii) The fraction of prevented efficiency loss for an agent who takes up the bet is

$$\frac{\mathbb{E}[U^W_{i,\mathcal{P}_i=1}]-\mathbb{E}[U^W_{i,\mathcal{P}_i=0}]}{\mathbb{E}[U^W_{i,eff}]-\mathbb{E}[U^W_{i,\mathcal{P}_i=0}]} \geq \max\left[1-\left(1-\frac{m}{(1-\beta_i)\delta_i b_i}\right)^2, 0\right] \tag{13}$$

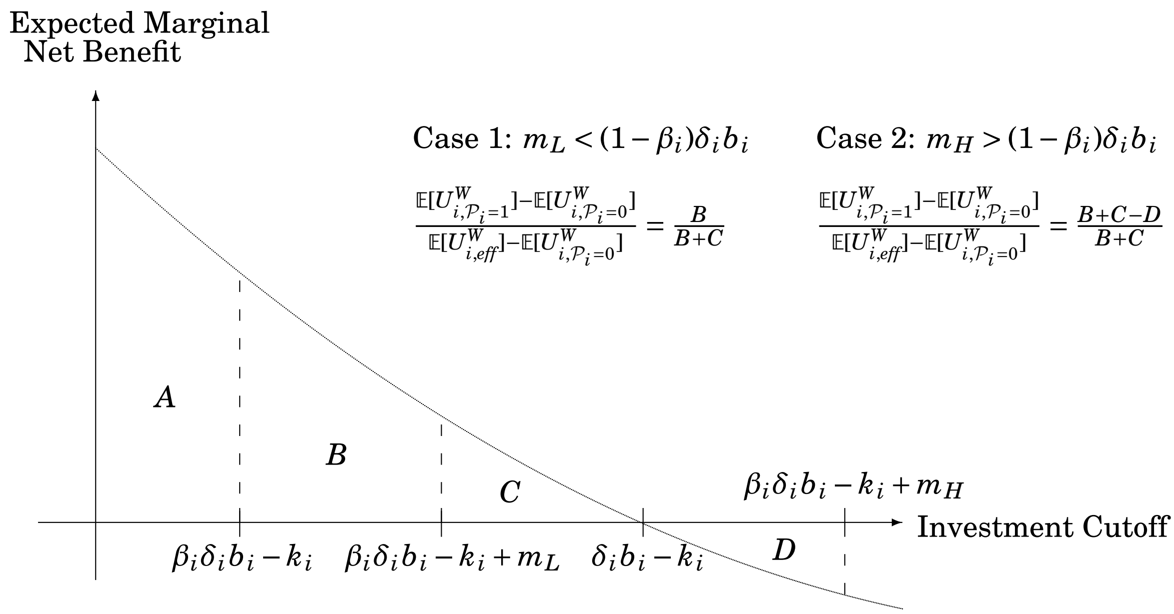
(iii) For agents with $\hat{\beta}_i = \beta_i$, the matched-bet mechanism maximizes efficiency among all take-it-or-leave-it mechanisms that provide agents with a dominant investment strategy.

Proof See Appendix B

The first part of the above proposition implies that social welfare never decreases with a matched bet. Matching is crucial for this result. Without matching, some agents might participate in a bet that induces them to actually invest less efficiently because this effect is overcompensated by a positive expected bet payoff (see Section A.1).

The second part of the above proposition shows that the matched bet is robust to deviations from the optimal bet stake $m = (1-\beta_i)\delta_i b_i$. For instance, an agent who participates in a matched bet with a bet stake that is half its optimal level already prevents at least 75% of the initial efficiency loss (Case 1 in Figure 2). The intuition is as follows. If costs are considerably lower than benefits, not investing yields a high efficiency loss. In contrast, if costs are only slightly lower than benefits, not investing yields only a small efficiency loss. This implies that a small bet stake, which prevents situations when the agent would incur a high efficiency loss, may already prevent most of the efficiency loss that occurs without a bet. The argument is analogous for a suboptimally high bet stake with one caveat (Case 2). As agents' willingness to participate in a matched bet decreases in the size of the bet stake, a suboptimally high bet stake might make naive agents erroneously reject the matched bet. Because of this, a benevolent policy maker offering a matched bet should lean to setting an overall conservative bet stake. This way, the policy maker ensures a high take-up rate and exploits the mechanism's robustness in efficiency to suboptimally small bet stakes.

Figure 2: Efficiency Gain



Note: The figure depicts the fraction of prevented efficiency loss for a present-biased bet participant when the bet stake is suboptimally low, $m_L < (1-\beta_i)\delta_i b_i$, or suboptimally high, $m_H > (1-\beta_i)\delta_i b_i$. Denoting the investment cutoff, i.e. the maximal c_i for which an agent still invests, by c_i', the expected marginal net benefit equals $(\delta_i b_i - k_i - c_i')f(c_i')$. It is convex in c_i' as $f(\cdot)$ is weakly decreasing. Initially, a bet participant invests if and only if $c_i \leq \beta_i\delta_i b_i - k_i$, which yields an initial net benefit equal to area A. As the efficient net benefit equals areas $A+B+C$, the initial efficiency loss equals areas $B+C$. With a matched bet, the efficiency loss reduces to area C with bet stake m_L and to area D with bet stake m_H. The fraction of prevented efficiency loss thus equals $\frac{B}{B+C}$ with bet stake m_L and $\frac{B+C-D}{B+C}$ with bet stake m_H.

The third part of proposition Proposition 5 states that for sophisticated agents the matched bet is the optimal mechanism among all take-it-or-leave-it mechanism that provide agents with a dominant investment strategy. The intuition is straightforward. With a matched bet, an agent is better off if and only if the agent exercises more efficiently as matching ensures an expected bet payment of zero. Sophisticated agents who take up a matched bet whenever it makes them better off, thus take up a matched bet whenever they invest more efficiently with it. Note that potentially other mechanisms might yield a higher efficiency for (partially) naive agents as these agents might not take up a matched bet even though it would be beneficial for them to do so. Numerical solutions suggest, however, that these inefficiencies are minor. In Section A.1, I compare the matched-bet mechanism to a subsidy, monetary commitment contract and unmatched bet, and show that the matched-bet mechanism yields the highest overall efficiency, robust to the chosen bet stake and cost distribution.

From Theory to Experiment. From the theoretical analysis, I obtain the following hypotheses that I can test in the experiment on exercising.

Hypothesis 1 *Time inconsistency has a positive effect on the likelihood of taking up the matched bet.*

Hypothesis 2 *Offering a matched bet increases gym attendance.*

4 Experimental Design

Recruitment. The experiment was conducted in collaboration with the university sports center (USC) of the University of Amsterdam in November and December 2017. I invited 1477 eligible gym members to complete a short baseline survey. All eligible members had a running student fitness membership at the USC in the period from October 16th (start of the matching period) to December 17th 2017 (end of the bet period). To target non-frequent gym attendees, only members who attended the gym on at most four days during the four-week matching period were invited to the survey.

Completion of the baseline survey was incentivized by a one-month extension of the fitness membership. The median person took about five minutes to complete the survey. In total, 629 subjects completed the baseline survey out of which 601 subjects were eligible for the analysis (206 subjects in a control group and 395 subjects in a treatment group).[7] The uneven group sizes were chosen to increase statistical power.

Procedure. Table 1 presents the timeline of the experiment. Eligible gym members were contacted via e-mail by the university sports center on November 14th. They were asked to click on a link which forwarded them to an online survey that they could complete until November 19th 2017. A reminder e-mail was sent on November 17th 2017.

The first part of this baseline survey included questions about demographics as well as past exercising behavior and future exercising beliefs. Subsequently, subjects were

[7] I excluded 28 subjects as they erroneously received incorrect information about their past gym attendance in the baseline survey.

randomized into two groups, control and treatment. Only subjects in the treatment group continued with the second part of the survey, which introduced subjects to the matched bet and then offered them to participate in it.

The four-week bet period started on November 20th and lasted until December 17th 2017. Bet participants were reminded of the beginning of the bet period and the rules on November 20th 2017 via e-mail. They were reminded that the bet period had ended on December 18th 2017 also via e-mail. Bet participants received another e-mail on December 20th with a link to a one-page follow-up survey.[8] The links were valid until December 31st 2017. Directly after the one-page follow-up survey bet participants were informed about their bet results and payment details.

Prior to the main experiment, I conducted a trial round in May and June 2017. Appendix C presents details about the design and results of the trial round.

Table 1: Timeline of Experiment

Date	Event
Sep 18, 2017 - Oct 15, 2017	Pre-matching period (pre-MP)
Oct 16, 2017 - Nov 12, 2017	Matching period (MP)
Nov 14, 2017 - Nov 19, 2017	Baseline survey
Nov 20, 2017 - Dec 17, 2017	Bet period (BP)
Dec 20, 2017 - Dec 31, 2017	Follow-up survey
Dec 18, 2017 - May 6, 2018	Post-bet period (post-BP)

Data. This paper combines data from two sources. It uses administrative data from the university sports center (USC) of the University of Amsterdam 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 five USC sport locations. The attendance data thus provides precise information about where and when a member entered a USC sport location.

The second source of data stems from the baseline and follow-up surveys. Both asked subjects about personal characteristics and exercising behavior. Appendix D gives the survey questions. In 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

[8]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.

'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. Bet participants were asked about their exercising frequency expectations given their bet participation and the (possibly negative) monetary net payoff they expect from the bet.

The follow-up survey was a shorter, non-incentivized version of the baseline survey except that bet participants were additionally asked how likely it is that they would take up a matched bet again.

Matched Bet Treatment. In the treatment group, subjects are *offered* to participate in a matched bet. Bet participants are anonymously grouped with all other participants who visited the sports center equally often in the four-week matching period. 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 scheme. 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 Propositions 3.i and 5.ii together suggest that a policy maker should lean to a conservative bet stake to maximize exercising efficiency.

Bet participants were 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. More elaborate matching procedures might predict future attendance even better and thus make the matching more precise. The performance of a matched bet, however, is robust to imperfect matching as shown in Section A.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 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 is 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 in 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.[9]

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 when it was framed as a fitness challenge.

Sample. Table 2 depicts the summary statistics. The first column shows the mean of baseline characteristics for all subjects. Columns 2 and 3 show the means for the control and treatment group. Subjects were on average 23 years old. There were slightly more

[9]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 with an unmatched bet).

women (59%) than men in the sample. About 16% of the subjects reported a BMI above 25 and are classified as overweight. 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 bet period, and expected to record 6.7.[10] To ease interpretation, subjects' answers to Likert-scale statements were converted into binary variables and coded as 1, if the subject answered 'slightly agree', 'agree' or 'strongly agree', and 0, otherwise. 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.

As one would expect from randomization, subjects in the control and treatment group are not significantly different from each other. A regression of the treatment assignment on the baseline characteristics shows that the characteristics cannot predict assignment to the treatment group as they are not jointly significant (p-value of F-statistic = 0.82). Only 1 out of 19 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 gym visits during the bet period, the treatment effect estimate will, if at all, be downward biased.

5 Experimental Results

This section presents the experimental results. Section 5.1 examines predictors of bet take-up. Section 5.2 presents the main treatment effects of offering a matched bet on gym attendance. Section 5.3 analyzes heterogeneity in the effect of offering a matched bet. Section 5.4 presents the effect of offering a matched bet on post-intervention gym attendance. Finally, Section 5.5 provides evidence that the increase in gym attendance of bet participants led to an increase in participants' welfare.

5.1 Bet Participation

In order to test whether the matched bet features favorable self-selection not only in theory but also in practice, this section investigates who participates in a matched bet. In total, 99 out of 395 subjects (25%) that were offered the matched bet chose to participate.

[10]Subjects in the control group turned out to record 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).

Table 2: 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 (0/1)	0.586	0.549	0.605	0.182	0.608	0.596	0.831
Age	23.448	23.660	23.337	0.294	23.149	23.899	0.047
International (0/1)	0.293	0.330	0.273	0.147	0.250	0.343	0.071
Overweight (0/1)	0.163	0.180	0.154	0.428	0.149	0.172	0.582
Duration of membership	11.087	11.126	11.066	0.774	11.189	10.697	0.081
Gym visits in pre-MP	2.877	2.874	2.878	0.984	2.851	2.960	0.737
Gym visits in MP	1.767	1.704	1.800	0.439	1.767	1.899	0.434
Avg. duration of exercise	60.780	61.544	60.382	0.533	59.878	61.889	0.416
Exercise outside USC in MP	4.905	5.267	4.716	0.260	5.159	3.394	0.005
Exp. gym visits in BP	6.691	7.083	6.486	0.078	6.264	7.152	0.042
Exp. gym visits in BP for €5	8.471	8.597	8.405	0.689	8.115	9.273	0.068
Gym visits goal in BP	8.867	9.330	8.625	0.049	8.463	9.111	0.160
Procrastinated in MP (0/1)	0.621	0.631	0.615	0.703	0.571	0.747	0.002
Expects to procr. in MP (0/1)	0.343	0.330	0.349	0.637	0.324	0.424	0.071
Motivated (0/1)	0.749	0.738	0.754	0.657	0.757	0.747	0.853
Competitive (0/1)	0.744	0.767	0.732	0.346	0.723	0.758	0.501
Willing to take risks (0/1)	0.696	0.709	0.689	0.611	0.669	0.747	0.144
Less gym visits in MP (0/1)	0.720	0.738	0.711	0.493	0.696	0.758	0.241
More gym visits in MP (0/1)	0.087	0.102	0.078	0.332	0.084	0.061	0.445
Fit (0/1)	0.784	0.786	0.782	0.907	0.787	0.768	0.684
Satisfied with exercise (0/1)	0.346	0.325	0.357	0.438	0.355	0.364	0.873
Happy (0/1)	0.842	0.864	0.830	0.283	0.848	0.778	0.107
Healthy lifestyle (0/1)	0.571	0.558	0.577	0.656	0.578	0.576	0.973
Exp. gym visits in BP with bet						8.899	
Exp. bet earnings in €						7.929	
F-statistic (p-value)				0.815			
Observations	601	206	395		296	99	

Note: 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 or tests of proportions. F-statistic to test joint significance. pre-MP = pre-matching period, MP = matching period, BP = bet period.

Columns 5 to 7 of Table 2 compare characteristics of bet rejecters and bet participants. Age, expected gym visits during the bet period and procrastination of exercising sessions during the matching period are significantly positively correlated with bet take-up, while exercising sessions outside the university gym is significantly negatively correlated. I also find that being an international student and expecting to procrastinate exercising sessions during the bet period are positively correlated with bet take-up, while contract duration is negatively correlated. There is no significant gender difference in the bet take-up rate.

The results of the univariate analysis are supported by a multivariate analysis. Table 3 shows regression results explaining bet take-up.[11] Column 1 shows the take-up rates depending on gym visits during the matching period. Zero visits during the matching period serves as the reference group. Subjects who visited the gym at least once during the matching period are more likely to take up the bet than subjects who recorded zero visits. Having visited the gym at least once during the matching period increases the bet take-up rate by 9.5% (p-value = 0.037). While subjects with a strictly positive gym attendance during the matching period reveal to be at least somewhat interested in going to the gym, some subjects with zero visits might have lost interest in doing so. Indeed, subjects with at least one visit are significantly more motivated to exercise (p-value < 0.001). Conditional on at least one visit, however, participation decreases in past gym attendance.

Column 2 shows the results of a regression of bet take-up on past gym attendance and demographic variables. This regression serves as an indication of how good a policy maker could predict who will take up a matched bet. Note that the variables can only explain about 5% of the variation in the bet take-up decision. The only significant variable is membership duration. Having a 3-month rather than a 12-month membership makes subjects more likely to take up the bet.

Column 3 includes variables that are usually unknown to a policy maker. There are two variables with a significant effect on bet take-up. One extra exercising session outside the USC during the matching period significantly decreases bet take-up by 0.9% (p-value = 0.007). An explanation for this finding is that people who already exercise outside the USC often do not need to increase their gym attendance at the USC to stay fit and healthy, and thus do not participate in the matched bet. Having procrastinated exercising sessions during the matching period significantly increases bet take-up by 10.9% (p-value = 0.028). The estimated effect of 6.3% of expecting to procrastinate exercising sessions during the bet period on bet take-up is positive, but not statistically significant (p-value = 0.231).

[11]For ease of interpretation, I present results from OLS regressions throughout this paper. All results are virtually the same when using probit regressions.

Table 3: Predictors of Bet Take-up

	(1)	(2)	(3)	(4)
1 gym visit in MP (0/1)	0.132**	0.135*		0.125*
	(0.067)	(0.071)		(0.070)
2 gym visits in MP (0/1)	0.121*	0.103		0.089
	(0.068)	(0.071)		(0.073)
3 gym visits in MP (0/1)	0.071	0.062		0.048
	(0.060)	(0.064)		(0.063)
4 gym visits in MP (0/1)	0.060	0.056		0.028
	(0.066)	(0.078)		(0.076)
Gym visits in pre-MP		0.001		0.000
		(0.010)		(0.010)
Female (0/1)		-0.009		0.009
		(0.046)		(0.046)
Age		0.014*		0.013*
		(0.007)		(0.007)
International (0/1)		0.066		0.045
		(0.051)		(0.051)
Overweight (0/1)		0.021		0.022
		(0.065)		(0.064)
3-month membership		0.288**		0.260**
		(0.123)		(0.124)
6-month membership		-0.017		-0.006
		(0.074)		(0.069)
Exercise outside USC in MP			-0.009***	-0.007**
			(0.003)	(0.003)
Expected gym visits in BP			0.012**	0.010
			(0.006)	(0.007)
Procrastinated in MP (0/1)			0.109**	0.110**
			(0.049)	(0.049)
Expects to procr. in BP (0/1)			0.063	0.059
			(0.053)	(0.053)
Motivated (0/1)			0.035	0.027
			(0.055)	(0.058)
Competitive (0/1)			0.031	0.039
			(0.047)	(0.048)
Willing to take risks (0/1)			0.057	0.035
			(0.045)	(0.046)
Constant	0.182***	-0.162	0.034	-0.324*
	(0.037)	(0.172)	(0.078)	(0.176)
Observations	395	395	395	395
R^2	0.013	0.048	0.057	0.094

Note: The table shows OLS estimates. The dependent variable indicates whether a subject participated in the matched bet. MP = matching period, BP = bet period. Omitted: 0 visits in MP (0/1) and 12-month membership. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

When we denote subjects who reported past or future procrastination as self-reported procrastinators, we find that being a procrastinator increases the bet take-up rate by 13.3% (p-value = 0.005). This confirms the theoretical prediction of Hypothesis 1 that time inconsistency has a positive effect on the likelihood of taking up a matched bet. There is thus evidence for favorable self-selection into the matched-bet mechanism.

Result 1 *Time inconsistency has a positive effect on the likelihood of taking up a matched bet.*

The sizes of the effects of past and future procrastination hardly change depending on whether past gym attendance data and demographic variables are included or not (columns 3 vs. 4). This suggests a policy maker cannot easily identify time-inconsistent people and has to rely on people's self-selection into the bet. Motivation to exercise, competitiveness, willingness to take risks and expected procrastination in the future all have a positive but insignificant effect on bet take-up. In total, all variables explain only about 9% of the variation in the bet take-up decision.

In the first survey, 70% of the bet participants report that they expect to win money, 21% to break-even, and 9% to lose money with the bet. On average, bet participants expected to win €7.93. Because overall bet payoffs sum up to zero, bet participants are thus overconfident in aggregate. Participants' expected bet payoff was not predictive of their actual bet payoff. Their payoff expectation is only marginally positively correlated with their actual bet payoff (corr. = 0.03) and does not predict it (p-value = 0.727).

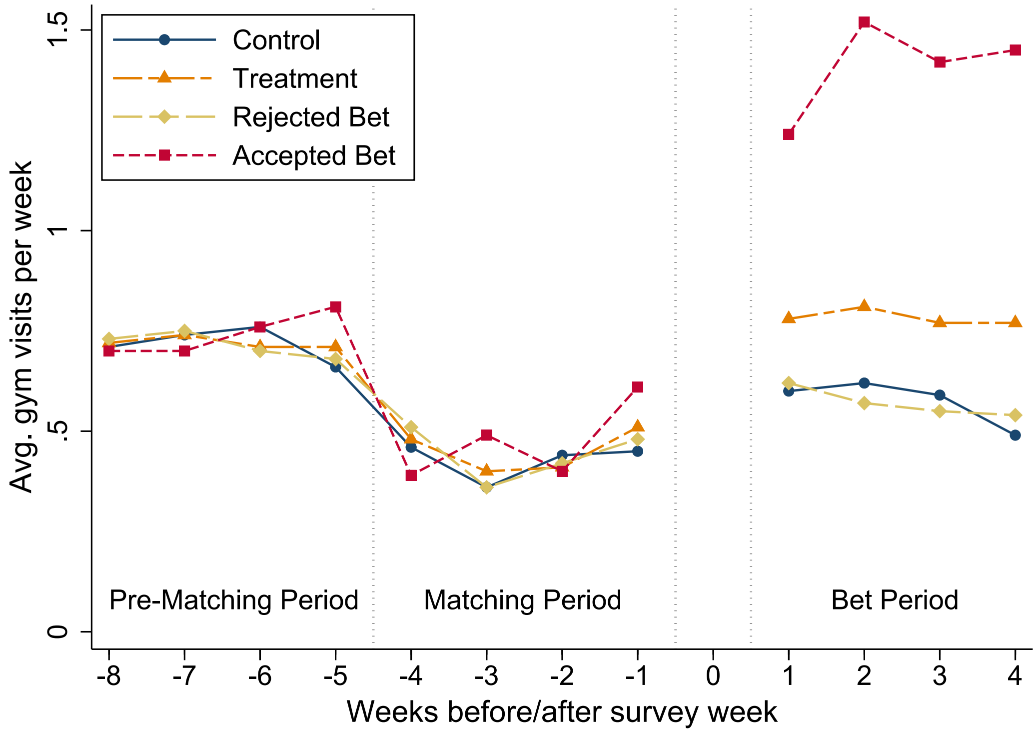
5.2 Main Effects

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. 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.

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 on gym attendance before and after the matching period.

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

Figure 3: Average Weekly Gym Visits over Time by Groups



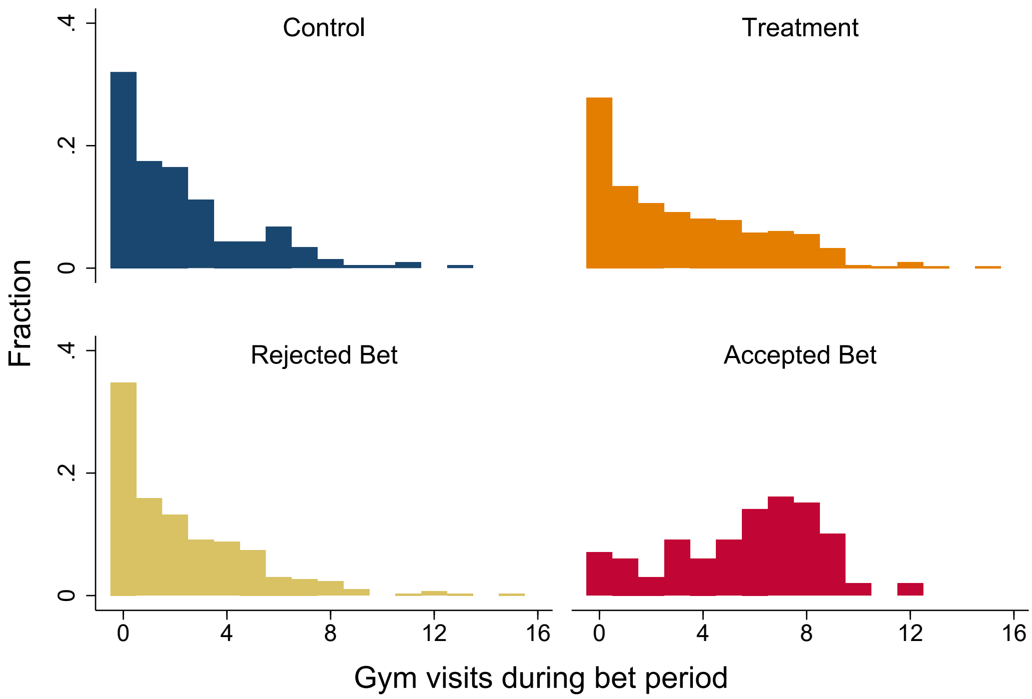
Note: The figure shows the average weekly gym visits over time by different groups. It shows averages for the control group (continuous blue line) and treatment group (long-short-dashed orange line). Splitting up the treatment group shows average visits over time for subjects who rejected the bet (long-dashed 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.

Out of the 395 subjects in the bet treatment 99 accepted and 296 rejected the bet, which yields a take-up rate of just over 25%. 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. The latter have a weekly gym attendance 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.

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



Note: The figure shows 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).

We observe a similar gym attendance distribution of the control and bet treatment. Both empirical distributions are shaped like an exponential distribution with zero-attendance subjects being overrepresented. The bet treatment distribution first-order dominates the control treatment distribution and a Wilcoxon rank-sum test shows that the two distributions are not equal (p-value = 0.002).

The frequency distribution of gym visits of bet participants looks distinctly different from the control group and from the subjects that rejected the bet. The distribution has a mode of 7 visits. Even though the matched bet monetarily incentivized gym visits up to the 8th visit, we do not observe a drastic drop in the attendance frequency from 8 to 9 visits. About 14% of the bet participants registered more than 8 gym visits during the bet period.

Table 4 shows results of regressing the number of gym visits on the treatment variable. Column 1 shows the result without controls while column 2 includes some controls to increase precision. Offering a matched bet increases gym attendance by 0.87 visits during the bet period (column 1). The effect is highly significant (p-value < 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 standard deviations.

Table 4: Treatment Effect of Offering Bet

	Gym visits in BP		1+ gym visits in BP (0/1)	
	(1)	(2)	(3)	(4)
Treated (0/1)	0.867***	0.928***	0.042	0.038
	(0.235)	(0.203)	(0.040)	(0.036)
Gym visits in MP		0.460***		0.114***
		(0.074)		(0.012)
Gym visits in pre-MP		0.254***		0.022***
		(0.047)		(0.007)
Expected gym visits in BP		0.179***		0.012***
		(0.033)		(0.004)
Constant	2.257***	-0.521**	0.680***	0.336***
	(0.177)	(0.230)	(0.033)	(0.047)
Observations	601	601	601	601
R-squared	0.020	0.269	0.002	0.215

Note: 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 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

The effect size is robust to including some control variables; here the treatment effect is estimated at 0.93 extra gym visits (column 2). This gives the following result, which confirms Hypothesis 2.

Result 2 *Offering a matched bet increases gym attendance.*

Columns 3 in Table 4 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 people that record at least one gym visit during the bet period (p-value = 0.291). This finding is robust to including some control variables (column 4). The matched bet thus showed no significant effect at the extensive margin. This finding is in contrast to Royer et al. (2015) who find significant effects at the extensive margin of existing gym members when a subsidy is used to incentivize exercising. One explanation for the different findings could be that a subsidy 'forces' monetary incentives on unmotivated subjects who would reject imposing monetary incentives on themselves through a bet.

Under the assumption that the pure act of offering the bet did not affect the exercising frequency of bet rejecters (exclusion restriction), we can use the treatment assignment as an instrument for bet take-up. This way we can estimate the treatment effects on the treated, depicted in Table 5. Column 1 shows that taking up a matched bet increases gym attendance by 3.46 visits during the bet period. The effect is highly significant (p-value < 0.001) and robust to including some control variables (column 2). With an average gym attendance of 2.26 of the control group, this translates into a 153% increase in gym attendance. The treatment effect on the treated equals 1.36 standard deviations. The magnitude of the increase in gym attendance 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 six extra visits with higher monetary incentives, while Rohde and Verbeke (2017) and Carrera et al. (2018a) find lower effects of about one extra visit with lower monetary incentives than provided with the matched bet in this experiment.

Table 5: Treatment Effect of Accepting Bet (IV)

	Gym visits in BP		1+ gym visits in BP (0/1)	
	(1)	(2)	(3)	(4)
Accepted Bet (0/1)	3.458***	3.650***	0.167	0.151
	(0.891)	(0.750)	(0.156)	(0.138)
Gym visits in MP		0.437***		0.113***
		(0.068)		(0.012)
Gym visits in pre-MP		0.260***		0.022***
		(0.044)		(0.006)
Expected gym visits in BP		0.153***		0.011***
		(0.030)		(0.004)
Constant	2.257***	-0.317	0.680***	0.344***
	(0.177)	(0.193)	(0.033)	(0.043)
Observations	601	601	601	601
R-squared	0.181	0.405	0.041	0.246

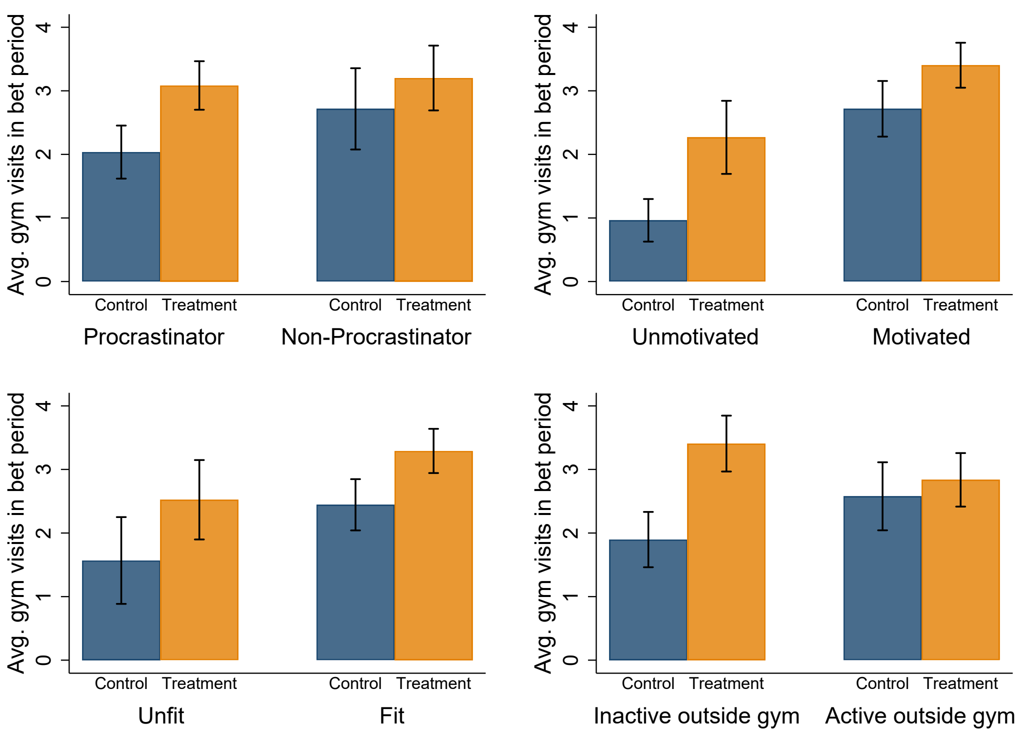
Note: The dependent variable in (1) and (2) is the number of gym visits during the bet period. The dependent variable in (3) and (4) indicates whether a subject recorded at least one gym visit during the (four-week) bet period. The treatment variable indicates whether a subject participated in the matched bet. The control variables 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. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Column 3 shows that taking up a matched bet increases the likelihood to record at least one gym visit during the bet period by 16.7%. This increase is robust to including some control variables (column 4), but is not significant (p-value = 0.285).

5.3 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 5 shows the effects of offering the matched bet on gym attendance along four dimensions.

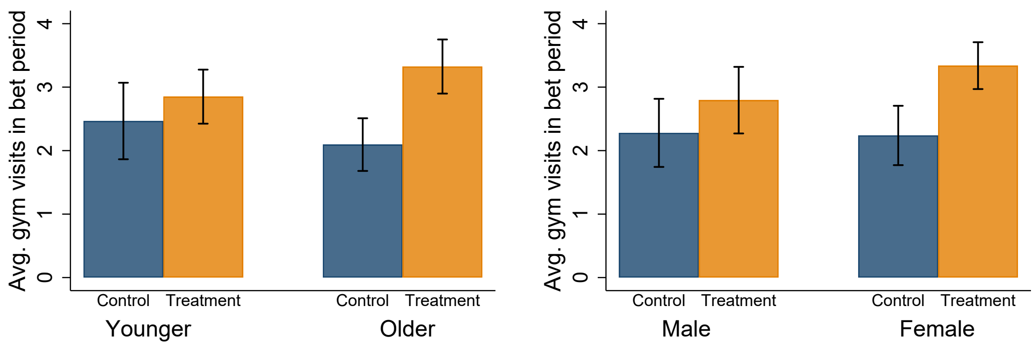
Figure 5: Differences in Effectiveness of Treatment



Note: 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 (top left), self-reported unmotivated vs. motivated subjects (top right), self-reported unfit vs. fit subjects (bottom left) and subjects who reported less vs. equal or more exercising sessions than the median outside the university gym during the (four-week) matching period (bottom right). The vertical lines denote the ninety-five percent confidence intervals.

The difference between the treatment and control group is about double the size for self-reported procrastinators than for non-procrastinators (p-value = 0.261), which can be explained by the higher bet take-up rate (30% vs. 16%). Subjects who reported fewer than the median number of exercising sessions outside the university gym during the matching period had a significantly higher increase in gym attendance than subjects who reported a number equal or above the median (p-value = 0.007). While subjects below the median are more likely to take up the matched bet (29% vs. 21%), those that accept also increase their gym attendance significantly more than subjects above the median (p-value = 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. There is a larger difference between the treatment and control group for unmotivated compared to motivated subjects (p-value = 0.159). As the take-up rates for unmotivated and motivated subjects are very similar, the larger difference for unmotivated subjects suggests that unmotivated bet participants 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 effect of offering the matched bet for self-reported unfit and fit subjects (p-value = 0.839).

Figure 6: Differences in Effectiveness of Treatment (Age and Gender)



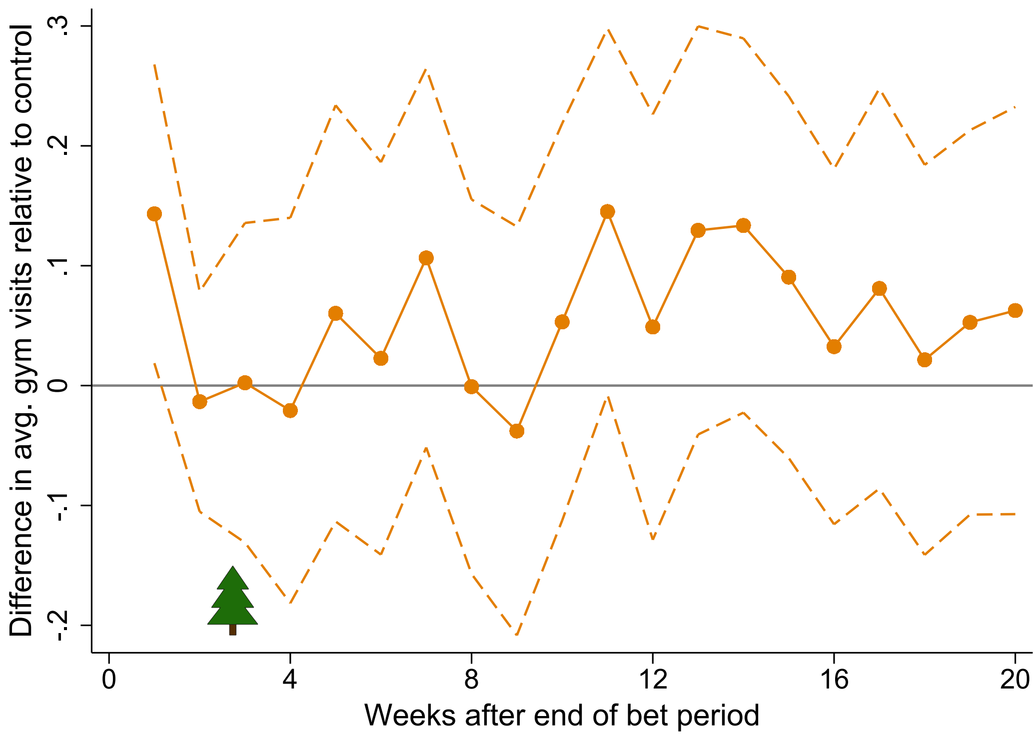
Note: The figure shows differences in the effect of offering the matched bet on gym attendance during the (four-week) bet period by splitting up the subject pool by gender (right), and into subjects who have below vs. equal or above median age (left). The vertical lines denote the ninety-five percent confidence intervals.

Figure 6 depicts the effect of offering a matched bet on gym attendance along two demographic dimensions, age and gender. There is a bigger change in differences 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-value = 0.077). There is also a bigger change for female compared to male subjects (p-value = 0.227). This difference is not driven by the bet take-up rate.

5.4 Long-Run Effects

The matched bet increases gym attendance during the intervention period. This section analyzes the long-run effects of offering a matched bet. Figure 7 depicts the weekly effect of offering the matched bet on gym attendance up to 20 weeks after the end of the bet period.

Figure 7: Long-Run Treatment Effects



Note: 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.

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-value = 0.024). From the second week onward, the weekly treatment effects – though mostly positive – are statistically insignificant. This could 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 (see e.g. Acland and Levy, 2015). Over the course of the 20-week post-bet period subjects in the treatment group recorded 1.11 gym visits – about 10% and 0.10 standard deviations – more than subjects in the control group (12.10 vs. 10.99). The difference is not significant (p-value = 0.269). Per week, the point estimate for the post-bet period is about one fourth of the treatment effect estimated for the bet period. This ratio is close to those in Acland and Levy (2015) and Royer et al. (2015), and slightly more than half the size found in Charness and Gneezy (2009). Note that, unlike for a subsidy, the cost-effectiveness of the matched bet does not rely on post-intervention effects. Due to its budget balancedness, matched bet rounds could be continuously offered (see Section 6.1).

5.5 Welfare Effects

The matched bet increases participants' gym attendance. But do bet participants also exercise more efficiently with a matched bet? It could be the case that the extra monetary incentive makes participants visit the gym too often. While a participant's efficient exercising level is not observable, the survey results provide evidence that the bet does indeed increase efficiency.

First, bet participants visit the gym less often than they aim and expect. On average, participants aim and expect 9.11 resp. 7.15 visits during the bet period without the matched bet, but only record 5.64 visits with the matched bet. Only 18% of bet participants recorded more visits than they initially aimed for. In general, it thus seems that the matched bet did not induce bet participants to overexercise, but instead helped them decrease the extent of underexercising.

Second, bet participants reported to be more satisfied with their exercising frequency at the USC and reported less procrastination in the prior four weeks when surveyed after the bet period than before. Table 6 shows a before-after comparison of several outcome measures. As there was some attrition in the follow-up survey, columns 1 and 2 show the difference assuming attrition was random, while columns 3 to 5 provide bounds on the difference. Assuming random attrition, the satisfaction of bet participants increased by 18% (p-value = 0.003) and self-reported procrastination of exercising sessions decreased by 32% (p-value < 0.001), both of which are highly significant. There seems to be 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).

Third, 72 out of 90 bet participants who completed the follow-up survey stated they would likely participate in a matched bet again in the future. Most participants thus perceive the matched bet as welfare-enhancing.

Fourth, there seems little substitution in exercising behavior. Bet participants report an almost identical (p-value = 0.976) average duration of their gym visits before (62.8 minutes) and during the bet period (63.0 minutes). They also report a similar (p-value = 0.209) number of exercising sessions outside the USC before (3.2 sessions) and during

Table 6: Welfare Effects of Offering Bet

	Random attrition		Manski Bounds		
	Baseline	Δ	Baseline	Lower Δ	Upper Δ
Satisfied with exercise (0/1)	0.356	0.178***	0.364	0.121	0.212
	(0.051)	(0.058)	(0.049)		
Procrastinated in prior 4 weeks (0/1)	0.756	-0.322***	0.747	-0.354	-0.263
	(0.046)	(0.072)	(0.044)		
Fit (0/1)	0.789	-0.033	0.768	-0.081	0.010
	(0.043)	(0.051)	(0.043)		
Healthy lifestyle (0/1)	0.600	0.078	0.576	0.040	0.131
	(0.052)	(0.060)	(0.050)		
Happy (0/1)	0.800	-0.022	0.778	-0.071	0.020
	(0.042)	(0.052)	(0.042)		
Observations	90	90	99	99	99

Note: The dependent variables are in the left column. The binary variables indicate self-reported satisfaction with one's exercising frequency at the university sports center, self-reported procrastination of exercising sessions at the university sports center in the prior four weeks, self-reported fitness, self-reported healthy lifestyle, and self-reported 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 0, the upper bound a 1 to all missing variables in the follow-up survey. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

the bet period (2.9 sessions).

In summary, participants thus came closer to their desired exercising frequency, reported to be more satisfied with their exercising behavior, procrastinated less and did not report significant substitution of exercising behavior. Also, most of the bet participants stated they would likely take up a matched bet again in the future. Together, these findings suggest that the matched bet indeed increased participants' welfare.

6 Discussion

The results of the field experiment have shown that the matched bet is a promising mechanism to help people overcome time inconsistency in exercising. This section discusses remaining practical challenges to increase the effectiveness of the matched-bet mechanism even further. It also discusses opportunities to apply the matched bet in other areas such as academic performance, weight loss and smoking cessation.

6.1 Challenges

The experiment shows that offering a matched bet increases participants' gym attendance during the intervention period to a statistically and economically significant extent. This positive outcome serves as a first step to establish the matched bet as a promising alternative to existing incentive schemes. Challenges remain with respect to increasing the bet take-up rate and establishing positive long-run effects.

Take-Up Rate. The experiment featured a bet take-up rate of 25%. This is about double the take-up rate observed in experiments with 'pure' deposit commitment contracts.[12] Given that 62% of the subjects self-identified as procrastinators, however, the efficient bet take-up rate is likely to be higher than 25%. This suboptimally low rate limits the matched bet's effectiveness. There could be several reasons why many subjects rejected the matched bet. In the baseline survey, the most commonly stated reasons to reject the matched bet were: being too busy with studying, being afraid of losing money and opposing linking exercising to money. While study obligations are an understandable reason to refrain from committing oneself to exercise, recent studies suggest that there is no actual trade-off between academic performance and exercising. Cappelen et al. (2017) and Fricke et al. (2018) provide evidence that exercising has a considerable and positive effect on academic performance. In order to also attract subjects who are comparatively busy in the first few weeks of the bet period, one might offer the matched bet with a longer bet period of several months. The longer bet period might also mitigate people's fear of losing money, as a longer period diminishes the effect of potential negative exercising frequency shocks such as injuries or sickness.

A straightforward alternative for a less budget-constrained policy maker to mitigate people's fear of losing money and thereby increasing bet take-up is to offer a subsidized matched bet. One way to implement a subsidized bet is to offer a matched bet with a participation bonus. The magnitude of this bonus should depend on the policy maker's budget, the current underparticipation in the matched bet and possible externalities of the incentivized behavior. The overall utility from exercising, for example, includes the utility for the individual and the utility for employers and society due to lower health costs. This implies that even when the matched bet helps bet participants to achieve their maximal utility from exercising, participants might still exercise at inefficiently low frequency from the point of view of the employer or society. In such cases, adding a

[12] Royer et al. (2015) and Giné et al. (2010) find take-up rates of 12% for commitment to exercise and 11% to stop smoking.

participation bonus to the matched bet can increase social welfare.

A minority of subjects refrained from taking up the matched bet because they opposed linking exercising to money. For these people offering a bet with a non-monetary bet stake might be more suitable. One could, for example, bet for gym membership days (exercising) or grade points (studying). Non-monetary bet stakes could also be a viable alternative if monetary bets cannot be implemented for other reasons.

Long-Run Effects. The second challenge concerns the lack of statistically significant positive long-run effects of the matched bet in the experiment. While offering the bet still has a significantly positive effect on gym attendance in the first week after the end of the bet period, the weekly effects – though mostly positive – are statistically insignificant from the second week onward. This might be partly due to the Christmas break starting one week after the end of the bet period. A different timing of the intervention might have yielded more persistent effects. Nevertheless, it could be that many bet participants need to participate in a matched bet not only once but repeatedly to continue visiting the gym on a more regular basis. As the matched bet is strictly budget-balanced, offering repeated bet rounds does not run into financing issues (as might be the case with a subsidy).

Note though that bet participants need to be willing to repeatedly participate in matched bet rounds. While whether they do so is an empirical question that calls for future studies, in this study at least 73% of bet participants find it likely that they would take up a matched bet again.[13] 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 (corr. = 0.42).

Offering the matched bet on a regular basis 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 exercising deliberately rarely during the matching period. This way they can ensure to be grouped with partners with a lower expected exercising frequency, which translates into an increase in their expected bet payoff. To prevent such behavior, the deliberately foregone exercising benefit during the matching period needs to outweigh the expected monetary gain due to an easier matching group. Two possible solutions are to either set the bet stake sufficiently low or to have a comparatively long matching period.

[13] 72 out of 90 (80%) responding bet participants stated in the follow-up survey that they would likely take up a matched bet again. The share drops to 73% if we assume that all 9 non-responding bet participants would not take up a matched bet again.

6.2 Applying the Matched Bet in other Areas

The matched bet is not limited to exercising only, but can be applied to other areas such as academic performance, weight loss and smoking cessation as well. The matched bet is especially promising if a large proportion of the targeted population exhibits time-inconsistent behavior, participants' target behavior is easily observable, and accurate matching is possible.

The more people of the targeted population exhibit time-inconsistent behavior, the more the matched bet can help people behave more efficiently. The matched bet shares the requirement that participants' target behavior is easily observable or estimable with other incentive schemes such as subsidies and commitment contracts. In many cases, however, target behavior is not easily observable. Then, the matched-bet mechanism might still work if there exists a sufficiently good and easily observable proxy to estimate the target behavior. For exercise e.g., gym attendance is a proxy for overall exercise, the target behavior. Proxies can be input- or output-driven. Ceteris paribus, input-driven proxies seem preferable as people can better control their input than their output (Gneezy et al., 2011). However, input-driven proxies are not always available, they might lead to inefficient substitution or make it difficult to match bet participants accurately. If a policy maker can neither easily observe input-driven nor output-driven proxies, a centralized version of the matched bet is not possible. In this case, one might turn to a decentralized version of matched bet where agents directly bet with each other and choose the bet stake themselves. An outline of this alternative mechanism is given in Section A.3.

The matched bet requires that accurate matching is possible. If matching is not possible, one can only offer an unmatched bet. Section A.1 shows the effects of a bet without matching. The matching instrument needs to be predictive of behavior during the bet period. Often, past behavior is a good predictor of future behavior. As previously discussed, however, past behavior might be prone to manipulation.

Given the three requirements, academic performance, weight loss and smoking cessation seem to be promising new areas of application. In all three areas many people exhibit time-inconsistent behavior. Grades are a good proxy for study effort, BMI is a good proxy for excessive body fat and cotinine tests are a good indicator of smoking behavior. Past grades in related courses should be a good matching instrument, as is current BMI for weight loss and current cotinine levels for smoking behavior.

7 Conclusion

Using theory and a field experiment, I study 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.

In a theoretical model inspired by DellaVigna and Malmendier (2004), I show that the matched-bet mechanism helps both sophisticated and naive procrastinators reduce time-inconsistent behavior. In a model that allows agents to have private and individual-specific degrees of time inconsistency, naiveté, investment benefits and effort costs, I show that it is sufficient to know agents' expected baseline investment frequencies to offer a Pareto improving matched bet.

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 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, suggesting favorable self-selection into the bet.

Overall, the matched-bet mechanism is a promising mechanism to help people overcome time-inconsistent behavior, both in theory and in practice. Unlike existing mechanisms, the matched bet is both low-cost and effective. For future research, it would be interesting to investigate whether the matched-bet mechanism can induce persistent behavioral change through repeated bet rounds, and whether the matched bet would also prove to be an effective mechanism in other areas such as academic performance, weight loss and smoking cessation.

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A Theoretical Extensions

This section discusses four theoretical extensions of the model. First, it compares the performance of the matched-bet mechanism to existing mechanisms. Second, it shows that the matched-bet mechanism is robust to imperfect matching. Third, it discusses a decentralized version of the matched bet. And fourth, I analyze a setting in which the underlying parameters of each agent are known.

A.1 Relative Performance of the Matched-Bet Mechanism

This section compares the relative performance of the matched-bet mechanism in comparison to existing mechanisms. I derive results analytically, but also rely on numerical solutions when results are not analytically tractable. I compare the matched bet to a subsidy, a monetary commitment contract and an unmatched bet. With a subsidy, a participant is paid a reward equal to the monetary stake m if she invests ($\mathcal{I}_i = 1$). Formally, this can be represented by a monetary transfer of $T_i^{Su} = \mathcal{I}_i m$. With a monetary commitment contract, a participant loses an amount equal to the monetary stake if she does not invest, so that $T_i^{Co} = -(1-\mathcal{I}_i)m$. In an unmatched bet, bet participants are grouped with all other participants, irrespective of their expected investment frequencies. Formally, an unmatched bet specifies the monetary transfer to a bet participant by $T_i^{Un} = \mathcal{I}_i m - \frac{1}{|S_i'|}\sum_{j \in S_i'} \mathcal{I}_j m$ with set $S_i' \equiv \{j \neq i | \mathcal{P}_j = 1\}$, and $|S_i'|$ denoting the number of agents in S_i'. Note that, as in a matched bet, agents who participate in a subsidy, commitment contract or unmatched bet also invest if and only if $c_i \leq \beta_i \delta_i b_i - k_i + m$. Conditional on participation, the mechanisms thus do not differ. They only differ regarding the agents' participation decisions.

Deriving the participation constraints for a subsidy, commitment contract and unmatched bet yields

$$\underbrace{\int_{\hat{\beta}_i \delta_i b_i - k_i}^{\hat{\beta}_i \delta_i b_i - k_i + m} (\delta_i b_i - k_i - c_i) f(c_i) dc_i}_{\text{Incentive Value}} + \underbrace{\int_0^{\hat{\beta}_i \delta_i b_i - k_i + m} m f(c_i) dc_i}_{\text{Monetary Value}} \geq 0, \tag{PC Su}$$

$$\underbrace{\int_{\hat{\beta}_i \delta_i b_i - k_i}^{\hat{\beta}_i \delta_i b_i - k_i + m} (\delta_i b_i - k_i - c_i) f(c_i) dc_i}_{\text{Incentive Value}} + \underbrace{\int_0^{\hat{\beta}_i \delta_i b_i - k_i + m} m f(c_i) dc_i - m}_{\text{Monetary Value}} \geq 0, \tag{PC Co}$$

and

$$\underbrace{\int_{\hat{\beta}_i\delta_i b_i - k_i}^{\hat{\beta}_i\delta_i b_i - k_i + m} (\delta_i b_i - k_i - c_i) f(c_i) dc_i}_{\text{Incentive Value}} + \underbrace{\int_0^{\hat{\beta}_i\delta_i b_i - k_i + m} m f(c_i) dc_i - \sum_{j \in S_i'} \int_0^{\beta_j \delta_j b_j - k_j + m} \frac{m}{|S_i'|} f(c_j) dc_j}_{\text{Monetary Value}} \geq 0. \tag{PC Un}$$

Note that the incentive values are equivalent for a subsidy, commitment contract, unmatched bet and matched bet (PC). The mechanisms differ in the monetary value though. Analyzing the participation constraints yields the following proposition.

Proposition A.1 (Take-up of Subsidy, Commitment Contract and Unmatched Bet)

(i) Every agent participates in a subsidy.

(ii) An agent's participation in a commitment contract and unmatched bet does not depend on her degree of time inconsistency.

Proof See Appendix B

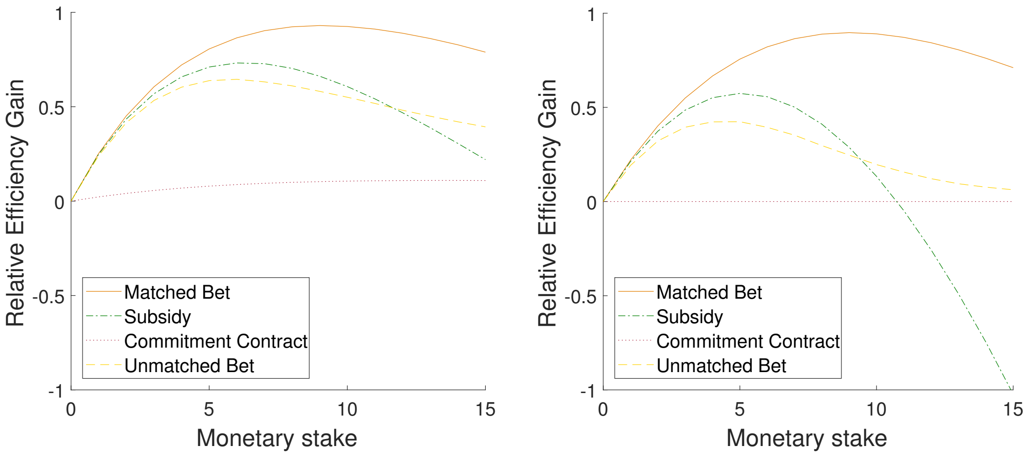
The first part states that a subsidy does not feature any non-trivial self-selection. The positive monetary value of a subsidy is always sufficiently large to make participation in a subsidy worthwhile. The second part of the proposition implies that, ceteris paribus, time-consistent agents and naive procrastinators take the same participation decision in a commitment contract resp. unmatched bet, even though their value of commitment is different. There is thus no separating equilibrium between naive and rational types in a commitment contract and unmatched bet.

To compare the welfare effects of a matched bet to a subsidy, commitment contract and unmatched bet, I rely on numerical solutions. I use the following calibration. I assume benefits b_i are uniformly distributed on the interval $[15,25]$. Similarly, effort costs k_i are uniformly distributed on the interval $[0,5]$. Opportunity costs c_i follow an exponential distribution with mean of 10 (case 1) or mean of 30 (case 2). This way, I capture situations when it is efficient to invest often and when it is efficient to invest only rarely. I inform the calibration of present bias $1-\beta_i$, perceived present bias $1-\hat{\beta}_i$ and long-run discount factor δ_i on the literature that has estimated people's time preferences (see e.g. Augenblick et al., 2015; Augenblick and Rabin, 2018). I assume that one third of the agents is time-consistent (β_i), while for the remaining two thirds of agents β_i is uniformly distributed on the interval $[\frac{1}{3},1]$. Further, $\hat{\beta}_i$ is uniformly distributed on the interval $[\beta_i,1]$ to account for the finding in the literature that most people tend to be partially unaware of their present bias. I assume a common long-run discount factor of 1, thus $\delta_i = 1$.

Figure A1 compares the matched-bet mechanism to a subsidy, commitment contract and unmatched bet with respect to the share of prevented efficiency loss for various monetary stakes. The figure depicts performance with low (left graph) and high expected investment costs (right graph). Even though agents are heterogeneous, the matched-bet mechanism is close to the first best for a medium-sized monetary stake irrespective of expected investment costs. The matched-bet mechanism achieves a higher relative efficiency gain than a subsidy, unmatched bet and commitment contract over all monetary stakes. For a low monetary stake, a matched bet increases relative efficiency only marginally more than a subsidy and unmatched bet. The difference in efficiency increases in the monetary stake. The reason is that the matched-bet mechanism is more robust to setting suboptimally high monetary stakes than the other mechanisms. With a subsidy, a high monetary stake incentivizes a considerable number of agents to overinvest. The right graph depicts that overall efficiency even drops below the baseline for a sufficiently high stake. For an unmatched bet, a high monetary stake amplifies the negative effect of grouping agents unfairly. The difference in efficiency between a matched bet and a commitment contract is large, irrespective of the monetary stake and expected investment costs. Even if expected investment costs are low (left graph), commitment contracts prevent only a small share of the initial efficiency loss. If expected investment costs are high (right graph), commitment contracts become too costly in expectation and all agents are unwilling to participate; a commitment contract then does not increase efficiency over the baseline.

The matched bet yields a higher efficiency than the other mechanisms because it uniquely features favorable self-selection. Figure A2 depicts selection into the mechanisms by agent's degree of time inconsistency. The left graph shows selection when expected investment costs are low, and the right graph shows selection when costs are high. In line with Proposition 3.ii, the figure shows a strong relationship between an agent's degree of time inconsistency and take-up of a matched bet. The relationship between time inconsistency and take-up is much weaker for an unmatched bet. Even though agents with a strong present bias would invest more efficiently with an unmatched bet, some do not participate to prevent losing too much money in expectation. On the other hand, some time-consistent agents participate in the unmatched bet, as their expected bet earnings overcompensate their efficiency loss from overinvesting. The figure also shows that the relationship between an agent's degree of time inconsistency and take-up is lower

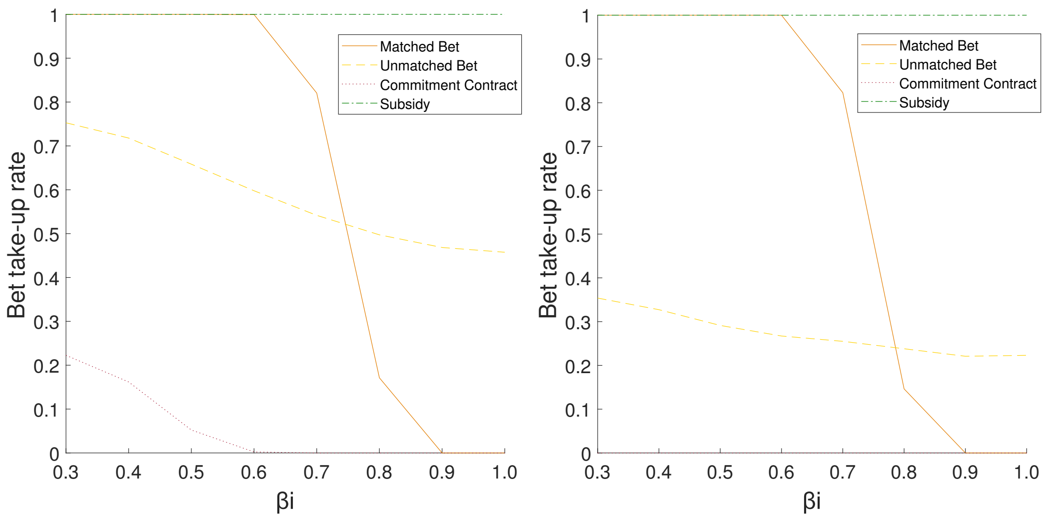
Figure A1: Efficiency of Mechanisms



Note: The figure shows the relative efficiency gain of the matched bet, unmatched bet, commitment contract and subsidy mechanisms by size of the monetary stake m. Variables are calibrated in the following way: $b_i \sim \mathrm{U}[15,25]$, $k_i \sim \mathrm{U}[0,5]$, $c_i \sim \mathrm{Exp}(10)$ for left graph and $c_i \sim \mathrm{Exp}(30)$ for right graph, $\beta_i \sim \min\{\mathrm{U}[\frac{1}{3},\frac{4}{3}],1\}$, $\hat{\beta}i \sim \mathrm{U}[\beta_i,1]$, $\delta_i = 1$.

for a commitment contract than for a matched bet. The reason is that the more present-biased an agent is, the more money she loses in expectation with a commitment contract. In contrast, in a matched bet matching ensures that agents break-even in expectation, irrespective of their present bias.

Figure A2: Selection into Mechanisms

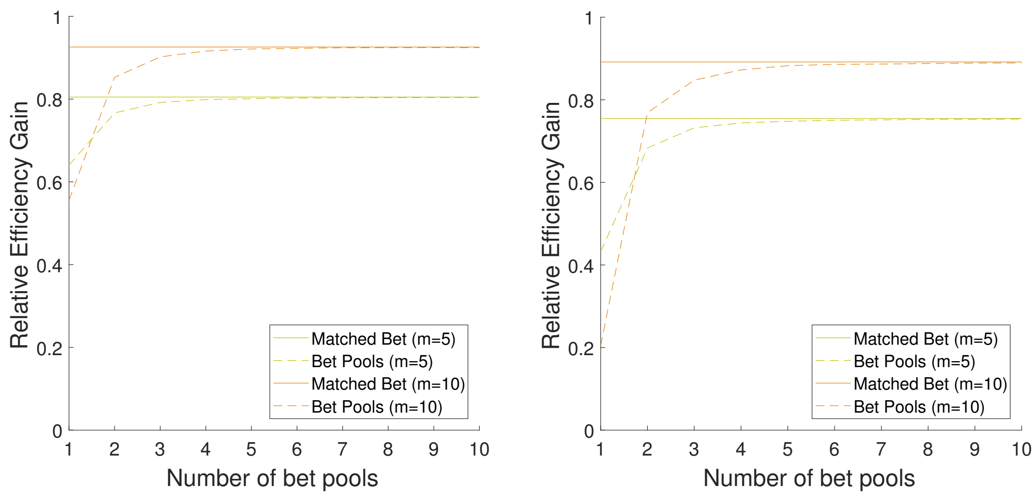


Note: The figure shows selection into the matched bet, unmatched bet, commitment contract and subsidy mechanism by agents' degree of time inconsistency. Variables are calibrated in the following way: $b_i \sim \mathrm{U}[15,25]$, $k_i \sim \mathrm{U}[0,5]$, $c_i \sim \mathrm{Exp}(10)$ for left graph and $c_i \sim \mathrm{Exp}(30)$ for right graph, $\beta_i \sim \min\{\mathrm{U}[\frac{1}{3},\frac{4}{3}],1\}$, $\hat{\beta}i \sim \mathrm{U}[\beta_i,1]$, $\delta_i = 1$, $m = 10$.

A.2 Robustness towards 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 expected investment frequency. In reality, perfect matching is not possible. This raises the question how robust the matched-bet mechanism is to imperfect matching. Figure A3 shows the prevented share of efficiency loss dependent on the number of bet pools using the same calibration as in Section A.1. Given a number of bet pools n, bet participants are grouped with other participants whose ranks in terms of expected investment frequency 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 the relative efficiency gain increases concavely in the number of bet pools. With one bet pool, i.e. an unmatched bet, efficiency is considerably lower than with a matched bet. There is a steep increase in efficiency when bet participants are divided into two bet pools according to their expected investment frequency. Efficiency with two bet pools is already closer to efficiency with an infinite number of bet pools, i.e. a matched bet, than with one bet pool. This finding is irrespective of low (left graph) or high expected investment costs (right), and a low (olive) or high (orange) bet stake. For a moderate number of bet pools, efficiency with an imperfectly matched bet already closely approaches efficiency with a matched bet. The figure thus illustrates that the matched bet is robust to imperfect matching.

Figure A3: Robustness of Matched Bet towards Imperfect Matching



Note: The figure shows the relative efficiency gain of the matched bet in comparison to an imperfectly matched bet with various numbers of bet pools. Variables are calibrated in the following way: $b_i \sim \mathrm{U}[15, 25]$, $k_i \sim \mathrm{U}[0, 5]$, $c_i \sim \mathrm{Exp}(10)$ for left graph and $c_i \sim \mathrm{Exp}(30)$ for right graph, $\beta_i \sim \min\{\mathrm{U}[\frac{1}{3}, \frac{4}{3}], 1\}$, $\hat{\beta}i \sim \mathrm{U}[\beta_i, 1]$, $\delta_i = 1$, $m = 5$ (olive) and $m = 10$ (orange).

A.3 Decentralized Matched Bet

The main text analyzes a centralized version of the matched-bet mechanism. The policy maker acts as a central institution that offers the bet, observes agents' decisions and enforces monetary transfers. In some cases the central institution might not be necessary and agents could directly bet with each other. In this decentralized version, agents choose their bet stakes. The matched-bet mechanism then requires that bet participants group with other participants who prefer the same bet stake and have the same expected investment frequency.

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

$$\max_{m_i} \beta_i \delta_i \left[\int_0^{\hat{\beta}_i \delta_i b_i + m_i - k_i} (\delta_i b_i - k_i - c_i) f(c_i) dc_i + \int_{\beta_i \delta_i b_i + m_i - k_i}^{\hat{\beta}_i \delta_i b_i + m_i - k_i} m_i f(c_i) dc_i \right]. \tag{A1}$$

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

$$m_i^* = (1-\hat{\beta}_i)\delta_i b_i \frac{f(\hat{\beta}_i \delta_i b_i - k_i + m_i^*)}{f(\beta_i \delta_i b_i - k_i + m_i^*)} + \frac{F(\hat{\beta}_i \delta_i b_i - k_i + m_i^*) - F(\beta_i \delta_i b_i - k_i + m_i^*)}{f(\beta_i \delta_i b_i - k_i + m_i^*)} \tag{A2}$$

For sophisticated agents ($\beta_i = \hat{\beta}_i$) the equation above simplifies to $m_i^* = (1-\beta_i)\delta_i b_i$, which yields the following proposition.

Proposition A.2 (Decentralized Matched Bet) *Sophisticated agents take up a decentralized matched bet. They choose the optimal bet stake $m_i^* = (1-\beta_i)\delta_i b_i$, and thereby invest efficiently.*

Proof See Appendix B

Sophisticated agents thus self-select into the matched bet contract that maximizes their utility. Partially naive agents take up a decentralized matched bet choosing $m_i^* \leq (1-\beta_i)\delta_i b_i$. Time-consistent agents do not take up a matched bet. The welfare comparison between a centralized and decentralized matched-bet mechanism is ambiguous. While the decentralized version is always better for sophisticated agents, the centralized version might be better for partially naive agents.

The desirable theoretical results of a decentralized matched bet raise the questions why we do not regularly observe it in the real world. There are several reasons that make it difficult to implement a decentralized matched bet in practice. First, 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 Section C). Theory predicts that participants with a higher degree of time inconsistency will opt for a higher bet stake. Participants' selection did not seem to be driven by their degree of time inconsistency, however, but seemed to be affected more by the participant's inclination to bet and compete. Second, fair decentralized matching is difficult to achieve. It would require a considerable amount of effort to find other people who want to take up a matched bet with the same bet stake and also have the same expected investment frequency as oneself. Third, it is difficult to enforce a monetary transfer from a matched bet without a central authority. This restricts possible partners to trustworthy people. And fourth, it might be socially not acceptable to claim money from bet partners, especially if one is sufficiently close (i.e. family or friends) to trust them. The centralized version does not have these issues and is thus more easily implementable.

A.4 Full Information

The theoretical model in the main text assumes that each agent's expected investment frequency $F(\beta_i\delta_i b_i - k_i)$ is common knowledge, but each agent's long-run discount factor δ_i, present bias β_i, benefits b_i, effort costs k_i and cost distribution function $F(\cdot)$ are private. This implies that the take-it-or-leave-it offer of the matched bet cannot be customized to every agent's need. The offered bet stake might be too low or too high for some agents.

It turns out that the matched bet is a more effective mechanism if each agent's long-run discount factor, present bias and benefits are known. In fact, the matched bet can then even make all agents invest efficiently as stated in the proposition below.

Proposition A.3 (First Best) *Assume that each agent's long-run discount factor δ_i, present bias $1-\beta_i$, benefits b_i and expected baseline investment frequency $F(\beta_i\delta_i b_i - k_i)$ are observable. By offering each agent a matched bet with bet stake $m_i = (1-\beta_i)\delta_i b_i$, every agent participates in the bet and invests efficiently.*

Proof See Appendix B

Note that while information about each agent's long-run discount factor, present bias, benefits and expected investment frequency is a strong requirement, the result does not require information about agents' perceived present bias, effort costs and cost distribution function.

Under the information structure of Proposition A.3, the first best outcome for all agents could also be achieved with a subsidy. This would, however, cost the policy maker $\sum_i Pr\{\mathcal{I}_i = 1\} m_i = \sum_i F(\delta_i b_i - k_i)(1-\beta_i)\delta_i b_i$ in total. With a matched bet, the efficient outcome can be achieved at zero costs to the policy maker.

B Proofs

Proof of Proposition 3 (Bet Take-up) ←

(i) *An agent's willingness to participate in a matched bet decreases in the size of the offered bet stake m. Define*

$$\mathbb{E}[\hat{G}_i^0] \equiv \mathbb{E}[\hat{U}^0_{i,\mathcal{P}_i=1}]-\mathbb{E}[\hat{U}^0_{i,\mathcal{P}_i=0}] = \beta_i\delta_i\int_{\hat{\beta}_i\delta_i b_i-k_i}^{\hat{\beta}_i\delta_i b_i-k_i+m}(\delta_i b_i-k_i-c_i)f(c_i)dc_i+\beta_i\delta_i\int_{\beta_i\delta_i b_i-k_i+m}^{\hat{\beta}_i\delta_i b_i-k_i+m} mf(c_i)dc_i.$$

Taking the derivative of $\mathbb{E}[\hat{G}_i^0]$ w.r.t. m yields

$$\frac{\partial\mathbb{E}[\hat{G}_i^0]]}{\partial m} = \beta_i[\delta_i F(\hat{\beta}_i\delta_i b_i-k_i+m)-\delta_i F(\beta_i\delta_i b_i-k_i+m)+(1-\hat{\beta}_i)\delta_i^2 b_i f(\hat{\beta}_i\delta_i b_i-k_i+m)-\delta_i mf(\beta_i\delta_i b_i-k_i+m)]$$

Bounding this expression from above yields

$$\frac{\partial\mathbb{E}[\hat{G}_i^0]]}{\partial m} \le \beta_i[(\hat{\beta}_i-\beta_i)\delta_i^2 b_i f(\beta_i\delta_i b_i-k_i+m)+(1-\hat{\beta}_i)\delta_i^2 b_i f(\beta_i\delta_i b_i-k_i+m)-\delta_i mf(\beta_i\delta_i b_i-k_i+m)]$$
$$\frac{\partial\mathbb{E}[\hat{G}_i^0]]}{\partial m} \le \beta_i[[(1-\beta_i)\delta_i b_i-m]\delta_i f(\beta_i\delta_i b_i-k_i+m)]$$

Therefore, $\frac{\partial\mathbb{E}[\hat{G}_i^0]]}{\partial m} \le 0$ if $m \ge (1-\beta_i)\delta_i b_i$. Now, note that $\mathbb{E}[\hat{G}_i^0] \ge 0$ if $m \le (1-\beta_i)\delta_i b_i$ as

$$\begin{aligned}\mathbb{E}[\hat{G}_i^0] &= \beta_i\delta_i\int_{\hat{\beta}_i\delta_i b_i-k_i}^{\hat{\beta}_i\delta_i b_i-k_i+m}(\delta_i b_i-k_i-c_i)f(c_i)dc_i+\beta_i\delta_i\int_{\beta_i\delta_i b_i-k_i+m}^{\hat{\beta}_i\delta_i b_i-k_i+m} mf(c_i)dc_i\\ &= \beta_i\delta_i\int_{\hat{\beta}_i\delta_i b_i-k_i}^{\hat{\beta}_i\delta_i b_i-k_i+m}(\delta_i b_i-k_i-c_i+m)f(c_i)dc_i+\beta_i\delta_i\int_{\beta_i\delta_i b_i-k_i+m}^{\hat{\beta}_i\delta_i b_i-k_i} mf(c_i)dc_i\\ &\ge 0\end{aligned}$$

for $m \le (\hat{\beta}_i-\beta_i)\delta_i b_i$. Also,

$$\begin{aligned}\mathbb{E}[\hat{G}_i^0] &= \beta_i\delta_i\int_{\hat{\beta}_i\delta_i b_i-k_i}^{\hat{\beta}_i\delta_i b_i-k_i+m}(\delta_i b_i-k_i-c_i)f(c_i)dc_i+\beta_i\delta_i\int_{\beta_i\delta_i b_i-k_i+m}^{\hat{\beta}_i\delta_i b_i-k_i+m} mf(c_i)dc_i\\ &= \beta_i\delta_i\int_{\hat{\beta}_i\delta_i b_i-k_i}^{\beta_i\delta_i b_i-k_i+m}(\delta_i b_i-k_i-c_i)f(c_i)dc_i+\beta_i\delta_i\int_{\beta_i\delta_i b_i-k_i+m}^{\hat{\beta}_i\delta_i b_i-k_i+m}(\delta_i b_i-k_i-c_i+m)f(c_i)dc_i\\ &\ge 0\end{aligned}$$

for $(\hat{\beta}_i-\beta_i)\delta_i b_i < m \le (1-\beta_i)\delta_i b_i$. Therefore, any agent who takes up a matched bet with bet stake m would also take up a matched bet with bet stake $m' : m' < m$ which proves the proposed result.

■

(ii) *Denote the maximal m for which an agent takes up the bet by $\overline{m}_i$. Rearranging the participation* *constraint (PC) yields*

$$m \le (1-\hat{\beta}_i)\delta_i b_i \frac{F(\hat{\beta}_i\delta_i b_i - k_i + m) - F(\hat{\beta}_i\delta_i b_i - k_i)}{F(\beta_i\delta_i b_i - k_i + m)} + \frac{\int_{\hat{\beta}_i\delta_i b_i - k_i}^{\hat{\beta}_i\delta_i b_i - k_i + m} F(c_i)dc_i}{F(\beta_i\delta_i b_i - k_i + m)} = \overline{m}_i. \tag{14}$$

As $F(\beta_i\delta_i b_i - k_i + m)$ increases in β_i, both terms decrease in β_i. Therefore, $\overline{m}_i$ decreases in β_i. As a consequence, for any m, there is a threshold for β_i where $\overline{m}_i$ drops below m. ■

(iii) Taking the derivative of $\overline{m}_i$ w.r.t. $\hat{\beta}_i - \beta_i$ keeping β_i fixed is equivalent to taking the derivative of $\overline{m}_i$ w.r.t. $\hat{\beta}_i$. One obtains

$$\frac{\partial \overline{m}_i}{\partial \hat{\beta}_i} = (1-\hat{\beta}_i)\delta_i^2 b_i^2 \frac{f(\hat{\beta}_i\delta_i b_i - k_i + m) - f(\hat{\beta}_i\delta_i b_i - k_i)}{F(\beta_i\delta_i b_i - k_i + m)} \le 0$$

as $f(\cdot)$ is weakly decreasing. Therefore, $\overline{m}_i$ decreases in $\hat{\beta}_i$. ■

Proof of Corollary 1 ← *Insert $\beta_i = \hat{\beta}_i = 1$ into the participation constraint which becomes*

$$\delta_i \int_{\delta_i b_i - k_i}^{\delta_i b_i - k_i + m} (\delta_i b_i - k_i - c_i) f(c_i) dc_i + \delta_i \int_{\delta_i b_i - k_i + m}^{\delta_i b_i - k_i + m} m f(c_i) dc_i.$$

For any bet stake $m > 0$ the first term becomes negative and the second term zero. The participation constraint is therefore never fulfilled for time-consistent agents. ■

Proof of Proposition 4 (Welfare) ←

(i) Denote the maximal m for which an agent is better off by taking up the bet by $\overline{m}_i^{BC}$. Transforming the better-off condition yields

$$m \le \overline{m}_i^{BC} = (1-\beta_i)\delta_i b_i \frac{F(\beta_i\delta_i b_i - k_i + m) - F(\beta_i\delta_i b_i - k_i)}{F(\beta_i\delta_i b_i - k_i + m)} + \frac{\int_{\beta_i\delta_i b_i - k_i}^{\beta_i\delta_i b_i - k_i + m} F(c_i)dc_i}{F(\beta_i\delta_i b_i - k_i + m)} \tag{15}$$

No agent is harmed by offering a matched bet if agents only take up a bet if the bet makes them better off in expectation, thus if $\overline{m}_i \le \overline{m}_i^{BC}$ (see proposition 3.ii). Note that $\overline{m}_i = \overline{m}_i^{BC}$ for sophisticated agents ($\beta_i = \hat{\beta}_i$). As $\frac{\partial \overline{m}_i}{\partial \hat{\beta}_i} \le 0$ (see proposition 3.iii) and $\beta_i \le \hat{\beta}_i$, $\overline{m}_i \le \overline{m}_i^{BC}$ holds for all agents. Therefore, no agent is harmed by offering a matched bet. ■

(ii) Note that an agent is strictly better off if $m < \overline{m}_i \le \overline{m}_i^{BC}$. From (i) we know that $\overline{m}_i \le \overline{m}_i^{BC}$. Substituting $F(\beta_i\delta_i b_i - k_i + m)$ for $F(\hat{\beta}_i\delta_i b_i - k_i + m)$ in (14) and using the concavity of $F(\cdot)$ one obtains the following condition

$$\begin{aligned} m \le\ & (1-\hat{\beta}_i)\delta_i b_i \frac{F(\beta_i\delta_i b_i - k_i + m) - F(\hat{\beta}_i\delta_i b_i - k_i)}{F(\beta_i\delta_i b_i - k_i + m)} \\ & + m - \frac{[m + (\beta_i - \hat{\beta}_i)\delta_i b_i][F(\beta_i\delta_i b_i - k_i + m) - F(\hat{\beta}_i\delta_i b_i - k_i)]}{2F(\beta_i\delta_i b_i - k_i + m)} \end{aligned}$$

Transforming above inequality yields

$$0 \leq 2\delta_i b_i - \hat{\beta}_i \delta_i b_i - \beta_i \delta_i b_i - m \tag{16}$$

from which condition $m \leq (2 - \hat{\beta}_i - \beta_i)\delta_i b_i$ immediately follows. ■

Proof of Proposition 5 ←

(i) Due to fair matching, an agent has an expected bet payoff of zero. Therefore, an agent is better off taking up a matched bet if and only if the agent invests more efficiently with the matched bet. From proposition 4.i we know that agents only take up a matched bet if they are better off with it. Thus, all agents who take up the matched bet increase their investment efficiency. ■

(ii) The prevented efficiency loss for an agent is

$$\frac{\mathbb{E}[U^W_{i,\mathcal{P}_i=1}] - \mathbb{E}[U^W_{i,\mathcal{P}_i=0}]}{\mathbb{E}[U^W_{i,eff}] - \mathbb{E}[U^W_{i,\mathcal{P}_i=0}]} = \frac{\delta_i \int_{\beta_i\delta_i b_i - k_i}^{\beta_i\delta_i b_i - k_i + m} (\delta_i b_i - k_i - c_i) f(c_i) dc_i}{\delta_i \int_{\beta_i\delta_i b_i - k_i}^{\delta_i b_i - k_i} (\delta_i b_i - k_i - c_i) f(c_i) dc_i}$$

For the case that $m \leq (1-\beta_i)\delta_i b_i$ one can transform above expression to

$$\begin{aligned}
\frac{\mathbb{E}[U^W_{i,\mathcal{P}_i=1}] - \mathbb{E}[U^W_{i,\mathcal{P}_i=0}]}{\mathbb{E}[U^W_{i,eff}] - \mathbb{E}[U^W_{i,\mathcal{P}_i=0}]} &= \frac{\delta_i \int_{\beta_i\delta_i b_i - k_i}^{\beta_i\delta_i b_i - k_i + m} (\delta_i b_i - k_i - c_i) f(c_i) dc_i}{\delta_i \int_{\beta_i\delta_i b_i - k_i}^{\beta_i\delta_i b_i - k_i + m} (\delta_i b_i - k_i - c_i) f(c_i) dc_i + \delta_i \int_{\beta_i\delta_i b_i - k_i + m}^{\delta_i b_i - k_i} (\delta_i b_i - k_i - c_i) f(c_i) dc_i} \\
&\geq \frac{[(\delta_i b_i - k_i)m - \frac{(\beta_i\delta_i b_i - k_i + m)^2}{2} + \frac{(\beta_i\delta_i b_i - k_i)^2}{2}] f(\beta_i\delta_i b_i - k_i + m)}{[(\delta_i b_i - k_i)(1-\beta_i)\delta_i b_i - \frac{(\delta_i b_i - k_i)^2}{2} + \frac{(\beta_i\delta_i b_i - k_i)^2}{2}] f(\beta_i\delta_i b_i - k_i + m)} \\
&= 1 - \left(1 - \frac{m}{(1-\beta_i)\delta_i b_i}\right)^2
\end{aligned}$$

as $f(\cdot)$ is weakly decreasing.

Similarly, for $m > (1-\beta_i)\delta_i b_i$ one can rewrite the initial expression to

$$\begin{aligned}
\frac{\mathbb{E}[U^W_{i,\mathcal{P}_i=1}] - \mathbb{E}[U^W_{i,\mathcal{P}_i=0}]}{\mathbb{E}[U^W_{i,eff}] - \mathbb{E}[U^W_{i,\mathcal{P}_i=0}]} &= \frac{\delta_i \int_{\beta_i\delta_i b_i - k_i}^{\delta_i b_i - k_i} (\delta_i b_i - k_i - c_i) f(c_i) dc_i + \delta_i \int_{\delta_i b_i - k_i}^{\beta_i\delta_i b_i - k_i + m} (\delta_i b_i - k_i - c_i) f(c_i) dc_i}{\delta_i \int_{\beta_i\delta_i b_i - k_i}^{\delta_i b_i - k_i} (\delta_i b_i - k_i - c_i) f(c_i) dc_i} \\
&\geq \frac{[(\delta_i b_i - k_i)m - \frac{(\beta_i\delta_i b_i - k_i + m)^2}{2} + \frac{(\beta_i\delta_i b_i - k_i)^2}{2}] f(\delta_i b_i - k_i)}{[(\delta_i b_i - k_i)(1-\beta_i)\delta_i b_i - \frac{(\delta_i b_i - k_i)^2}{2} + \frac{(\beta_i\delta_i b_i - k_i)^2}{2}] f(\delta_i b_i - k_i)} \\
&= 1 - \left(1 - \frac{m}{(1-\beta_i)\delta_i b_i}\right)^2
\end{aligned}$$

as $f(\cdot)$ is weakly decreasing.

As proposition 4.i shows that all agents who take up the bet are weakly better off, one obtains the proposed result. ■

(iii) First, note that all mechanisms with a dominant investment strategy can be rewritten as yielding a transfer of $T_i = \mathcal{I}_i m' + f(\boldsymbol{x_{-i}}, m')$ and increase a bet participant's incentive to invest in period 1 by

m'. The second-stage strategy-proof mechanisms thus solely differ in which agents accept a given contract. Second, for sophisticated agents, the better-off condition coincides with the participation constraint in the matched-bet mechanism. Therefore, for any given m there exists no second-stage strategy-proof mechanism that yields a higher investment efficiency to sophisticated agents than the matched bet. ■

Proof of Proposition A.1 (Take-up of Subsidy, Commitment Contract and Unmatched Bet) ←

(i) *Rearranging the participation constraint for a subsidy yields $\int_{\hat{\beta}_i\delta_i b_i - k_i}^{\hat{\beta}_i\delta_i b_i - k_i + m}(\delta_i b_i - k_i - c_i + m) f(c_i) dc_i + \int_0^{\hat{\beta}_i\delta_i b_i - k_i} m f(c_i) dc_i \geq 0$. Clearly, both terms are always positive.* ■

(ii) *As there is no β_i in the participation constraint equations of (PC Co) and (PC Un), it is straightforward to see that take-up cannot depend on an agent's degree of time inconsistency.* ■

Proof of Proposition A.2 ← *Taking the first and second derivative of (A1) w.r.t. m_i yield*

$$\frac{\partial \mathbb{E}[\hat{U}_i^0]}{\partial m_i} = \beta_i\delta_i[(1-\hat{\beta}_i)\delta_i b_i f(\hat{\beta}_i\delta_i b_i - k_i + m_i) + F(\hat{\beta}_i\delta_i b_i - k_i + m_i) - F(\beta_i\delta_i b_i - k_i + m_i) - m_i f(\beta_i\delta_i b_i - k_i + m_i)]$$

$$\frac{\partial^2 \mathbb{E}[\hat{U}_i^0]}{\partial^2 m_i} = \beta_i\delta_i[(1-\hat{\beta}_i)\delta_i b_i f'(\hat{\beta}_i\delta_i b_i - k_i + m_i) + f(\hat{\beta}_i\delta_i b_i - k_i + m_i) - 2f(\beta_i\delta_i b_i - k_i + m_i) - m_i f'(\beta_i\delta_i b_i - k_i + m_i)]$$

Inserting $\hat{\beta}_i = \beta_i$ into the first derivative, we obtain the first order condition

$$\frac{\partial \mathbb{E}[\hat{U}_i^0]}{\partial m_i} = \beta_i\delta_i[(1-\beta_i)\delta_i b_i - m] f(\beta_i\delta_i b_i - k_i + m_i) \stackrel{!}{=} 0$$

which is fulfilled only for $m_i = (1-\beta_i)\delta_i b_i$ if $f(\beta_i\delta_i b_i - k_i + m_i) > 0$ which can be assumed without loss of generality. Inserting $\hat{\beta}_i = \beta_i$ and $m_i = (1-\beta_i)\delta_i b_i$ into the second derivative, it simplifies to

$$\frac{\partial^2 \mathbb{E}[\hat{U}_i^0]}{\partial^2 m_i} = -\beta_i\delta_i f(\beta_i\delta_i b_i - k_i + m_i) < 0.$$

Sophisticated agents thus choose the optimal bet stake $m_i^* = (1-\beta_i)\delta_i b_i$. Following proposition 2.iv, sophisticated agents thus invest efficiently. ■

Proof of Proposition A.3 (First Best) ← *From Proposition 4.ii it follows that all present-biased agents $\beta_i < 1$ take up a matched bet with bet stake $m = (1-\beta_i)\delta_i b_i$. Now, substitute m by $(1-\beta_i)\delta_i b_i$ in $\mathbb{E}[U^W_{i,\mathcal{P}_i=1}]$. One obtains $\mathbb{E}[U^W_{i,eff}]$. All agents thus invest efficiently.* ■

C Trial Round

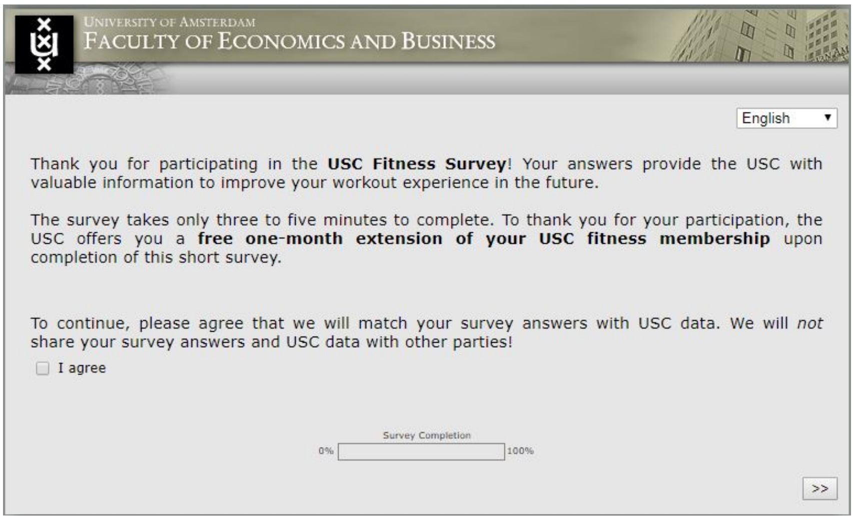
I conducted a trial round of the matched bet experiment with a similar design in May/June 2017. The trial round had a bet take-up rate of only 10%. I used survey answers of subjects of the trial round to make participation in the main experiment more appealing. The trial round differed from the main 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 were grouped with only one partner in the trial round. In the trial round participants were required to check out at exit gates to make the gym visit count for the bet and 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 A1.

Table A1: Differences between Experiment and Trial Round

	Experiment	Trial Round
Sample	Only student members	All members
	Only non-frequent gym goers	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

D Survey Questions

Figure A4: 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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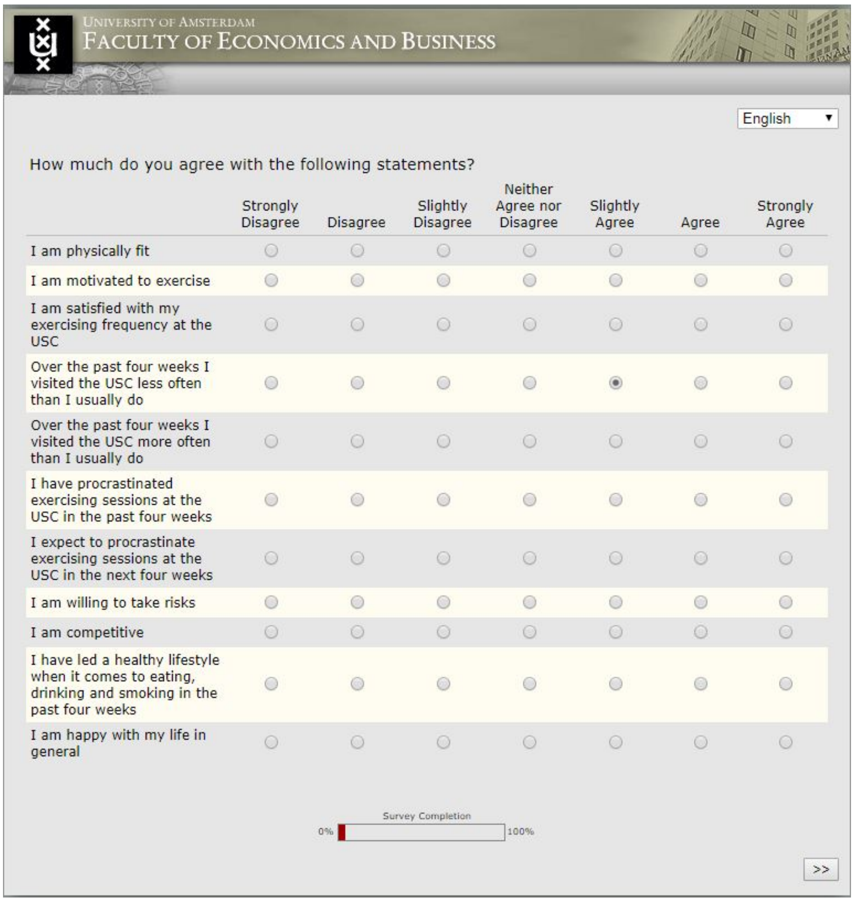

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English

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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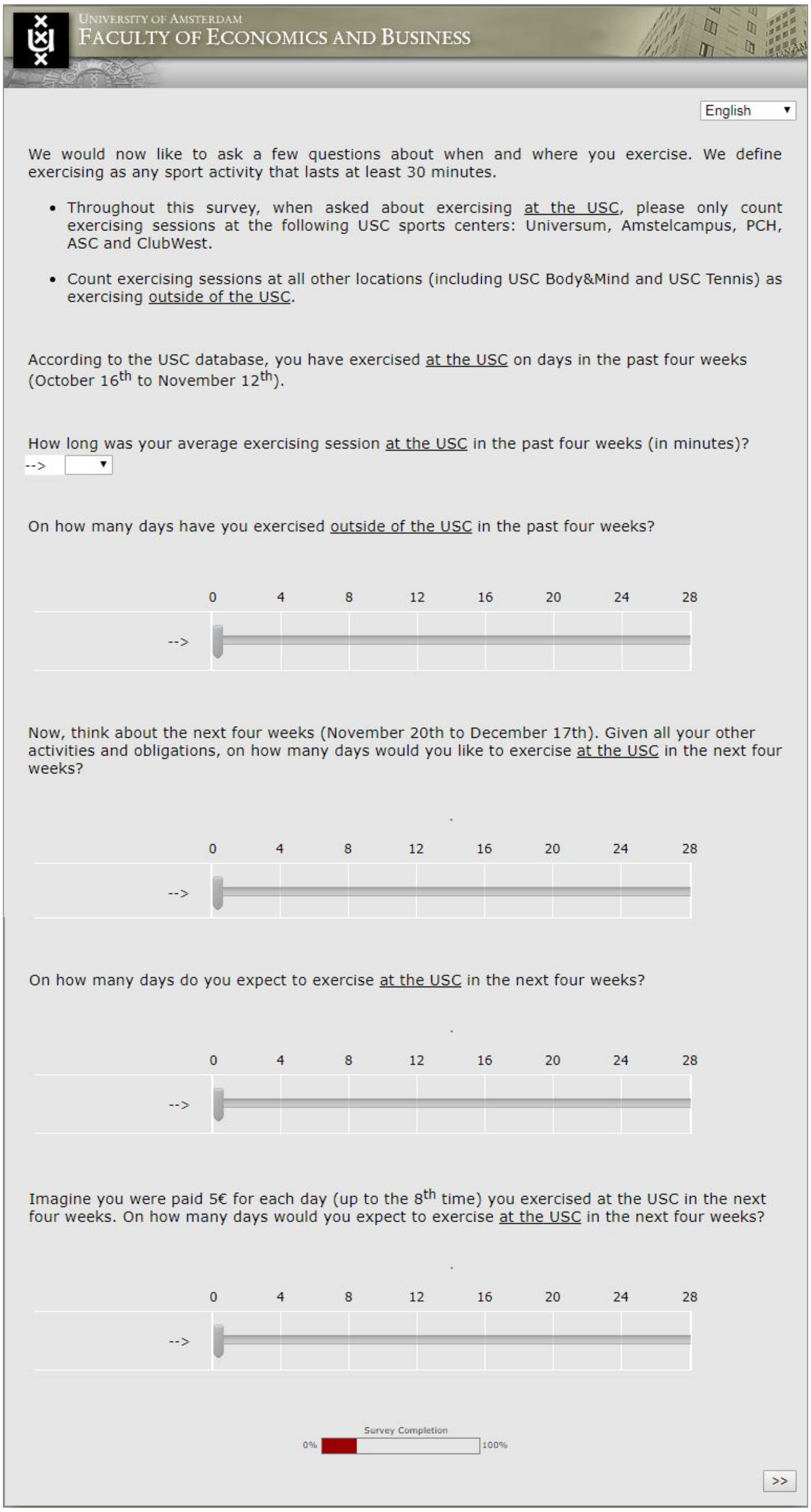
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English

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

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Survey Completion

0% 100%

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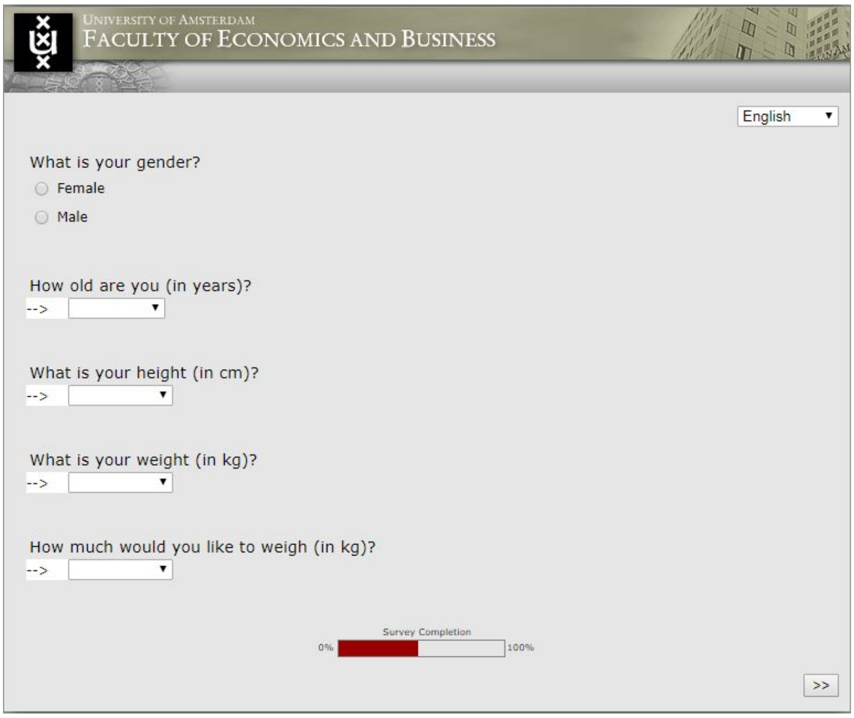
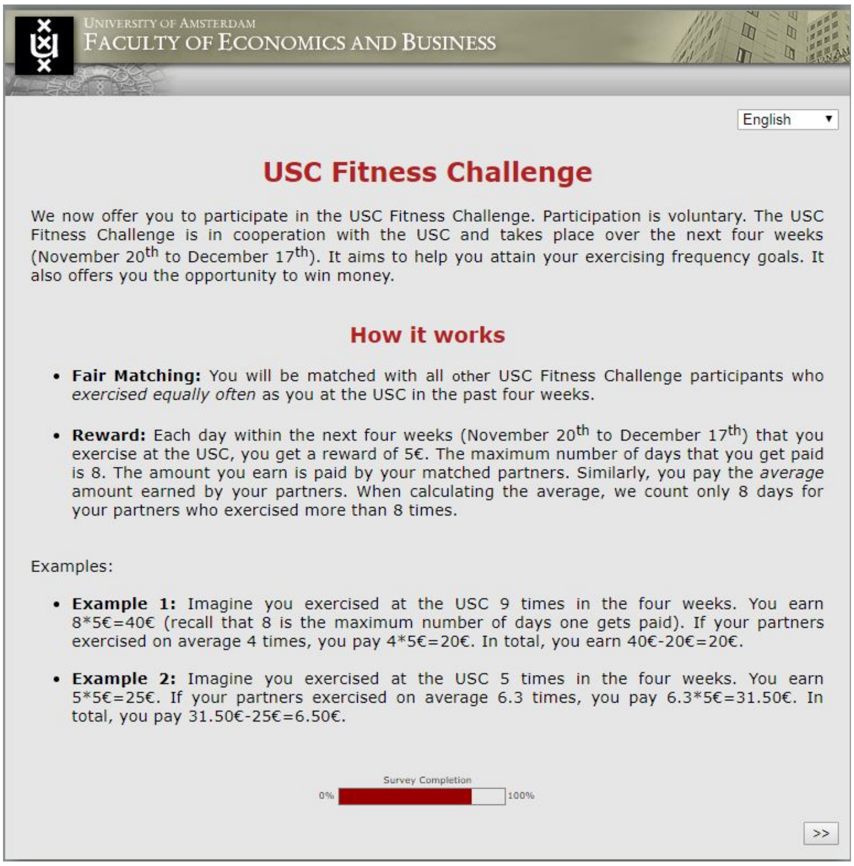


Figure A5: Control Group

Figure A6: Bet Treatment



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English

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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English

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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English

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
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Figure A7: Bet Participants

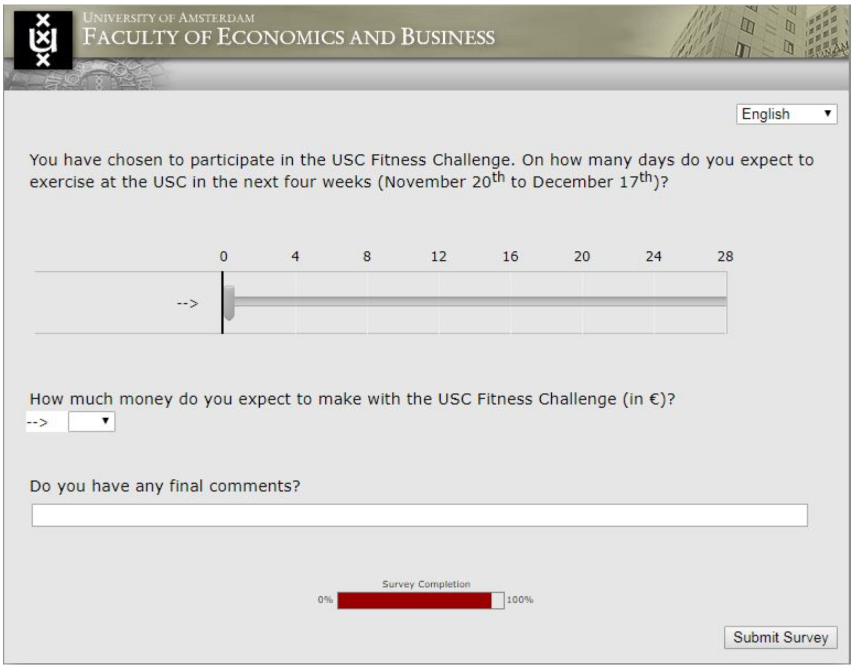


Figure A8: Bet Rejecters

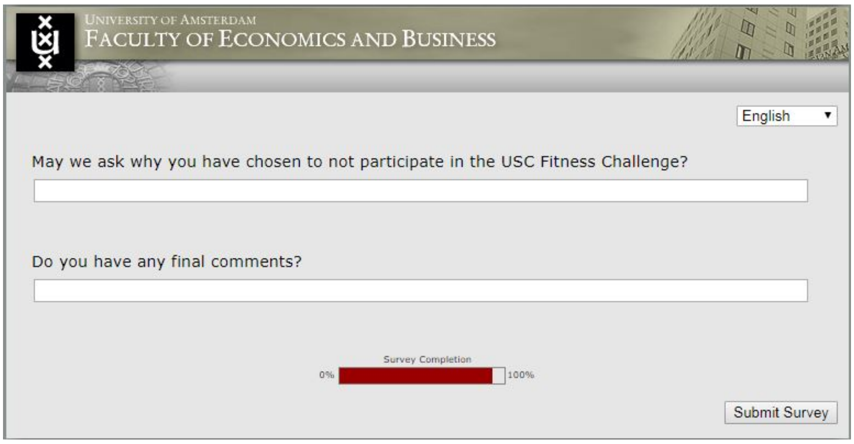
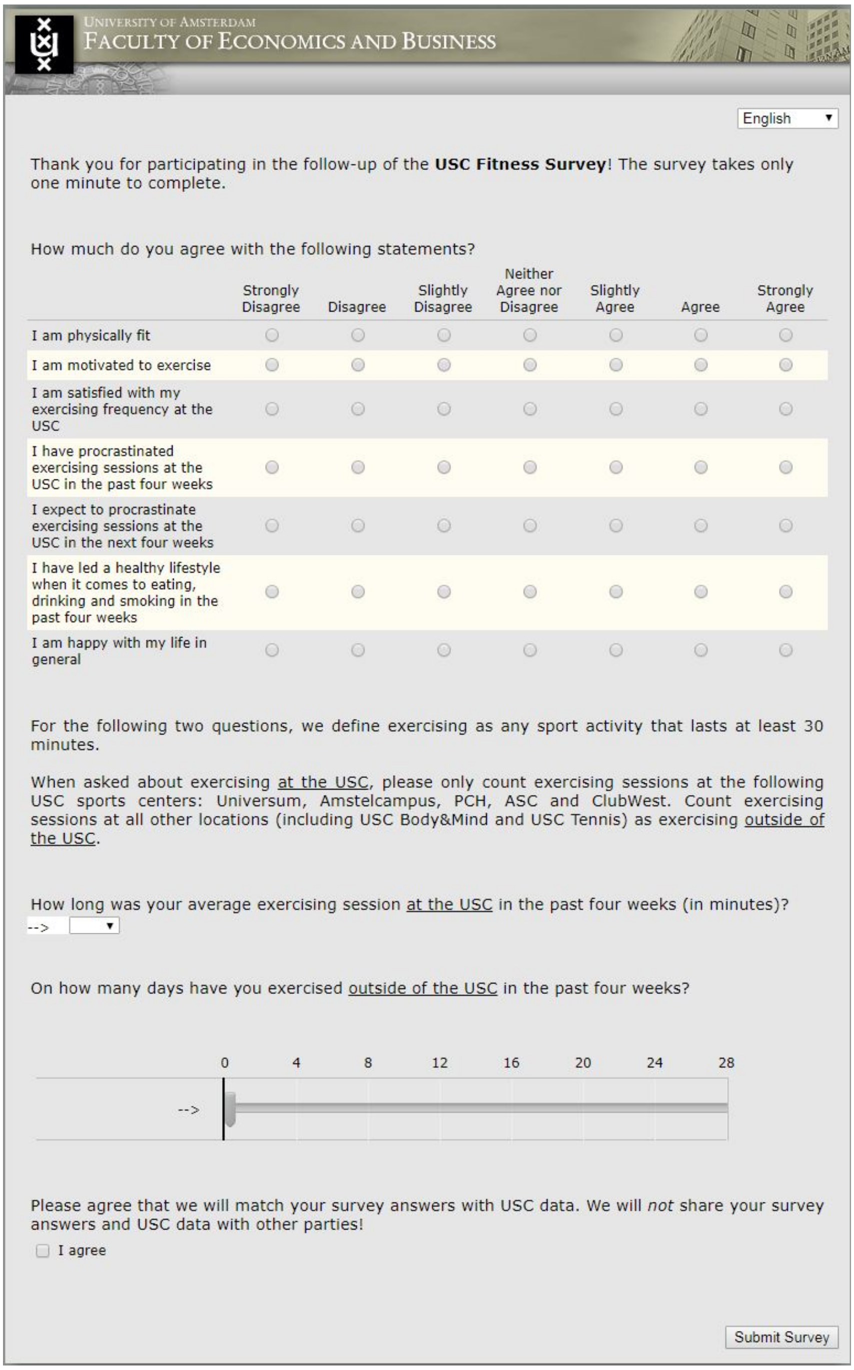


Figure A9: Follow-up Survey Questions Control Group & Bet Rejecters



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English

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

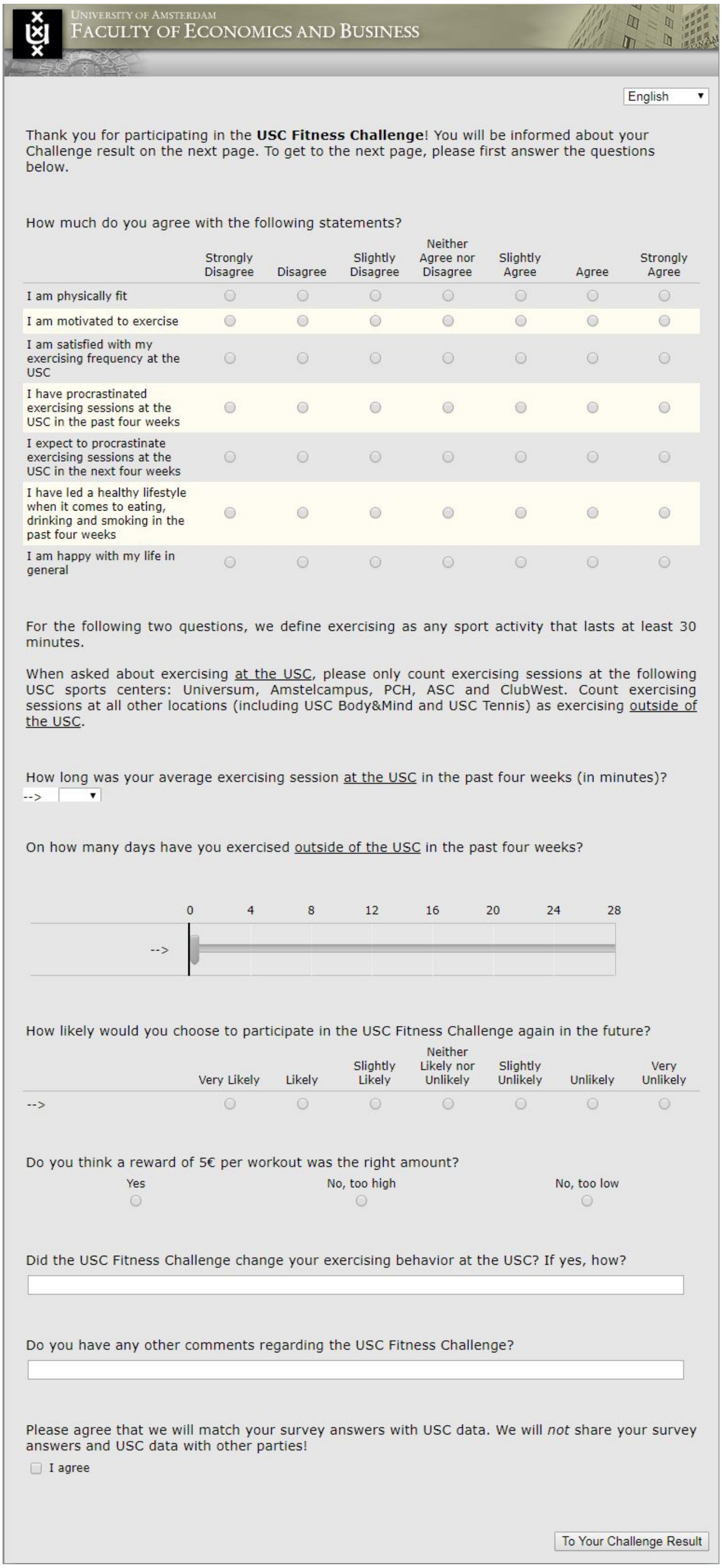
-->

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 A10: Follow-up Survey Questions Bet Participants



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English

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.

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

-->

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?

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

To Your Challenge Result

Figure A11: Rules of Matched Bet

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 <u>maximum</u> number of days that you get paid is <u>8</u>. 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 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€.

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.

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 bet.
- 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 bet (at most 40€).
- If you win money with the bet, 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.

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