

Deposit? Yes, please!

The effect of different modes of assigning reward-and deposit-based financial incentives on effort.

EsCHER Working Paper No. 2022009
August 2022

Stefan A. Lipman, PhD
Nienke W. Boderie, MSc
Jasper V. Been, PhD
Hans van Kippersluis, PhD



EsCHER

ERASMUS CENTRE
FOR HEALTH ECONOMICS
ROTTERDAM

Title

Deposit? Yes, please! The effect of different modes of assigning reward-and deposit-based financial incentives on effort.

Authors

Stefan A. Lipman, PhD, Erasmus School of Health Policy & Management.
Nienke W. Boderie, MSc, Erasmus MC
Jasper V. Been, PhD, Erasmus MC
Hans van Kippersluis, PhD, Erasmus School of Economics

Corresponding author and contact details

Keywords

financial incentives, deposit contract, loss aversion, tailored incentives, nudge

JEL classification

C91; D90; D91

Cite as

Lipman, S.A., Boderie, N.W., Been, J.V., & v. Kippersluis, J.L.W. (2022). Deposit? Yes, please! The effect of different modes of assigning reward-and deposit-based financial incentives on effort. EsCHER Working Paper Series No. 2022009, Erasmus University Rotterdam. Available from: <https://www.eur.nl/en/research/escher/research/working-papers>

Erasmus Centre for Health Economics Rotterdam (EsCHER) is part of Erasmus University Rotterdam.
Want to know more about EsCHER? Visit www.eur.nl/escher
Want to contact EsCHER? E-mail escher@eur.nl

Interested in more EsCHER Working Papers? Download from www.eur.nl/escher/research/workingpapers

© Lipman et al., 2022

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means without the written permission of the copyright holder.

Deposit? Yes, please!

The effect of different modes of assigning reward-and deposit-based financial incentives on effort.

Stefan A. Lipman^{a,b}*, Nienke W. Boderie^c, Jasper V. Been^{c,d}, Hans van Kippersluis^{b,e,f}

^aErasmus School of Health Policy & Management, Erasmus University Rotterdam, Rotterdam, the Netherlands

^bErasmus Centre for Health Economics Research, Erasmus University Rotterdam, Rotterdam, the Netherlands

*Corresponding author, E: lipman@eshpm.eur.nl

^c Department of Public Health, Erasmus MC, University Medical Centre Rotterdam, Rotterdam, the Netherlands

^d Division of Neonatology, Department of Paediatrics, Erasmus MC Sophia Children's Hospital, University Medical Centre Rotterdam, Rotterdam, Netherlands

^e Erasmus School of Economics, Erasmus University Rotterdam, Rotterdam, The Netherlands

^f Tinbergen Institute, Amsterdam, The Netherlands

Keywords: financial incentives, deposit contract, loss aversion, tailored incentives, nudge

Acknowledgements: The work reported in this manuscript was made possible through funding by Erasmus Initiative: Smarter Choices for Better Health and the Erasmus Trustfonds. The authors also acknowledge insightful comments provided by Wilbert van de Hout and Peter Wakker during discussions of preliminary versions of this work.

Abstract:

Objectives: The effectiveness and uptake of financial incentives can differ substantially between reward- and deposit-based incentives. Therefore, it is unclear to whom and how different incentives should be assigned. In this study, the effect of different modes of assigning reward- and deposit-based financial incentives on effort is explored.

Methods: The experiment consisted of two sessions. First, students' (n=228, recruited online) discounting, loss aversion and willingness to pay a deposit were elicited. Second, an incentivized real-effort task was completed (n=171, 25% drop-out). Two modes of assigning incentives were compared in reward or deposit-based financial incentives: random assignment, and 'nudged' assignment – assignment based on respondent characteristics allowing opting out.

Results: Respondents receiving nudged assignment earned more and persisted longer on the real-effort task than respondents randomly assigned to incentives. We find no differences in effectiveness between reward-based or deposit-based incentives. Overall, 39% of respondents in the nudged assignment mode followed-up the advice to take deposit-based incentives. The effect of deposit-based incentives was larger for the respondents who followed-up the advice than for respondents that randomly received deposit-based incentives.

Discussion: Nudged assignment may increase incentives' effect on effort. Future work should extend this approach to other contexts (e.g., health behaviour change).

Introduction

Motivation is a key component for engaging in behaviour and behaviour change with a significant impact on health or wellbeing, e.g., smoking cessation or physical exercise. Often these behaviours involve costs and/or effort in the short term with potential benefits only occurring later. Some individuals may complete these tasks exclusively on basis of their intrinsic motivation (our natural tendency to seek challenge, novelty and learning opportunities), while for others extrinsic motivation is also needed (Deci and Ryan, 2008). One potential strategy to increase motivation is the use of financial incentives. Although some worry that this strategy would reduce intrinsic motivation (Frey and Oberholzer-Gee, 1997, Gneezy et al., 2011), the use of financial incentives for promoting behaviour change is widespread. For example, financial incentives have been found to be an effective tool to increase motivation for health behaviour change, at least in the short term (for systematic reviews, see: Strohacker et al., 2013, Mitchell et al., 2013, Giles et al., 2014, Mantzari et al., 2015, Notley et al., 2019).

In practice, many different incentive schemes can be used. Adams et al. (2014) distinguish between incentives based on (inter alia) the size, timing and direction of payment. Perhaps obviously, the size of a financial reward is of importance. Generally it is assumed that higher rewards yield stronger motivation, although evidence suggests there are diminishing returns to increasing incentive size (Augurzky et al., 2012, Finkelstein et al., 2007). The timing of payments should also be carefully considered. A large body of economics literature suggests that future rewards are discounted (Frederick et al., 2002), and that many individuals overweigh any cost or benefit experienced today (Laibson, 1997). Hence, postponing payments into the future (heavily) decreases their value today. Finally, the direction of financial incentives is important, defined by Adams et al. (2014) as the “sign” of the incentive used: is the incentive perceived as a reward to be gained through performing a task or as a loss (e.g., a fine) imposed when tasks are not completed? The difference between gain and loss incentives is crucial when individuals are loss averse, i.e., the tendency that losses receive more weight than gains of the same size (Tversky and Kahneman, 1992).

Earlier work has used and/or compared financial incentives for behaviour change with different sizes, timing and direction (e.g. Patel et al., 2016, Haisley et al., 2012, Halpern et al., 2011, Halpern et al., 2015). Several studies show that incentives involving losses are effective compared to a no incentive control (Royer et al., 2015, Cawley and Price, 2013, Giné et al., 2010). Some studies also present evidence suggesting that loss incentives are more effective than incentives based on gains (Patel et al., 2016), although other studies find no evidence for differences in effectiveness (Donlin Washington et al., 2016, Halpern et al., 2018), or evidence in the opposite direction (Halpern et al., 2015). Interpreting the existing literature is complicated by the various operationalisations of loss incentives. A common strategy used to operationalise incentives involving losses is to ask respondents to commit some of their own money into a deposit contract, to which some amount is added as an incentive. The total deposit is only returned to respondents after they attain an agreed-upon goal. Such matched deposit contracts have been used by e.g. John et al. (2011). Other authors (Royer et al., 2015, Giné et

al., 2010), on the other hand, used completely self-funded deposit contracts, i.e., respondents put their own money at stake without matching. Note that for simplicity, we will refer to all incentives in which respondents risk losing some amount of their own money as deposit-based incentives.

In addition to the *incentive scheme*, an additional choice to be made is the *mode of assignment* of financial incentives. That is, should individuals be free to choose their incentive scheme, or can it be beneficial to provide incentives without individuals being consulted on their preferences beforehand? This is an important question, as the effectiveness of some types of incentive schemes may seem promising, but it appears voluntary take-up is low. For example, stated preference studies typically find large hypothetical take-up of deposit-based incentives (Adjerid et al., 2021, Lipman, 2020, Sykes-Muskett et al., 2017), in practice far fewer people are willing to actually deposit their own money (Halpern et al., 2015), especially when deposits are completely self-funded (Ashraf et al., 2006, Giné et al., 2010, Royer et al., 2015), as summarized in Carrera et al. (2019). Although offering individuals a choice of incentive schemes may potentially increase the effectiveness of incentives due to increased autonomy (Adjerid et al., 2021, Woerner et al., 2021, Dizon-Ross and Zucker, 2021, Boderie et al., 2020), take-up of commitment devices such as deposit-based incentives is typically considered dependent on individuals' being sophisticated about their preferences (Laibson, 1997). As such, as also explored by Halpern et al. (2015) and Adjerid et al. (2021), deposit-based incentives may seem more effective than incentives based on gains, but perhaps this is driven primarily by the self-selection of particularly eager participants into deposit-based incentive. As such, there may be a benefit of exogenously assigning or nudging less eager individuals towards supposedly beneficial incentive schemes (Adjerid et al., 2021). However, so far only a handful of studies have investigated variation in effectiveness of incentive schemes according to their mode of assignment (Woerner et al., 2021, Adjerid et al., 2021, Dizon-Ross and Zucker, 2021), with conflicting evidence.

In this paper we conduct an online experiment with a real-effort task among 228 students. The setting intends to mimic a health behaviour intervention with effort now and benefits in the future (in our case, payments one week later). Note that we implemented financial incentives with different sizes. That is, respondents could earn either 8, 12, or 20 euro in our experiment. Our experimental design enables studying both the *assignment mode* of incentives, as well as the *incentive scheme* on effort for incentives of different sizes. In the 2x2 experiment, our first basic contrast is a comparison of a treatment arm where individuals are randomized into incentive schemes versus a treatment arm where individuals receive informed advice about which incentive to take. That is, in the latter treatment arm participants are not only offered a choice between deposit and reward-based incentives, but we additionally provide them with informed advice based on personal characteristics, e.g., loss aversion. The informed advice is implemented as a default selection of one of the two incentives schemes, with the opportunity to opt-out. In other settings, implementing or changing the default with the goal of helping respondents is often referred to as nudging (Thaler and Sunstein, 2009). Hence, we will refer to this mode of assignment as nudged assignment. This contrast, therefore, sheds light on whether a nudged, yet voluntary choice enhances effort over simple random assignment to

financial incentives. Our second basic contrast involves studying the effect of a deposit-based incentive scheme versus reward-based incentive scheme among the ones who were randomly assigned an incentive scheme. This second contrast sheds light on whether incentive schemes based on losses yield more effort than incentive schemes based on gains. Third, by comparing the effects of the deposit-based incentive scheme across the nudged (with free choice) and the random assignment groups, and by studying the characteristics of those that choose a deposit, we learn more about self-selection into deposit-based incentive schemes and which individuals are most likely to take up deposit-based incentive schemes and benefit from them.

In line with the three contrasts in our experiment, our contribution to the literature is threefold. First, our work extends the literature on modes of assigning financial incentives by implementing nudged assignment. Earlier work in contract theory (Larkin and Leider, 2012, Chaudhry and Klinowski, 2016), has suggested that free choice among different types of incentives enables individuals to ‘sort’ into incentives that fit their preferences. That is, individuals sort into contracts that they expect will maximize earnings, but these expectations (e.g., in case of overconfidence) may be inaccurate (Larkin and Leider, 2012). Choice also offers opportunities for sophisticated individuals to commit themselves to future actions (Dizon-Ross and Zucker, 2021), e.g., by allowing individuals to self-select into more challenging incentive schemes. Other studies, however, have found that, on balance, those that had the opportunity to choose their own incentive scheme perform the same or worse than those randomly assigned to incentives (Chaudhry and Klinowski, 2016, Adjerid et al., 2021, Woerner et al., 2021). Our work follows up on the suggestion by Adjerid et al. (2021), i.e., we default (a selection of) participants into deposit-based incentives, which may help promote their take-up when free choice exists. Indeed, other related studies have found default settings to affect uptake in commercially available deposit-based incentives i.e., on www.stickk.com (Goldhaber-Fiebert et al., 2010, Bhattacharya et al., 2015).

Second, by randomly assigning deposit-based incentives in one treatment arm, our study enables to estimate the effect of deposit-based incentives over reward-based incentives without having to worry about the self-selection of individuals into deposit-based incentives. In addition, we randomly varied the size of the reward. As such, our work contributes to an existing literature that has compared the effectiveness of reward- and deposit-based incentives as well as incentives of different sizes. Typically, diminishing or no effects of increasing financial incentive size are found (e.g. Finkelstein et al., 2007, Augurzky et al., 2012, Jeffery et al., 1983). Studies on health behaviour change that randomize respondents to deposit-based incentives (i.e., punishment) over reward-based incentives have found mixed effects (Patel et al., 2016, Donlin Washington et al., 2016, Halpern et al., 2015, Halpern et al., 2018), and our study could help interpret mixed results in earlier work.

Third, by studying the characteristics of individuals opting-in and opting-out of deposit-based incentives in the treatment arm that combined a nudge with voluntary choice, we contribute to the understanding of the self-selection of individuals into deposit-based incentives. So far, the available evidence suggests that take-up of deposit-based incentives is higher among men and individuals with higher income (Halpern et al., 2016). Furthermore, some studies suggest that

preference for immediate rewards (i.e., present bias) is associated with take-up of deposit-based incentives (Ashraf et al., 2006, Augenblick et al., 2015). Lipman (2020), however, found no such evidence, and furthermore, hypothetical take-up of deposit-based incentives was not associated with loss aversion. Moreover, since preferences for deposit-based incentives and the personal characteristics on which the informed advice was based, e.g., loss aversion, were elicited at baseline irrespective of the experimental condition, we can compare the effectiveness of the deposit-based incentive among different types of individuals. This enhances the understanding of which individuals benefit most from this type of incentive scheme. Hence, our work will provide further insight into the often supposed (but rarely studied) link between loss aversion and take-up and/or effectiveness of deposit-based incentives (Halpern et al., 2015).

Our findings suggest that respondents who are able to choose an incentive scheme after receiving advice allocate more effort and earn more than respondents randomly allocated to an incentive scheme. In respondents randomly assigned to incentive schemes, no effects of deposit-based incentives were observed compared with regular rewards. Interestingly, our results show that those who follow the advice to take up deposit-based incentives earn more and allocate more effort compared to those who were assigned to deposit-based incentives randomly, but no such effects are found for incentives based on rewards. The only predictor of take-up of deposit-based incentives was demand for commitment, which may suggest that the effect of deposit-based incentives could partially be due to sophisticated individuals self-selecting into deposits, and that sophisticated individuals are not easily identified through traditional measures of present bias and loss aversion.

Methods

Approval for this online experiment was provided by Erasmus School of Economics' (ESE) internal review board, section Experiments (reference: Application 2021-09). Furthermore, we prepared a demo version of the experiment for review (<https://tinyurl.com/436z7nzd>).

Sample and recruitment

A sample of $n=228$ respondents was recruited through the ESE Econlab panel, a system designed to recruit students for research participation. Panel members are typically (former) ESE students, i.e., students enrolled in economics, business or management programmes. Respondents were recruited through an email message inviting them to take part in a two-session study on the effect of different payments on effort in which they could earn up to 20 euro. The only inclusion criterion was having a Dutch bank account, as this facilitated digital payments. Note that the sample size for this study was determined to be in line with the budget available for the study (rather than being informed by a priori power analysis).

Experimental Design

Figure 1 shows the timeline of this experiment, while Figure 2 shows the design of this experiment. We provided individuals with financial incentives for completing a tedious task.

Two modes of assignment were compared, which were operationalized as between-subjects conditions:

- **random assignment arm:** assignment to incentives (i.e., deposit-based vs. regular) occurs randomly¹, and
- **nudged assignment arm:** a mode of assignment in which respondents have free choice between incentives, but receive informed advice on which to take in the form of a default from which respondents can opt-out.

We also randomized respondents into one of 3 payment conditions, henceforth referred to as low/medium/high payment. These conditions determined the maximum amount respondents could earn, €8, €12, or €20 respectively. Participants were informed about their payment condition simultaneously with their randomisation status. The online experiment consisted of three time points, **T0**, **T1**, and **T2**. Note that, as can be seen from Figure 1, the experiment mimics the effort-reward trade-off that typically occurs for behaviour change, i.e., effort allocation at T1 leads to a delayed reward at T2.

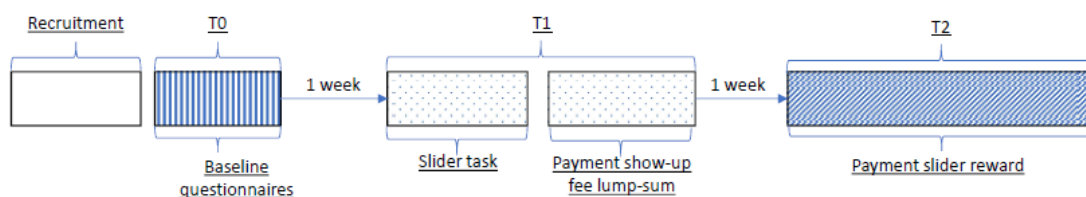


Figure 1. Experimental timeline

¹ Note that respondents were aware of the different incentive options.

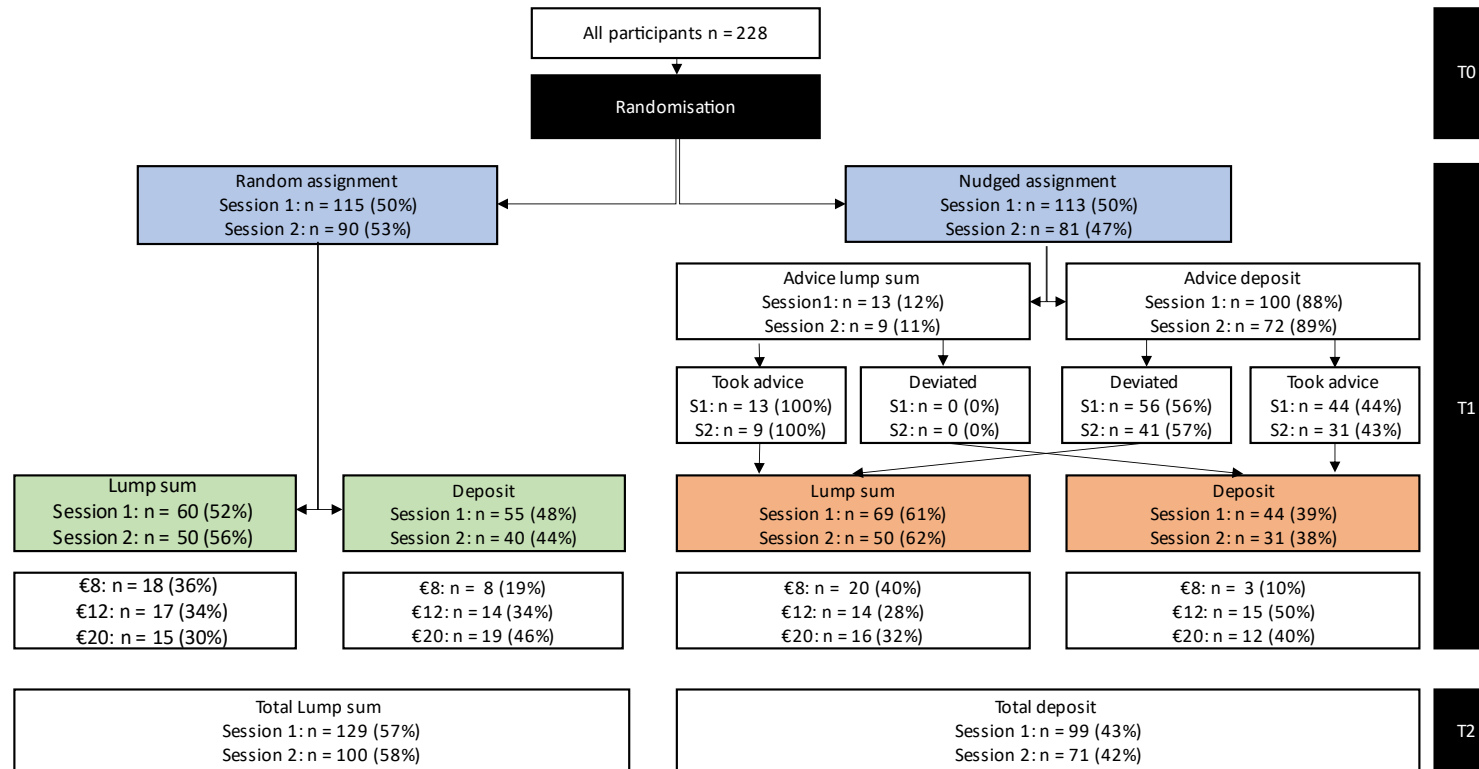


Figure 2: Study design and experimental flow (including drop-out).

T0: Baseline session

At T0, 228 participants were recruited to take part in the study (after providing informed consent), completed a set of baselines measures (used for nudged assignment), practiced the tedious task and were informed about the incentives used in the study.

Baseline measures

Respondents completed a series of questions collecting demographics (age, sex, income and educational attainment), as well as measures of delay discounting, demand for commitment, and loss aversion.

Delay discounting, in line with Boderie et al. (2020) was measured with the 27-item monetary choice questionnaire (MCQ) developed by Kirby and Maraković (1995), a standard measure of delay discounting. In the MCQ respondents are asked to make a series of decisions between a smaller monetary amount paid out sooner (e.g., €54 today) or a larger amount paid out later (e.g., €55 in 117 days). Smaller-sooner amounts would be paid out today and ranged between €14 and €80, while larger-later rewards ranged between €25 and €85 and would be paid out between 7 and 186 days. Respondents with a stronger tendency to choose the immediate reward would display stronger delay discounting. The MCQ was developed to estimate discount rate k in a hyperbolic discount function (Mazur, 1987). That is, the present value of a delayed reward V can be expressed as $V = A / (1 + kD)$, where A is the amount, and D is the delay. In this study we used the automated scoring developed by Kaplan et al. (2016) to estimate k . Furthermore, a non-parametric measure of discounting was used, i.e., the proportion of larger-later responses, which is derived as $X/27$ where X is the number of larger later responses. Note that all rewards and delays were hypothetical.

Demand for commitment was measured by presenting respondents with a multiple-choice question. The following question was used: ‘Imagine you have made plans to invest some amount of effort on a task you would normally not enjoy much, but has benefits in the future, for example: exercising, doing taxes, going to the doctor/dentist. To make sure you actually stick to your plan next week, you are offered to pay a small deposit. That is, you can pay €5 that you will receive back in full if you indeed stick to your plan (i.e., go exercise, do the taxes, visit the doctor), but is lost if you forget or postpone. Would you pay this deposit?’. Respondents could answer: 1) Yes, absolutely, 2) Yes, probably, 3) I’m not sure, 4) No, probably not, and 5) No, absolutely not. The first two answers are interpreted as having demand for commitment.

Loss aversion was, in line with Lipman (2020), measured with the non-parametric method (Abdellaoui et al., 2016). The method involves eliciting three chained indifferences between monetary gambles, enabling estimation of a loss aversion coefficient λ as defined by Köbberling and Wakker (2005). Loss aversion is defined with $\lambda > 1$ ($\lambda = 1$, $\lambda < 1$) indicating loss aversion (loss neutrality, gain seeking). More details on the implementation of the non-parametric method can be found in Appendix A.

Tedious task and incentives for effort

After completing these measures, respondents were reminded that they had to complete a second online session (i.e., at T1), in which they would complete a set of tedious tasks. The

tedious task was modelled after the slider task developed by Gill and Prowse (2019). In this task, respondents are asked to move adjustable slider bars to a specific point. Participants were explained they could complete as little or many sliders as they wanted (between 0 and 400), and they would earn a reward for each task completed. After this explanation, respondents completed a practice task (i.e., one page with 20 sliders), such that they could judge the type of effort provision required of them. Finally, respondents were informed that they had earned a €4 show-up fee and received information about the incentives provided for their effort on the slider task in T1. The show-up fee would be paid when they completed the second session (T1), for which automated invitations were sent out exactly 1 week later. With the slider tasks they would earn a reward, that would be paid out at T2, i.e., one week after completing the slider task. Effort-contingent payments were delayed to T2 to be able to draw parallels between the slider tasks and health behaviour change (e.g., exercise), as in these cases immediate effort is often traded off against a reward in the future.

The following parametrisation and incentives were used. Respondents completed P number of pages ($P \leq 20$) and each page consisted of 20 sliders that were set to 0. As such the total number of sliders respondents could complete before exiting the experiment was $S = 20P, S \leq 400$. Each slider had to be moved to exactly 25. For each slider moved to 25, respondents would earn a reward r (i.e., paid out at T2). Two types of incentives were used: reward- and deposit-based incentives. Reward-based incentives entailed that respondents would earn $\text{€}(S * r)$ at T2, as well as their show-up fee being paid out after completing the online experiment (these were paid within 4 hours of completing the experiment). Note that respondents could also return at T1, complete 0 sliders and exit the experiment with their €4 show-up fee. Deposit-based incentives were operationalised by informing respondents that their show-up fee was added to the per-slider fee. That is, rather than receiving the show-up fee at T1, the per-slider reward r was increased to $r_d = r + \frac{\text{€}4}{S}$. In other words, respondents deposited their show-up fee and earned it back by completing sliders. The full deposit would only be earned back by completing 400 sliders. Hence, from a rational actor perspective, the deposit-based incentive is dominated by the lump-sum incentive. However, the reward for effort is higher in the deposit-based incentive scheme, such that some actors may use this incentive scheme as a commitment device to exert more effort while completing the task.

Payment conditions were operationalised by taking $r = \text{€}0.01$ (low), $r = \text{€}0.02$ (medium) and $r = \text{€}0.04$ (high), respectively. With a €4 show-up fee, this implies $r_d = \text{€}0.02$ (low), $r_d = \text{€}0.03$ (medium) and $r_d = \text{€}0.05$ (high) respectively. As such, compared to reward-based incentives the per-slider reward would be increased by 100%, 50% or 25% respectively when the show-up fee was deposited.

Assignment to incentives

In both treatment arms (i.e., random and nudged assignments) respondents received information on both incentive schemes, referred to as the basic and deposit scheme (see Online Supplements). Respondents in the random assignment arms ($n = 115$) were informed of the incentive they were randomly assigned to. Respondents in the nudged assignment arm ($n = 113$) received the following instruction: *‘In both the basic and deposit scheme you have the*

opportunity to earn the same amount of money for persistent effort on a tedious task. The deposit scheme may help to keep you motivated, however, because you are not only earning “extra” money, but also earning back money you made earlier. If you don't complete all tasks, however, you might lose money. You have the opportunity to choose between the two schemes, and you are free to choose whichever you prefer. However, based on the monetary choices and questionnaires you filled in earlier, we have preselected the scheme we think will help best to motivate you. Whether you follow our recommendation or not is your choice.’. In line with Boderie et al. (2020), the advice was based on pragmatic thresholds, as follows: whenever respondents 1) demanded commitment, 2) chose the larger-later reward in fewer than 14 out of 27 questions (i.e. proportion of larger, later rewards < 50% indicating preference for earlier rewards), or 3) had $\lambda > 2$, they were recommended to take-up deposit-based incentives. If none of these 3 conditions was met respondents were recommended to take-up reward-based incentives. The first two decision rules were modelled after Boderie et al. (2020), whereas the decision rule for loss aversion was based on the observation that, on average, λ typically is around 2 (Tversky and Kahneman, 1992, Lipman et al., 2019).

T1: Effort provision

One week after completing the T0 experimental session, respondents received an e-mail invitation for session T1. 171 participants out of 228 showed up at T1, see figure 1. In this session the slider tasks were completed, but respondents first completed the MCQ, demand for commitment question and the non-parametric method again. This repeated measurement was included to test the robustness of the default selection in nudged assignment arm (i.e., would people receive the same advice?). After completing these measures respondents were asked if they wanted to start on the sliders or finish the experiment and earn their show-up fee (if they had not deposited it). If they decided to start on the slider tasks, they could complete a page of 20 sliders. After each page respondents' current earning (to be paid out at T2) was updated and they were again asked if they wanted to continue completing sliders or exit the task. Once respondents completed the final page with sliders or decided to quit, they were instructed to prepare up to 2 digital payment requests. The first involved the show-up fee (if not deposited) and the second involved slider earnings.

T2: Payment

Payment requests were automatically sent to an inbox, with delivery of the payment request for slider earnings being delayed by exactly 1 week. The inbox was monitored on a daily basis, with payments being made as soon as possible.

Data analysis

Descriptive statistics are provided for the sample of participants at each time point and chi-squared tests are used to assess differences between these samples. The main outcome measures are: 1) effort, and 2) earnings. Effort is operationalised as persistence (we will use these terms interchangeably), is operationalised as the number of sliders a participant completed at T1. We also report the number of pages (rather than the number of sliders), because the experiment was set-up such that after each page respondents were asked if they wanted to complete another *page* of sliders, and respondents would generally finish the whole page or quit the experiment. Earning reflects the total monetary reward earned. Following the study design, we first contrast

the random and nudged assignment arm, followed by contrasting the reward- and deposit-based incentives within the random arm, and finally contrast the reward- and deposit-based incentive schemes within the nudged arm. Each contrast is explored descriptively, followed by regression models explaining effort or earnings based on each contrast. Finally, we performed linear regression models investigating the impact of each contrast on persistence and earnings corrected for payment condition. Appendix B also contains a set of additional results, e.g., Kaplan-Meier survival curves for ‘survival’ in the experiment (i.e., continuing the slider tasks) and a set of regression analyses where persistence and earnings are modelled whilst controlling for demographics.

Results

Demographics

A total of 228 students participated in the first session, of whom the majority were master students with an income below €15,000 annually and were aged 18 to 24. Gender was roughly equally distributed with a slight majority of females. Of these respondents, 171 returned for the second session one week later (drop-out rate 25%). No evidence was found for selective drop-out according to the characteristics listed in Table 1 (Chi-squared analyses, all p 's > 0.05), except by education ($p = .031$). First year students had a higher tendency to drop out. The propensity to drop out was also not associated with assignment arm or payment condition².

Table 1. Demographic characteristics of the study sample at both sessions

	Session T0; n (%)	Session T1; n (%)	Dropout; n (%)	p-value (Session T1 vs Dropout)
Assignment arm				.320
Nudged assignment	113 (49.6)	81 (47.4)	32 (56.1)	
Random assignment	115 (50.4)	90 (52.6)	25 (43.9)	
Sex				.645
Male	104 (45.6)	80 (46.8)	24 (42.1)	
Female	124 (54.4)	91 (53.2)	33 (57.9)	
Age				.537
18-20	81 (35.5)	60 (35.1)	21 (36.8)	
21-23	95 (41.7)	69 (40.4)	26 (45.6)	
24+	52 (22.8)	42 (24.6)	10 (17.5)	
Income				.763
less than €5,000	45 (19.7)	34 (19.9)	11 (19.3)	
€5,000-€7,499	30 (13.2)	23 (13.5)	7 (12.3)	
€7,500 - €14,999	78 (34.2)	57 (33.5)	21 (36.8)	
€15,000 - €29,999	34 (14.9)	24 (14.0)	10 (17.5)	
€30,000 - €44,999	22 (9.6)	17 (9.9)	5 (8.8)	
€45,000 - €59,999	8 (3.5)	5 (2.9)	3 (5.2)	

² Figure 1 shows that drop-out appears to be considerably higher among respondents in low payment conditions that were either randomized to or chose deposit-based incentives. In Appendix C, we explored the degree to which this selective drop-out affects our findings. Although we find some evidence of selection effects, we find no evidence of bias in our results.

€60,000 - €79,999	3 (1.3)	3 (1.8)	0 (0.0)	
€80,000 - €99,999	2 (0.9)	2 (1.2)	0 (0.0)	
Don't want to share	6 (2.6)	6 (3.5)	0 (0.0)	
Highest education attained				.042
First year	21 (9.2)	11 (6.4)	10 (17.5)	
Tertiary education (HBO)	6 (2.6)	3 (1.8)	3 (5.3)	
Bachelor	127 (55.7)	98 (57.3)	29 (50.9)	
Master	72 (31.6)	58 (33.9)	14 (24.6)	
PhD	2 (0.9)	1 (0.6)	1 (1.8)	
Payment condition				.907
€8	67 (29.4)	49 (28.7)	18 (31.6)	
€12	81 (35.5)	61 (35.7)	20 (35.1)	
€20	80 (35.1)	61 (35.7)	19 (33.3)	
Incentive type				
Reward-based	129 (56.6)	100 (58.5)	29 (50.9)	.781
Deposit-based	99 (43.4)	71 (41.5)	28 (49.1)	

Baseline and repeated measures

Our data showed considerable hypothetical demand for commitment, as seen in Table 2. That is, 65% of the sample would demand commitment at T0 (66% among those that showed up for T1). In the repeated measure completed at T1 this was somewhat lower, with 56% demanding commitment. Chi-squared tests were suggestive of slightly lower demand for commitment in T1 and the repeated measure ($p = .06$).

In session T0 we found considerable loss aversion. That is, 212 out of 228 respondents were loss averse (93%), and the same was true for 160 out of the 171 respondents returning for session T1. The proportion of loss averse respondents was similar for the repeated measurement in session 2 (92%). Although mean loss aversion appeared lower in session T0 compared to T1 (3.69 vs 6.05, respectively), paired t-tests suggest this difference was not statistically significant ($t(169)=1.49$, $p=0.14$).

Table 2, furthermore, shows that across all sessions a slight majority of participants preferred the larger delayed rewards in most items. The k-parameter indicates the degree of sensitivity to delay, where the small numbers in Table 2 indicate that respondents were generally not strongly discounting delays. Furthermore, the test-retest reliability of the MCQ appears reasonable, as differences between measurements appeared small.

Table 2. Baseline and repeated measures used for nudged assignment

		Session T0 (n=228)	T0 measurement for those attending Session T1 (n=171 remaining)	Session T1: Repeated measurement
Would you commit?	Yes, absolutely (n, %)	42 (18%)	32 (18%)	28 (16%)

	Yes, probably (n, %)	105 (46%)	81 (47%)	67 (29%)
	Not sure (n, %)	28 (12%)	21 (12%)	32 (18%)
	No, probably not (n, %)	38 (17%)	26 (15%)	35 (20%)
	No, absolutely not (n, %)	15 (7%)	11 (6%)	8 (4%)
Loss aversion	Median (Q1- Q3)	2.68 (1.64 - 4.81)	2.63 (1.64 - 4.74)	2.38 (1.64 - 4.29)
	Mean (SD)	5.55 (15.95)	6.06 (18.29)	3.69 (4.06)
Discounting: Proportion of LL*	Median (Q1- Q3)	0.56 (0.41 - 0.67)	0.52 (0.41 - 0.67)	0.52 (0.41 - 0.67)
	Mean (SD)	0.56 (0.21)	0.56 (0.21)	0.55 (0.20)
Discounting: K- parameter	Median (Q1- Q3)	0.01 (0 - 0.02)	0.01 (0 - 0.02)	0.01 (0 - 0.02)
	Mean (SD)	0.02 (0.03)	0.02 (0.03)	0.01 (0.03)

*LL = larger delayed reward

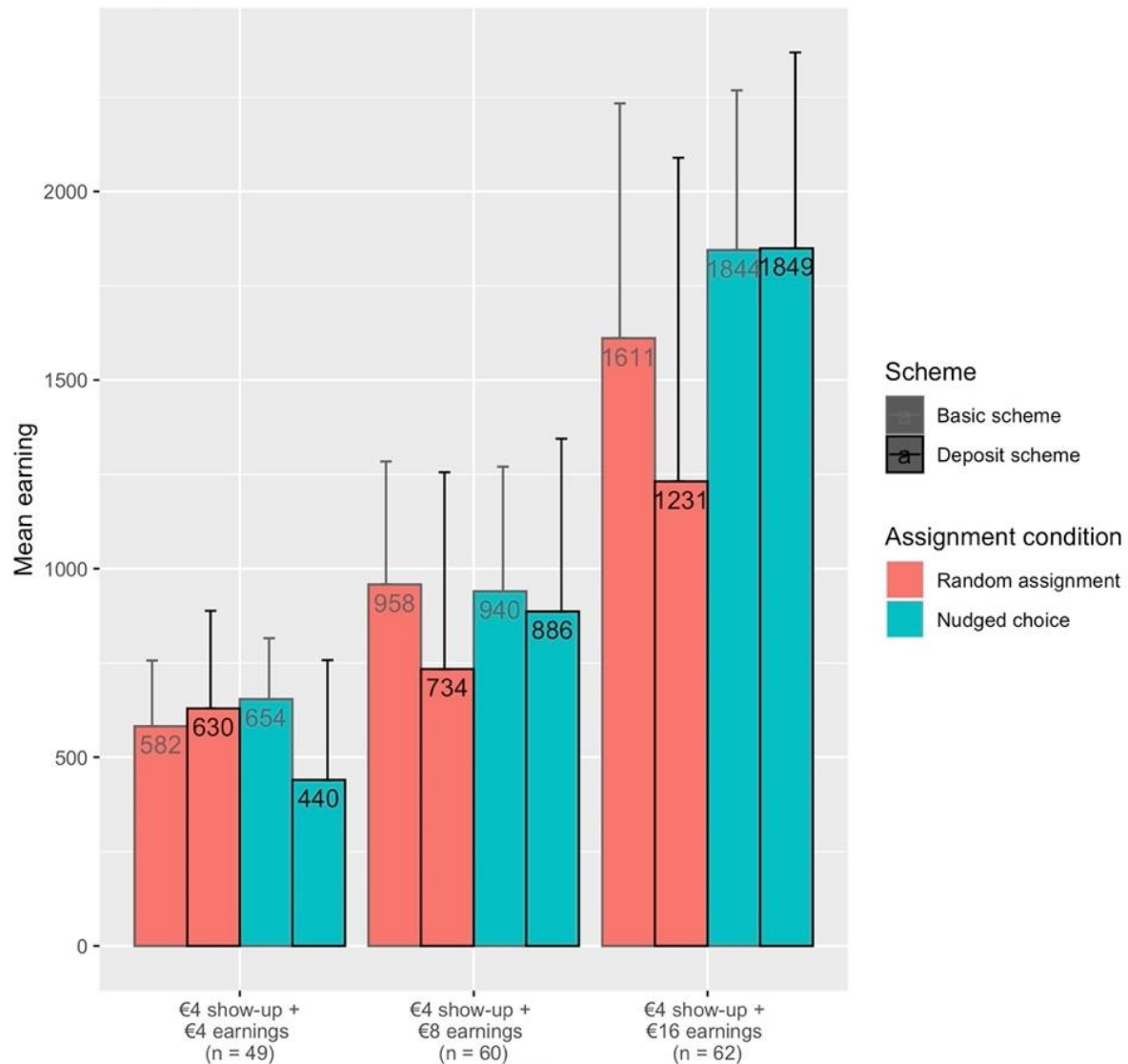


Figure 2. Mean earnings by assignment arm, payment condition and incentive scheme

Payment conditions

Figure 2 shows the mean earnings per payment condition, separated by assignment arms and incentive scheme. Perhaps unsurprisingly, the proportions of respondents completing the slider task differed between payment condition, such that it was highest for the high payment condition and lowest for the low condition. When looking at the effect of payment condition on persistence, we find some evidence for differences in persistence between payment condition. That is, respondents in the low, medium and high payment condition completed 235, 273, 315 out of 400 sliders respectively (see Appendix B for a figure that shows the amount of sliders completed across all subgroups in the experiment). Note that the increase from low to medium, or medium to high was not significant (t-tests, p 's > 0.14), while the number of sliders completed was significantly higher when comparing the low and high payment condition (t-test, $p = 0.01$). Given that the total monetary amount available might influence persistence of participants, we included payment condition as a control variable in a set of regression analyses investigating differences in persistence and earnings in different subsets of the sample. Table 3

also shows the effect of payment condition across different specifications. It appears that the high payment condition generally yielded higher effort and earnings, whereas the significance of medium payment condition depended on model specification.

Contrast 1: The effect of (nudged) choice

With 115 participants in the random assignment arm and 113 in the nudged assignment arm distribution was spread evenly at T0 (as expected given treatment arms were randomly assigned). Drop-out was slightly higher in the nudged arm (32 out of 113, 23%) compared to the random arm (25 out of 115, 22%, see also Figure 1), but this difference was not statistically significant (Chi-square test, $p = .32$). Visual inspection of respondent persistence (see Figure 3) suggests that a difference in starting point and a difference in slope exists between the arms. The starting point reflects the percentage of participants that started slider tasks, and very few participants completed the experiment without allocating any effort. Furthermore, the percentage of participants continuing with the slider task tended to be higher in the nudged arm. However, the difference was not significant (t-test, $p = .32$). A similar pattern can be observed for the total earnings between the random and nudged arm, where the earnings in the nudged arm are higher, but with the difference on the margin of being significant statistically significant (t-test, $p = .08$). Table 3 model 1 shows the regression equivalent of contrast 1 taking payment condition into account. Having a choice (i.e., the nudged assignment arm) was positively associated with both persistence ($\beta = 48.4$, $p = .04$) and earnings ($\beta = 189.6$, $p = .01$). Hence, conditional on payment condition, nudged assignment with an opt-out significantly increased both effort and earnings compared to randomly assigned incentives.

Contrast 2: The effect of deposit-based incentives (for random assignment)

Within the random assignment arm respondents were evenly distributed among reward- and deposit-based incentives schemes. Drop-out was slightly larger among those randomly assigned deposit-based incentives (15 out of 55, 27%) than those assigned reward-based incentives (10 out of 60, 17%), but this difference was not statistically significant (Chi-squared test, $p=0.25$). Figure 3 panel 2 shows that persistence and earnings were similar between the two incentive schemes. In Table 3, Model 2 regression results showed no significant differences between reward and deposit-based incentive schemes corrected for payment condition for both persistence and earnings. Those randomised to the deposit-based scheme seemed to earn less, again on the margin of being statistically significant ($\beta = -214.0$, $p = .07$). This is intuitive: if persistence is not higher among those who take up for a deposit-based incentives, then total earnings will be lower in this group since they have given up their show-up fee.

Contrast 3: The effect of deposit-based incentives (for nudged arm)

Contrast 3a: Who chooses deposit-based incentives?

Most respondents in the nudged assignment arm were advised to take up deposit-based incentives (i.e., 100 out of 113 respondents). This result is explained by the high hypothetical

demand for commitment as well as considerable loss aversion³. Interestingly, when respondents were recommended to take reward-based incentives, 100% of the participants adhered to this advice. In contrast, only 44% adhered to the advice to choose a deposit-based scheme⁴. Next, we explored if the demographics were associated with adherence to the informed advice implemented in the nudged assignment arm, as well as investigating if the baseline measures that determine the advice are related to adherence. In a set of univariate tests (i.e., t-tests or Chi-squared tests) we found no evidence in favour of associations between demographics and adherence to informed advice. As such, participants' propensity to take the informed advice was not dependent on their demographics. Similar, participants propensity to take the informed advice was neither dependent on economic preferences, i.e., delay discounting, demand for commitment and loss aversion. This result was robust to excluding those receiving the advice to take reward-based incentives, of whom everyone took the advice, and no one deviated. Further multivariate analyses supported the previous findings. The only evidence in favour of an association between advice adherence and economic preferences was observed when restricting the data to only those who showed up for both sessions, i.e., ignoring drop-out. In this model demand for commitment was associated with advice adherence ($\beta = -0.30$, $p = .010$), suggesting that those who demanded commitment were more inclined to adhere to their nudged assignment.

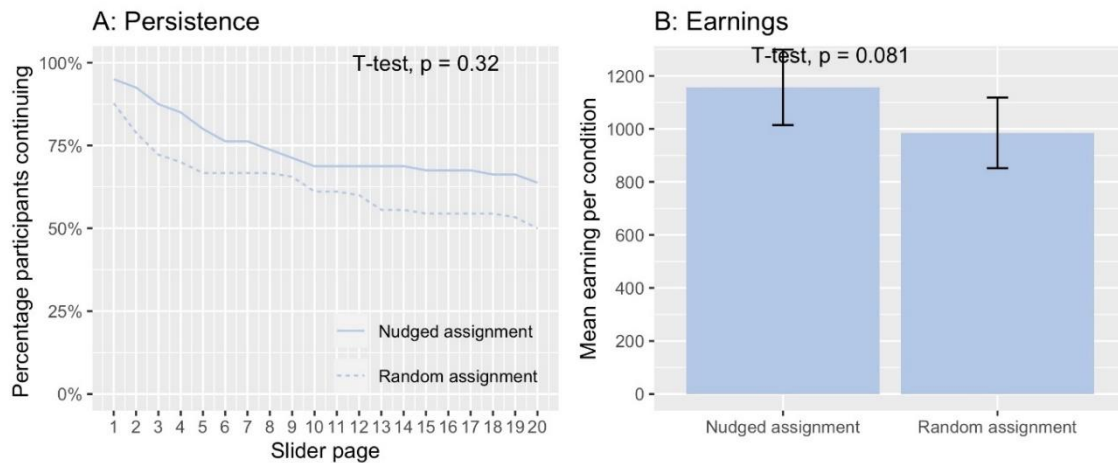
Contrast 3b: The effect of deposit-based incentives in those who chose them

Within the nudged assignment arm participants were free to choose the incentive scheme of their preference, hence the distribution was not equal between the two schemes. 69 out of 113 (61%) participants chose reward-based incentives while 44 (39%) chose the deposit-based incentive scheme. Since this assignment was not random, any possible difference between the two groups reflects a combination of effects of the incentive scheme and selection bias deriving from a self-selection of participants into the incentive scheme of their choice. There was no difference in drop-out between the schemes at T1 (Chi-squared test, $p = .98$). The persistence and earnings within the deposit-based incentive group tended to be higher but the differences were not statistically significantly different (see Table 3: Model 3). Finally, we looked at the effect of assignment in those who received deposit-based incentives (Model 4) or reward-based incentives (Model 5), whilst taking into account the payment condition. As seen from Model 4, having a choice did have a significant effect on earnings for participants who chose a deposit.

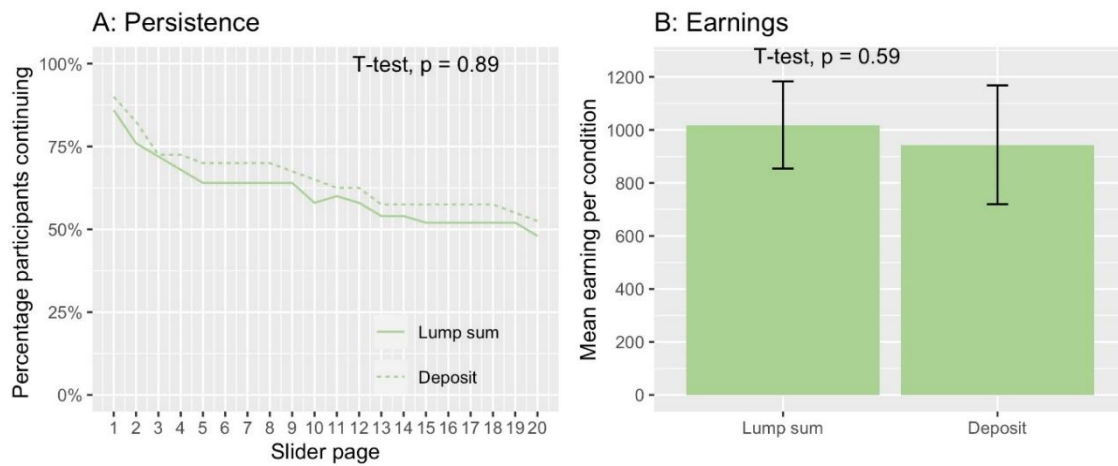
³ One respondent in the nudged assignment condition was incorrectly advised to take-up deposits due to a computing error. This respondent followed up on the 'incorrect' deposit advice.

⁴ It appears that between sessions drop-out was not associated with taking up the advice for deposit-based incentives. That is, the proportion of respondents following up on deposit advice in session T0 and returning for session T1 was approximately the same: in T0 this applied to 44 out of 100 respondents (44%) and of the 72 respondents returning for T1 $n=31$ adhered to deposit advice (39%), see also Figure 1. The differences between baseline and repeated measurements observed for would have led to a different advice in 17 out of 81 respondents that showed up for the second session in that condition. Of those whose advice would have changed when repeated measurements were used, the far majority would have received the advice to take reward-based incentives instead of deposit-based incentives (16 out of 17).

Contrast 1: Random vs. Nudged assignment



Contrast 2: Deposit vs. Lump sum - Random arm



Contrast 3: Deposit vs. Lump sum - Nudged arm

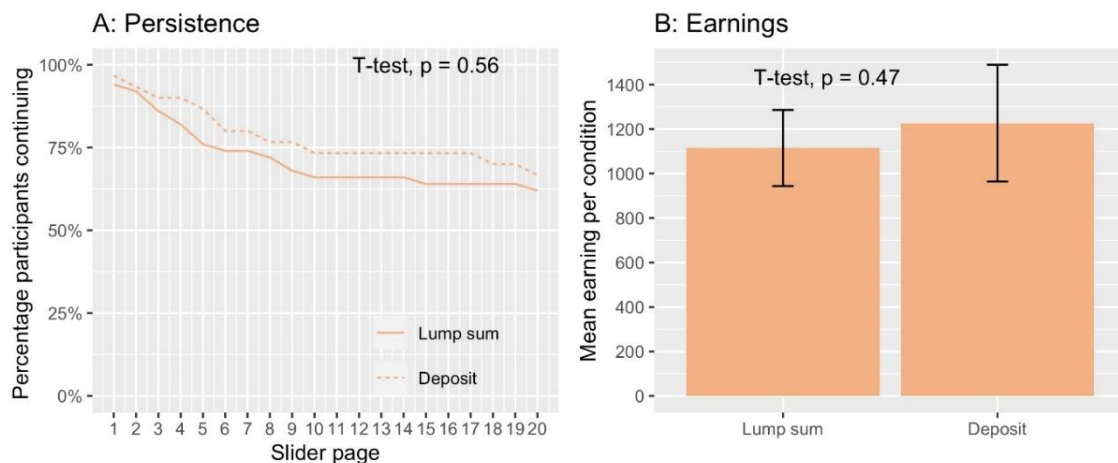


Figure 3: Slider pages completed (i.e., persistence) and earnings (in cents) for each contrast our design enables.

Table 3. Linear regression analysis results with persistence and total earnings as independent variables

		<i>Model 1</i>		<i>Model 2</i>		<i>Model 3</i>		<i>Model 4</i>		<i>Model 5</i>	
Sample		<i>Both arms</i>		<i>Only random</i>		<i>Only nudged</i>		<i>Only deposit-based</i>		<i>Only reward-based</i>	
Persistence		β	<i>p-value</i>	β	<i>p-value</i>	β	<i>p-value</i>	β	<i>p-value</i>	β	<i>p-value</i>
	Intercept	212.7	.000	223.0	.000	248.4	.000	217.5	.000	197.5	.000
	Nudged assignment	48.4	.044					68.3	.097	42.7	.174
	Payment condition €12	36.9	.219	40.6	.368	30.0	.474	-33.6	.549	58.2	.126
	Payment condition €20	78.9	.009	48.3	.283	112.5	.008	-2.1	.969	113.3	.003
	Deposit-based incentives			-0.2	.996	9.3	.789				
Earnings	Intercept	521.5	.000	662.8	.000	633.2	.000	492.7	.011	570.2	.000
	Nudged assignment	189.6	.011					312.1	.039	94.5	.195
	Payment condition €12	270.5	.004	291.1	.048	307.4	.007	158.6	.470	337.1	.000
	Payment condition €20	993.8	.000	855.9	.000	1236.7	.000	857.0	.000	1112.4	.000
	Deposit-based scheme			-214.0	.068	-54.7	.555				

Model1: Effect of choice on persistence and earnings

Model2: Effect of deposit-based incentives on persistence and earnings when it is not a choice

Model3: Effect of deposit-based incentives on persistence and earnings when it is a choice

Model 4: Effect of choice on persistence and earnings among those who have a deposit-based incentive scheme

Model 5: Effect of choice on persistence and earnings among those who have a reward-based incentive scheme

Discussion

In this study, we studied the effect of both the *assignment mode* of incentives, as well as the *incentive scheme* in an incentivized real-effort task for incentives of different sizes. Two modes of assigning respondents to either reward or deposit-based financial incentives are compared: random assignment and ‘nudged’ assignment. In the nudged assignment condition assignment was based on respondent characteristics (discounting, loss aversion and willingness to pay a deposit) allowing opting out. This design allowed us to expand the literature in several directions, discussed below.

Random vs. nudged assignment to incentive designs

Earlier work has shown that those who have the opportunity to choose their own incentive scheme perform the same or worse than those randomly assigned to incentives (Chaudhry and Klinowski, 2016, Adjerid et al., 2021, Woerner et al., 2021). The findings of our study are in contrast to that literature, as it appears that respondents allocated more effort and earned slightly more when offered a choice among incentives (after controlling for payment condition). A key difference between our study and early work is the main dependent variable: in our work effort on a tedious task and in other studies different forms of health behaviour. Hence, whether or not choice among incentive schemes is beneficial may be related to how difficult it is to anticipate what type of incentives will help them stay motivated. In particular, Woerner et al. (2021), in the context of meditation, find that given the choice between incentive schemes respondents sort into incentives that would theoretically be optimal given their anticipated meditation benefits. Their findings, however suggest that choice has a negative effect on meditation frequency, but only for respondents that did not meditate before the study. This may suggest that choice among incentive schemes is not beneficial when individuals lack the experience needed to anticipate the effort needed and benefits associated with some behaviour. In our case, respondents practice the real-effort task and due to the simple nature of the experiment, the effort needed and benefits associated with completing slider tasks should have been clear. Potentially, choice between incentive schemes is beneficial for simple and easy tasks (i.e., slider tasks) and (potentially) detrimental for complex behaviours (e.g., health behaviour change).

Reward vs. deposit-based incentives of different sizes

The second key contrast in this study was between reward- and deposit-based incentives of different sizes. In particular, we compared effectiveness of these incentive schemes in those randomly assigned to them, as this avoids self-selection. We find that respondents were slightly less likely to show up for the next session of our experiment if they were assigned to deposit-based incentives. This appears to be in line with the low attractiveness of deposit-based incentives observed in earlier work, in which voluntary take-up was typically low (Halpern et al., 2015, Giné et al., 2010, Royer et al., 2015), however this effect was not statistically significant. Importantly, effort provision was not affected by the type of incentive scheme respondents were assigned to, and as a result respondents earned less when they were randomly assigned to deposit-based incentives. This finding is in contrast to work by Patel et al. (2016) who found larger effectiveness for deposit-based incentives (compared to reward-based

incentives) for physical exercise. On the other hand, our null-result is in line with findings by Halpern (2018) for smoking cessation. Hence, it appears the use of deposit-based incentives is beneficial compared to not using incentives at all (John et al., 2011, Giné et al., 2010, Royer et al., 2015), but it remains unclear if deposit-based incentives outperform incentives that do not involve losses. Future work may compare reward- and deposit-based incentives in a design that also includes a control condition without incentives to further explore this issue. Furthermore, our study included incentives of different sizes. Increasing reward size by 50% and 150% significantly increased persistence by ~16% and 34% respectively, which seems to suggest some degree of diminishing sensitivity to increasing reward size. This finding is in contrast to de Araujo et al. (2015), who find that persistence on slider task is largely insensitive to reward sizes.

Take-up of deposit-based incentives

Using a set of pragmatic decision rules (modelled after Boderie et al. (2020)), we advised respondents that demanded commitment and/or displayed considerable delay discounting/loss aversion to take-up deposit-based incentives (other respondents were advised to take-up reward-based incentives). This advice was implemented as a pre-selection of the advised incentive scheme, i.e., as a default. We find that many individuals display demand for commitment, as well as strong discounting and considerable loss aversion with estimates in line with earlier work using similar methodology (Kirby and Maraković, 1995, Lipman, 2020). Take-up of these default schemes was high, 100% for reward-based incentive schemes and a considerable 44% for deposit-based incentive schemes. In other words, nearly half of our respondents elected to voluntarily deposit part of the money they earned in order to commit themselves to complete more sliders, even though no matching was applied. Take-up of deposit-based incentives in our study is larger than in some published studies using deposit-based incentives without matching (Ashraf et al., 2006, Giné et al., 2010, Royer et al., 2015), in line with the high hypothetical take-up typically found in lab-based studies (Adjerid et al., 2021, Lipman, 2020). Carrera et al. (2019), however, estimated that the average take-up rate of deposit contracts for earned money, as in our study, was 47%, i.e., quite close to the take-up in this study. This would imply that the use of defaults appears to add little to take-up of deposit-based incentives, in contrast to what was suggested in work done with commercially available deposit-based incentives i.e., on www.stickk.com (Goldhaber-Fiebert et al., 2010, Bhattacharya et al., 2015). Yet, another treatment arm with voluntary choice without a default would be needed to draw this conclusion.

Predicting take-up of deposit-based incentives

Although the advice to take-up deposit-based incentives was based on discounting, loss aversion and demand for commitment, only the latter was associated with take-up (when ignoring drop-out). These results are in accordance with work by Lipman (2020), who also found no association between discounting and loss aversion and uptake of deposit-based incentives. Yet, this null-result for both discounting and loss aversion remains puzzling. In a study on the use of deposit-based incentives to promote savings, Ashraf et al. (2006) found evidence that take-up was associated with discounting, and loss aversion is often discussed as

a reason for low take-up of deposit-based incentives (Halpern et al., 2015). The association between demand for commitment observed in this study suggests that it is particularly ‘sophisticated’ individuals who take-up deposit-based incentives. That is, individuals who realize they need commitment to perform tedious tasks realize that without such commitment in place they would not perform the behaviour even if they planned to do it. Sophisticated individuals realize they have such time-inconsistent preferences (Laibson, 1997), and look for ways to constrain their future choices. In our study, this meant taking up deposit-based incentives, and, as such, voluntarily taking-up an incentive scheme in which previously earned money is only returned in full if respondents complete all slider tasks. The association observed between demand for commitment and take-up of deposit-based incentives, therefore, shows that individuals who believe they want commitment in a hypothetical context actually restrict themselves.

Furthermore, our results suggest that among respondents receiving deposit-based incentives, those that chose them (by taking-up our advice) completed more tasks and earned more than those we randomly assigned to deposit-based incentives. Interestingly, this analysis showed that payment condition was no longer a significant predictor of the amount of slider tasks. A potential explanation is that when participants get a choice in selecting their own incentive scheme, more motivated participants self-select into a deposit-based incentive scheme, explaining the higher levels of effort among those with deposit-based incentive schemes in the nudged assignment. We find no such effect of choice for reward-based incentives. Collectively, these results seem in line with Dizon-Ross and Zucker (2021) who find that respondents use free choice among incentives to commit themselves to future actions. That is, those that expect to need commitment and are willing to pay a deposit self-select into deposit-based incentives and as a consequence earn more. This result, therefore, may also caution against widespread use of (nudged) choice, as sophistication is not the only predictor of demand for commitment. Willingness to enter into incentive schemes with deposit-based incentives may also be associated with *ability* to pay, i.e., income or socio-economic status.

Limitations

The findings of this study should be interpreted in light of a set of limitations. First, the informed advice we provided respondents with was, in line with Boderie et al. (2020), based on a set of pragmatic cut-offs determined a priori, which raises several issues. For example, under the current specification a large majority of respondents was given the advice to take-up deposit-based incentives. This may be considered problematic, as in fact, in our study reward-based deposits dominate deposit-based incentives, as respondents can only be equally good off and only if they complete all tasks (in all other cases they earn less for the same effort). Future research should include a theoretical model of incentive design (e.g. Gonzalez-Jimenez, 2022), which may allow designing optimal incentives for respondents given their time and risk preferences. Such work could also explore alternative modes of assignment, e.g., if respondents’ characteristics can be measured beforehand for them to be assigned optimal incentive schemes (without opt-out). Second, our study used a (relatively small) student sample, which suggests that both the test power for the contrasts included as well as the external validity

of our results may be questioned. Future work could extend our design, where an important addition would be to expand our design to study health behaviour change (as in other recent work exploring modes of assignment, e.g., Woerner et al., 2021, Dizon-Ross and Zucker, 2021, Adjerid et al., 2021) rather than experiment-based effort provision. Third, the economic preferences (i.e., delay discounting and loss aversion) were elicited for hypothetical rewards. Typically, it is preferred for risk and time preferences to be elicited with incentive-compatible procedures (Galizzi and Wiesen, 2018), i.e., with procedures that translate to real payments. Fourth, in this study economic preferences, including demand for commitment, was measured before offering respondents choice of reward- or deposit-based incentives. As such, respondents may have felt a need to act consistent with their hypothetical demand for commitment, which would not have been observed if this question was not asked. Finally, in the design that was used for this study, it was impossible to disentangle the effect of having the opportunity to choose incentives from receiving informed advice. Disentangling these effects would require comparing nudged assignment with a condition in which respondents choose incentives without receiving advice.

Conclusion

To conclude, our study provides evidence that offering respondents free choice of incentives, including advice on which to take, may be beneficial in enhancing effort. That is, respondents that could self-select into incentives earned more and allocated more effort than those randomly allocated to an incentive scheme. We find that this may be driven by self-selection into deposit-based incentives by sophisticated individuals, which suggests that offering choice among different incentives scheme could only be beneficial for the subgroup that is sophisticated about requiring a deposit-scheme to maximize their long-run utility.

References

- ABDELLAOUI, M., BLEICHRODT, H., L'HARIDON, O. & VAN DOLDER, D. 2016. Measuring Loss Aversion under Ambiguity: A Method to Make Prospect Theory Completely Observable. *Journal of Risk and Uncertainty*, 52, 1-20.
- ADAMS, J., GILES, E. L., MCCOLL, E. & SNIHOTA, F. F. 2014. Carrots, sticks and health behaviours: a framework for documenting the complexity of financial incentive interventions to change health behaviours. *Health psychology review*, 8, 286-295.
- ADJERID, I., LOEWENSTEIN, G., PURTA, R. & STRIEGEL, A. 2021. Gain-Loss Incentives and Physical Activity: The Role of Choice and Wearable Health Tools. *Management Science*.
- ASHRAF, N., KARLAN, D. & YIN, W. 2006. Tying Odysseus to the mast: Evidence from a commitment savings product in the Philippines. *The Quarterly Journal of Economics*, 121, 635-672.
- AUGENBLICK, N., NIEDERLE, M. & SPRENGER, C. 2015. Working over time: Dynamic inconsistency in real effort tasks. *The Quarterly Journal of Economics*, 130, 1067-1115.
- AUGURZKY, B., BAUER, T. K., REICHERT, A. R., SCHMIDT, C. M. & TAUCHMANN, H. 2012. Does money burn fat?—Evidence from a randomized experiment. *Evidence from a Randomized Experiment (September 1, 2012)*. *Ruhr Economic Paper*.

- BHATTACHARYA, J., GARBER, A. M. & GOLDHABER-FIEBERT, J. D. 2015. Nudges in exercise commitment contracts: a randomized trial. National Bureau of Economic Research.
- BODERIE, N. W., VAN KIPPERSLUIJ, J. L., CEALLAIGH, D. T. Ó., RADÓ, M. K., BURDORF, A., VAN LENTHE, F. J. & BEEN, J. V. 2020. PERSONALISED Incentives for Supporting Tobacco cessation (PERSIST) among healthcare employees: a randomised controlled trial protocol. *BMJ open*, 10, e037799.
- CARRERA, M., ROYER, H., STEHR, M., SYDNOR, J. & TAUBINSKY, D. 2019. Who Chooses Commitment? Evidence and Welfare Implications. National Bureau of Economic Research.
- CAWLEY, J. & PRICE, J. A. 2013. A case study of a workplace wellness program that offers financial incentives for weight loss. *Journal of health economics*, 32, 794-803.
- CHAUDHRY, S. J. & KLINOWSKI, D. 2016. Enhancing autonomy to motivate effort: an experiment on the delegation of contract choice. *Experiments in Organizational Economics*. Emerald Group Publishing Limited.
- DE ARAUJO, F. A., CARBONE, E., CONELL-PRICE, L., DUNIETZ, M. W., JAROSZEWICZ, A., LANDSMAN, R., LAMÉ, D., VESTERLUND, L., WANG, S. & WILSON, A. J. 2015. The effect of incentives of real effort: Evidence from the slider task. Available at SSRN 2615704.
- DECI, E. L. & RYAN, R. M. 2008. Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian psychology/Psychologie canadienne*, 49, 182.
- DIZON-ROSS, R. & ZUCKER, A. 2021. Can price discrimination increase behavioral change? Evidence from a randomized field experiment. Working paper, University of Chicago.
- DONLIN WASHINGTON, W., MCMULLEN, D. & DEVOTO, A. 2016. A matched deposit contract intervention to increase physical activity in underactive and sedentary adults. *Translational Issues in Psychological Science*, 2, 101.
- FINKELSTEIN, E. A., LINNAN, L. A., TATE, D. F. & BIRKEN, B. E. 2007. A pilot study testing the effect of different levels of financial incentives on weight loss among overweight employees. *Journal of occupational and Environmental medicine*, 981-989.
- FREDERICK, S., LOEWENSTEIN, G. & O'DONOGHUE, T. 2002. Time discounting and time preference: A critical review. *Journal of economic literature*, 40, 351-401.
- FREY, B. S. & OBERHOLZER-GEE, F. 1997. The cost of price incentives: An empirical analysis of motivation crowding-out. *The American economic review*, 87, 746-755.
- GALIZZI, M. M. & WIESEN, D. 2018. Behavioral experiments in health economics.
- GILES, E. L., ROBALINO, S., MCCOLL, E., SNIHOTTA, F. F. & ADAMS, J. 2014. The effectiveness of financial incentives for health behaviour change: systematic review and meta-analysis. *PloS one*, 9, e90347.
- GILL, D. & PROWSE, V. 2019. Measuring costly effort using the slider task. *Journal of Behavioral and Experimental Finance*, 21, 1-9.
- GINÉ, X., KARLAN, D. & ZINMAN, J. 2010. Put your money where your butt is: a commitment contract for smoking cessation. *American Economic Journal: Applied Economics*, 2, 213-35.
- GNEEZY, U., MEIER, S. & REY-BIEL, P. 2011. When and why incentives (don't) work to modify behavior. *Journal of economic perspectives*, 25, 191-210.
- GOLDHABER-FIEBERT, J. D., BLUMENKRANZ, E. & GARBER, A. M. 2010. Committing to exercise: contract design for virtuous habit formation. National Bureau of Economic Research.

- GONZALEZ-JIMENEZ, V. 2022. Incentive design for reference-dependent preferences.
- HAISLEY, E., VOLPP, K. G., PELLATHY, T. & LOEWENSTEIN, G. 2012. The Impact of Alternative Incentive Schemes on Completion of Health Risk Assessments. *American Journal of Health Promotion*, 26, 184-188.
- HALPERN, S. D., FRENCH, B., SMALL, D. S., SAULSGIVER, K., HARHAY, M. O., AUDRAIN-MCGOVERN, J., LOEWENSTEIN, G., ASCH, D. A. & VOLPP, K. G. 2016. Heterogeneity in the effects of reward-and deposit-based financial incentives on smoking cessation. *American journal of respiratory and critical care medicine*, 194, 981-988.
- HALPERN, S. D., FRENCH, B., SMALL, D. S., SAULSGIVER, K., HARHAY, M. O., AUDRAIN-MCGOVERN, J., LOEWENSTEIN, G., BRENNAN, T. A., ASCH, D. A. & VOLPP, K. G. 2015. Randomized trial of four financial-incentive programs for smoking cessation. *New England Journal of Medicine*, 372, 2108-2117.
- HALPERN, S. D., HARHAY, M. O., SAULSGIVER, K., BROPHY, C., TROXEL, A. B. & VOLPP, K. G. 2018. A pragmatic trial of e-cigarettes, incentives, and drugs for smoking cessation. *New England Journal of Medicine*, 378, 2302-2310.
- HALPERN, S. D., KOHN, R., DORNBRAND-LO, A., METKUS, T., ASCH, D. A. & VOLPP, K. G. 2011. Lottery-based versus fixed incentives to increase clinicians' response to surveys. *Health services research*, 46, 1663-1674.
- JEFFERY, R. W., GERBER, W. M., ROSENTHAL, B. S. & LINDQUIST, R. A. 1983. Monetary contracts in weight control: effectiveness of group and individual contracts of varying size. *Journal of consulting and clinical psychology*, 51, 242.
- JOHN, L. K., LOEWENSTEIN, G., TROXEL, A. B., NORTON, L., FASSBENDER, J. E. & VOLPP, K. G. 2011. Financial incentives for extended weight loss: a randomized, controlled trial. *Journal of general internal medicine*, 26, 621-626.
- KAPLAN, B. A., AMLUNG, M., REED, D. D., JARMOLOWICZ, D. P., MCKERCHAR, T. L. & LEMLEY, S. M. 2016. Automating scoring of delay discounting for the 21-and 27-item monetary choice questionnaires. *The Behavior Analyst*, 39, 293-304.
- KIRBY, K. N. & MARAKOVIĆ, N. N. 1995. Modeling myopic decisions: Evidence for hyperbolic delay-discounting within subjects and amounts. *Organizational Behavior and Human decision processes*, 64, 22-30.
- KÖBBERLING, V. & WAKKER, P. P. 2005. An index of loss aversion. *Journal of Economic Theory*, 122, 119-131.
- LAIBSON, D. 1997. Golden eggs and hyperbolic discounting. *The Quarterly Journal of Economics*, 112, 443-478.
- LARKIN, I. & LEIDER, S. 2012. Incentive schemes, sorting, and behavioral biases of employees: Experimental evidence. *American Economic Journal: Microeconomics*, 4, 184-214.
- LIPMAN, S. A. 2020. One size fits all? Designing financial incentives tailored to individual economic preferences. *Behavioural Public Policy*, 1-15.
- LIPMAN, S. A., BROUWER, W. B. & ATTEMA, A. E. 2019. A QALY loss is a QALY loss is a QALY loss: a note on independence of loss aversion from health states. *European Journal of Health Economics*, 20, 419-426.
- MANTZARI, E., VOGT, F., SDEMILT, I., WEI, Y., HIGGINS, J. P. & MARTEAU, T. M. 2015. Personal financial incentives for changing habitual health-related behaviors: A systematic review and meta-analysis. *Preventive medicine*, 75, 75-85.
- MAZUR, J. E. 1987. An adjusting procedure for studying delayed reinforcement. *Quantitative analyses of behavior*, 5, 55-73.
- MITCHELL, M. S., GOODMAN, J. M., ALTER, D. A., JOHN, L. K., OH, P. I., PAKOSH, M. T. & FAULKNER, G. E. 2013. Financial incentives for exercise adherence in

- adults: systematic review and meta-analysis. *American journal of preventive medicine*, 45, 658-667.
- NOTLEY, C., GENTRY, S., LIVINGSTONE-BANKS, J., BAULD, L., PERERA, R. & HARTMANN-BOYCE, J. 2019. Incentives for smoking cessation. *Cochrane Database of Systematic Reviews*.
- PATEL, M. S., ASCH, D. A., ROSIN, R., SMALL, D. S., BELLAMY, S. L., HEUER, J., SPROAT, S., HYSON, C., HAFF, N. & LEE, S. M. 2016. Framing financial incentives to increase physical activity among overweight and obese adults: a randomized, controlled trial. *Annals of internal medicine*, 164, 385-394.
- ROYER, H., STEHR, M. & SYDNOR, J. 2015. Incentives, commitments, and habit formation in exercise: evidence from a field experiment with workers at a fortune-500 company. *American Economic Journal: Applied Economics*, 7, 51-84.
- STROHACKER, K., GALARRAGA, O. & WILLIAMS, D. M. 2013. The impact of incentives on exercise behavior: a systematic review of randomized controlled trials. *Annals of Behavioral Medicine*, 48, 92-99.
- SYKES-MUSKETT, B. J., PRESTWICH, A., LAWTON, R. J., MEADS, D. M. & ARMITAGE, C. J. 2017. Exploration of likely engagement with Monetary Contingency Contracts for weight loss: a questionnaire study. *Psychology, Health & Medicine*, 22, 1278-1283.
- THALER, R. H. & SUNSTEIN, C. R. 2009. *Nudge: Improving decisions about health, wealth, and happiness*, Penguin.
- TVERSKY, A. & KAHNEMAN, D. 1992. Advances in prospect theory: Cumulative representation of uncertainty. *Journal of risk and uncertainty*, 5, 297-323.
- WOERNER, A., ROMAGNOLI, G., PROBST, B. M., BARTMANN, N., CLOUGHESY, J. N. & LINDEMANS, J. W. 2021. Should Individuals Choose Their Own Incentives? Evidence from a Mindfulness Meditation Intervention. *Evidence from a Mindfulness Meditation Intervention*.

Appendix A: Method for measuring loss aversion

In the non-parametric method, estimating loss aversion requires a reference-point (denoted RP) which separates outcomes in the task into gains and losses. In this study the reference point was 0 euro, i.e., status quo, and outcomes were denoted as compared to this reference point (i.e., +€20 and €-20). Furthermore, the method requires specifying an amount G . The gauge outcome G was set to €100. As can be seen in the demo task, the method was operationalised with 3 choice lists to elicit indifferences. Providing a full formal rationale for the method would be beyond the scope of this paper, but Table 1 gives an example.

Table 2. Indifferences elicited in the non-parametric method, where $x_{0.5}y$ denotes a gamble yielding x with probability 0.5 and y otherwise and the example indifferences yield a loss aversion coefficient of $\lambda = 2$.

	General notation	Goal	Example
Indifference 1: Mixed prospect	$G_{0.5} \mathcal{L} \sim RP$	Eliciting \mathcal{L}	$100_{0.5} -60 \sim 0$
Indifference 2: Certainty equivalence – gains	$G_{0.5} r \sim x_1^+$	Eliciting x_1^+	$100_{0.5} 0 \sim 40$
Indifference 3: Certainty equivalence - losses	$\mathcal{L}_{0.5} r \sim x_1^-$	Eliciting x_1^-	$-60_{0.5} 0 \sim -20$
Köbberling and Wakker (2005)	$\lambda = \frac{x_1^+}{-x_1^-}$	Loss aversion coefficient	$\lambda = \frac{40}{-(-20)} = 2$

Appendix B: Additional results

Survival-analysis

As the figures presented closely represent survival analysis, additional Kaplan-Meier survival curves were estimated. A Mantel-Haenszel test indicated no significant difference between the two conditions ($p=.2$), which is also observable by the crossing lines in figure 6.

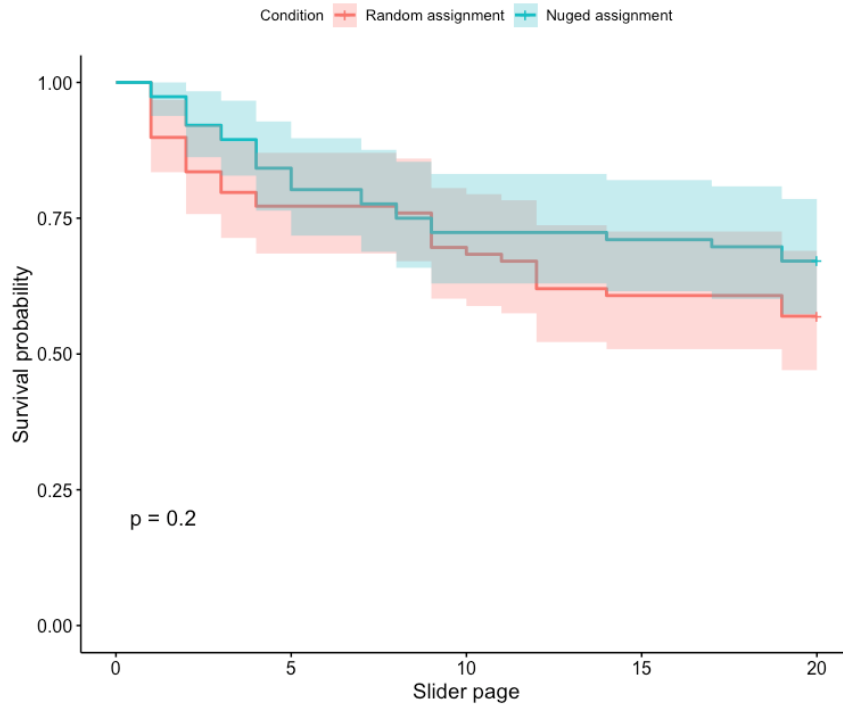


Figure B1: Kaplan-Meier survival curve

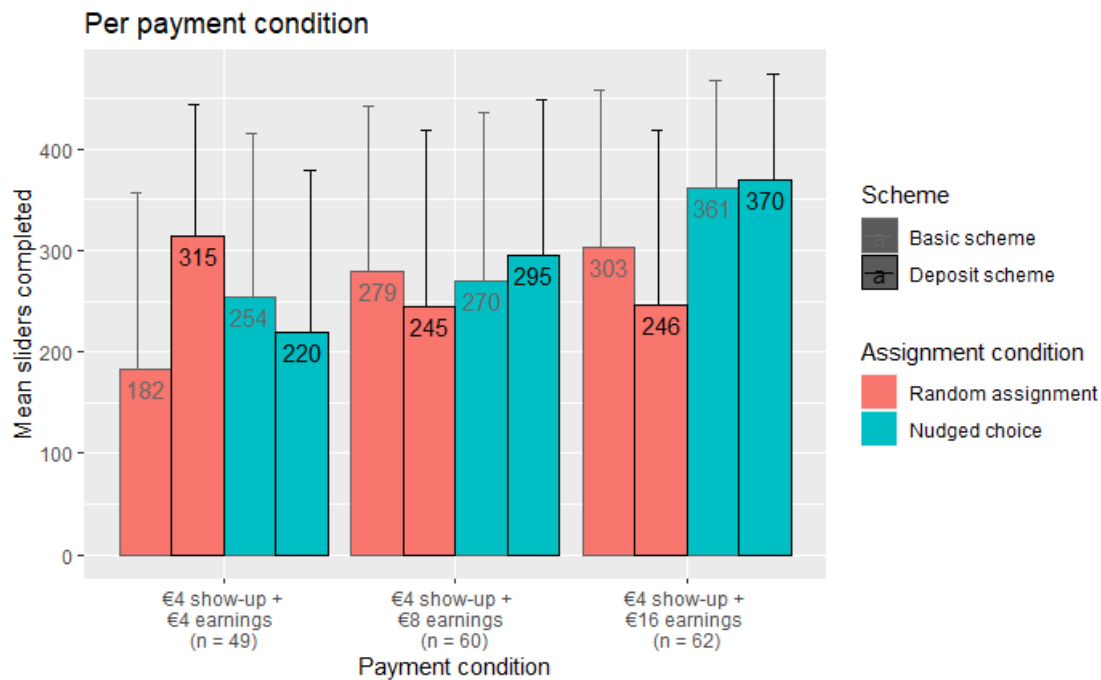


Figure B2 : Sliders completed per payment condition

Table B1. Linear regression analysis results with persistence and total earnings as independent variables and including personal characteristics													
		Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
Sample		Both arms		Both arms		Only random		Only nudged		Only deposit-based		Only reward-based	
Persistence		β	<i>p-value</i>	β	<i>p-value</i>	β	<i>p-value</i>	β	<i>p-value</i>	β	<i>p-value</i>	β	<i>p-value</i>
	Intercept	187.7	.005	119.2	.082	119.0	.251	297.9	.041	220.1	.040	62.0	.511
	Nudged assignment			37.7	.213					53.7	.198	32.2	.314
	Payment condition €12			41.7	.160	48.3	.278	31.1	.465	-15.7	.796	54.4	.163
	Payment condition €20			86.1	.004	63.0	.156	114.0	.008	10.6	.853	117.9	.002
	Deposit scheme					7.1	.846	7.3	.839				
	Gender (ref. male)	52.2	.031	56.6	.018	72.9	.039	30.0	.364	39.6	.305	63.3	.047
	Income	-6.3	.225	-5.3	.319	-7.6	.293	1.6	.859	-4.0	.641	-4.4	.584
	Educational level	6.2	.543	5.1	.614	3.3	.817	0.6	.969	-0.1	.994	10.5	.478
Earnings	Intercept	922.6	.001	273.1	.202	243.4	.467	776.8	.003	377.8	.364	186.4	.392
	Nudged assignment			156.3	.042					283.5	.086	67.6	.359
	Payment condition €12			282.2	.003	312.5	.032	306.5	.008	217.1	.364	328.3	.000
	Payment condition €20			1006.3	.000	902.2	.000	1248.5	.000	888.7	.000	1122.8	.000
	Deposit scheme					-197.8	.095	-74.1	.440				
	Gender (ref. male)	60.7	.540	137.4	.066	225.7	.048	2.2	.980	111.1	.464	149.5	.042
	Income	-17.8	.406	-22.9	.169	-20.9	.373	19.4	.4	-15.2	.651	-10.2	.0577
	Educational level	22.2	.599	24.1	.447	26.1	.577	-37.7	.362	-3.2	.956	36.4	.288

Model0: Effect of personal characteristics persistence and earnings

Model1: Effect of choice on persistence and earnings corrected for personal characteristics

Model2: Effect of deposit incentives on persistence and earnings when it is not a choice corrected for personal characteristics

Model3: Effect of deposit incentives on persistence and earnings when it is a choice corrected for personal characteristics

Model 4: Effect of choice on persistence and earnings among those who have a deposit-based incentive scheme corrected for personal characteristics

Model 5: Effect of choice on persistence and earnings among those who have a reward-based incentive scheme corrected for personal characteristics

Table B2. Linear regression analysis results with persistence and total earnings as independent variables and including loss aversion, discounting and demand for commitment (i.e. economic characteristics)

		Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
Sample		Both arms		Both arms		Only random		Only nudged		Only deposit-based		Only reward-based	
Persistence		β	p-value	β	p-value	β	p-value	β	p-value	β	p-value	β	p-value
	Intercept	334.3	.000	277.1	.000	288.7	.000	260.0	.001	316.3	.000	224.6	.002
	Nudged assignment			20.3	.399					49.4	.214	1.3	.969
	Payment condition €12			46.6	.126	28.7	.545	65.8	.125	8.8	.869	58.9	.139
	Payment condition €20			72.1	.017	27.8	.693	128.2	.003	26.4	.608	94.1	.019
	Deposit scheme					2.4	.971	25.1	.551				
	Demand for commitment (ref. willing to commit)	015.5	.526	-10.3	.677	-10.8	.779	-3.3	.933	-18.2	.691	14.3	.684
	Loss aversion	-2.1	.382	-2.6	.289	-1.7	.595	-3.1	.480	-2.8	.307	-0.9	.851
	Kirby score	-342.2	.446	-379.8	.394	423.7	.646	-732.9	.149	-636.9	.279	-10.6	.989
Earnings	Intercept	1198.5	.000	567.1	.000	570.7	.028	735.2	.000	572.9	.045	510.9	.002
	Nudged assignment			129.1	.080					280.0	.073	13.6	.864
	Payment condition €12			351.4	.000	356.0	.028	389.6	.000	275.3	.190	376.0	.000
	Payment condition €20			1064.4	.000	902.2	.000	1285.4	.000	985.5	.000	1114.6	.000
	Deposit scheme					-123.2	.342	4.6	.963				
	Demand for commitment (ref. willing to commit)	-32.6	.754	25.3	.737	67.7	.599	-40.4	.659	11.9	.947	70.4	.389
	Loss aversion	-5.2	.613	-12.2	.089	-7.4	.480	-11.3	.267	-14.0	.198	2.0	.863
	Kirby score	-769.6	.688	-905.4	.504	2284.0	.471	-2312.6	.052	-2039.4	.374	74.4	.967

Model0: Effect of economic characteristics persistence and earnings

Model1: Effect of choice on persistence and earnings corrected for economic characteristics

Model2: Effect of deposit incentives on persistence and earnings when it is not a choice corrected for economic characteristics

Model3: Effect of deposit incentives on persistence and earnings when it is a choice corrected for economic characteristics

Model 4: Effect of choice on persistence and earnings among those who have a deposit-based incentive scheme corrected for economic characteristics

Model 5: Effect of choice on persistence and earnings among those who have a reward-based incentive scheme corrected for economic characteristics

Appendix C. Robustness checks for selective drop-out

Figure 1 shows that only very few respondents completed the experiment that were in the low payment condition and had chosen or were randomized to deposit-based incentives. In this Appendix we ran a set of test to demonstrate the robustness of our results to this selective drop-out effect. In particular, we report the following:

- a. A set of analyses that compare the characteristics of the respondents that showed up for the second session with low-paying deposit-based incentives to two groups. First, we compare these respondents to respondents with low-paying deposit-based incentives that dropped out of the experiment between session T0 and T1. Second, seeing as with so few observations the power of these tests may be low, we contrast the low-payment deposit-based incentives respondents to the remaining respondents that showed up for session T1. The characteristics of all 3 groups are found in Table C1. It appears that any potential selection occurs at T0, as only 20 out of 67 (30%) low payment participants are within the deposit arm. In both other payment conditions the distribution between lumpsum and deposit is approximately even. Nonetheless, there are no significant differences between those 20 participants and all other respondents that showed up for session T1.
- b. The regression analyses reported in Table 3 were defined to take low payment as the reference-case. As such, some of the estimated fixed effects could be biased if there is selective drop-out. As such, we also reprint Table 3 with the medium payment condition as a reference-case, here shown as Table C2. Comparing Table 3 and Table C2 no major differences are observed.

Table C1.

	Low-paying deposit respondents at T0 (n=20)	Low-paying deposit respondents at T1 (n=11)	Dropped out low-paying deposit respondents (n=9)	All other respondents that showed up for session T1 (n=160)
Sex – n (%)				
Male	7 (35)	3 (27)	4 (44)	77 (48)
Female	13 (65)	8 (73)	5 (56)	83 (52)
Age – n (%)				
18-20	8 (40)	4 (36)	4 (44)	56 (35)
21-23	7 (35)	4 (36)	3 (33)	65 (41)
24+	5 (25)	3 (27)	2 (22)	39 (24)
Demand for commitment				
Yes	15 (75)	9 (82)	6 (67)	103 (64)
No	5 (25)	2 (18)	3 (33)	57 (36)
Loss aversion				
Mean (SD)	5.41 (3.99)	4.89 (3.51)	6.05 (4.63)	6.14 (18.9)

Discounting: Proportion of LL*				
Mean (SD)	0.51 (0.15)	0.53 (0.10)	0.48 (0.20)	0.56 (0.21)
Discounting: K- parameter				
Mean (SD)	0.017 (0.025)	0.009 (0.009)	0.025 (0.035)	0.018 (0.034)

Table C2

		<i>Model 1</i>		<i>Model 2</i>		<i>Model 3</i>		<i>Model 4</i>		<i>Model 5</i>	
Sample		<i>Both arms</i>		<i>Only random</i>		<i>Only nudged</i>		<i>Only deposit-based</i>		<i>Only reward-based</i>	
Persistence		β	<i>p-value</i>	β	<i>p-value</i>	β	<i>p-value</i>	β	<i>p-value</i>	β	<i>p-value</i>
	Intercept	249.6	.000	263.6	.000	278.4	.000	237.9	.000	255.7	.000
	Nudged assignment	48.4	.044					63.8	.097	42.7	.174
	Payment condition €8*	-36.9	.219	-40.6	.369	-30.0	.474	33.6	.549	-58.2	.126
	Payment condition €20*	42.0	.137	7.6	.856	82.5	.031	35.1	.439	55.1	.168
	Deposit-based incentives			-0.2	.997	9.3	.789				
Earnings	Intercept	792.0	.000	953.9	.000	940.6	.000	651.3	.011	907.3	.000
	Nudged assignment	189.6	.011					312.1	.039	94.5	.195
	Payment condition €8*	-270.5	.004	291.1	.048	-307.4	.007	-158.6	.470	-337.1	.000
	Payment condition €20*	723.3	.000	564.9	.000	929.4	.000	698.4	.000	775.3	.000
	Deposit-based scheme			-214.9	.069	-54.7	.555				

Model0: Effect of personal characteristics persistence and earnings

Model1: Effect of choice on persistence and earnings corrected for personal characteristics

Model2: Effect of deposit incentives on persistence and earnings when it is not a choice corrected for personal characteristics

Model3: Effect of deposit incentives on persistence and earnings when it is a choice corrected for personal characteristics

Model 4: Effect of choice on persistence and earnings among those who have a deposit-based incentive scheme corrected for personal characteristics

Model 5: Effect of choice on persistence and earnings among those who have a reward-based incentive scheme corrected for personal characteristics

Erasmus University Rotterdam

Erasmus Centre for Health Economics Rotterdam

Burgemeester Oudlaan 50

3062 PA Rotterdam, The Netherlands

T +31 10 408 8555

E escher@eur.nl

W www.eur.nl/escher