Behavioural Public Policy, Page 1 of 15
 doi:10.1017/bpp.2020.21

One size fits all? Designing financial incentives tailored to individual economic preferences

STEFAN A. LIPMAN*

Erasmus School of Health Policy & Management, Erasmus University Rotterdam, Rotterdam, The Netherlands

Abstract: Financial incentives are often designed to benefit from behavioral insights. Individuals' preferences for such behaviorally inspired incentives are rarely studied, nor is the role played by the behavioral insights that motivated them. This study aimed to let individuals design their own incentives (i.e., tailored incentives) and to explore which individual characteristics are associated with these preferences for tailored incentives. A sample of students ($n = 182$) tailored hypothetical incentives for visiting the gym. Incentives could be tailored by: (1) committing personal funds; (2) picking weekly payouts (increasing or decreasing); and (3) introducing payout risk while increasing value. Afterwards, (*inter alia*) loss aversion, probability weighting, time discounting, present bias, cognitive reflection and trait self-control were measured. A large majority indicated being willing to deposit their own money, and only very few individuals selected risky incentives. These heterogeneous preferences for financial incentives are poorly predicted by the individual characteristics measured (i.e., economic preferences and psychological traits). These results suggest that preferences for tailored incentives could be studied as input for the design of financial incentives. However, it is unclear whether tailoring incentives improves cost-effectiveness, as the lack of association between tailored incentives and the behavioral insights that motivate them has multiple conflicting interpretations.

Submitted 10 June 2019; accepted 6 May 2020

Introduction

Financial incentives appear to be a promising public policy tool to promote behavior change for the most prominent causes of chronic, non-communicable disease (WHO, 2009), such as tobacco use, poor diet and physical inactivity

* Correspondence to: Erasmus School of Health Policy & Management, PO Box 1738, 3000 DR Rotterdam, The Netherlands. E-mail: lipman@eshpm.eur.nl

(for systematic reviews, see Mitchell *et al.*, 2013; Strohacker *et al.*, 2013; Giles *et al.*, 2014; Mantzari *et al.*, 2015). Many different financial incentive schemes are used, which differ for example in terms of the size, timing or certainty of payment (Adams *et al.*, 2014). Often, insights from behavioral economics are used to motivate or design the financial incentives used. For example, financial incentives have been used that capitalize on behavioral insights such as loss aversion (e.g., deposit/commitment contracts: Bryan *et al.*, 2010; Giné *et al.*, 2010; Bhattacharya *et al.*, 2015; Volpp *et al.*, 2008) or probability weighting (e.g., lottery incentives: Volpp *et al.*, 2008; Haisley *et al.*, 2012; Kimmel *et al.*, 2012; van der Swaluw *et al.*, 2018). The effectiveness of such financial incentives, which Galizzi (2014) refers to as behaviorally inspired incentives, is hypothesized to be amplified by deviations from traditional rationality.

However, no conclusive evidence exists to support policymakers in the choice between different (behaviorally inspired) financial incentive schemes. Several randomized controlled trials (e.g., Haisley *et al.*, 2012; Patel *et al.*, 2016) have systematically compared different incentive schemes directly against each other (e.g., lottery versus commitment incentives) or against fixed incentives (Halpern *et al.*, 2011). However, given the costly nature of studying financial incentives, such studies far from exhaust all possible comparisons between behaviorally inspired incentives. The use of incentive schemes that mix behavioral components of different designs is even rarer (e.g., van der Swaluw *et al.*, 2018). As a result, it is unclear who responds to financial incentives and why (Paloyo *et al.*, 2015), which may explain why a one-size-fits-all approach is often applied, offering all respondents the same type of financial incentives (often motivated by a single behavioral insight, if any at all). The main motivation of this paper is to move beyond such one-size-fits-all approaches and instead to provide incentives tailored to individuals' preferences. This extends earlier work on incentives in two domains.

First, existing work mostly compared behaviorally inspired incentives by means of random assignment (e.g., Volpp *et al.*, 2008; Kullgren *et al.*, 2016), rather than exploring which types of financial rewards individuals prefer themselves. However, scarce evidence suggests that preferences for behaviorally inspired incentives are heterogeneous. For example, Halpern and colleagues (2015) find that only 14% voluntarily accept deposit contracts, while Vashistha and colleagues (2015) find a small majority prefers lotteries over fixed incentives (in a non-health context). Allowing individuals full autonomy in selecting those incentives they prefer (i.e., tailoring incentives) could increase individuals' motivation to engage in healthy behavior (see the work on self-determination theory by Deci & Ryan, 2008). Hence, in this study, a newly developed tool is implemented that allows individuals to tailor their own

incentives (i.e., each individual could select a unique combination of different incentive design elements). This tool was tested in a lab experiment in which individuals were asked to self-select (hypothetical) tailored incentives to promote exercise.

Second, even though large heterogeneity exists in the economic preferences that motivate behaviorally inspired incentive designs, the importance of these individual differences has rarely been explored in the context of financial incentives. For example, a plethora of work in experimental economics has shown large differences in, for example, probability weighting and loss aversion, both for money (e.g., Kahneman & Tversky, 1979; Tversky & Kahneman, 1992; Abdellaoui *et al.*, 2007, 2016; Bruhin *et al.*, 2010; Bleichrodt *et al.*, 2016) and for health (e.g., Attema & Lipman, 2018; Kemel & Paraschiv, 2018; Lipman *et al.*, 2019a, 2019b). This large heterogeneity in economic preferences raises several issues. For example, it is unknown whether those who show preferences consistent with a behavioral insight (e.g., are loss averse) are to a larger extent affected by financial incentives designed with this behavioral insight in mind (e.g., deposit contracts) than those who are not. To date, only a small amount of evidence exists for lottery incentives for secondary prevention (Björkman Nyqvist *et al.*, 2018) and financial incentives for exercise procrastination (Woerner, 2018). Furthermore, it is unknown whether these economic preferences may explain the heterogeneity in uptake of behaviorally inspired incentives (i.e., if those who are loss averse would be more or less likely to sign up for deposit contracts). This study addresses the latter issue by measuring a set of economic preferences for each respondent that are often used to motivate particular incentive design choices. To further explore who responds to financial incentives and why, the association between these economic preferences and tailored incentives is investigated.

Experiment

Sample and setting

The sample consisted of 182[1] Business Administration students (63 females, average age = 19.17 years, SD = 1.47) who were rewarded course credits for their participation. Sessions lasted 30 minutes and were run in adjacent cubicles with an instructor present to answer any questions.

1 To my knowledge, this is the first study of tailored incentives (i.e., no studies were available as a basis for *a priori* sample size calculation). Post-hoc power analysis suggests that this study was powered to find small to medium effects (see Online Supplementary Material for analysis and interpretation).

Tool for tailored incentives

Students were presented with a (hypothetical) scenario in which their employer was facilitating their achievement of a weight-loss goal by offering a financial incentive for visiting the gym at least twice every week for a 10-week period. The reward had a fixed expected value of $100 over this 10-week period. The tool for tailored incentives[2] allowed individuals to interactively design their own incentive scheme while keeping the expected value of the incentives constant. The following instruction was used:

> Your employer is quite flexible, and besides the expected payout has no preference in how your financial reward is structured. Obviously, you yourself know best what kind of payout structure would motivate you to go to the gym and reach your goal of losing weight. Therefore, we ask you to indicate how you would like your payout(s) to be structured.

Students could tailor incentives along four dimensions, by: (1) deciding to commit personal funds (*Pre-commitment*);[3] (2) picking weekly payouts (*Timing*); (3) which could be increasing or decreasing (*Sequence*); and (4) introducing payout risk that increases value (*Risk*). Table 1 shows an overview of the framing and parametrization used for each dimension.

Economic preference elicitation

Table 2 provides an overview of the economic preferences elicited in this study and the implications of these risk and time preferences (full detail on measurement and definitions can be found in the Online Supplementary Material). Risk preferences were elicited by measuring loss aversion, utility curvature (for gains and losses) and probability weighting (for gains and losses) using non-parametric methodology (adapted from Abdellaoui, 2000; Abdellaoui *et al.*, 2016). This methodology has been recently introduced, and *inter alia* successfully applied to measure behavioral biases for decisions about money and health (Abdellaoui *et al.*, 2016; Lipman *et al.*, 2019a, 2019b). The use of such non-parametric methodology may be preferred, as it does not rely on certain parametric assumptions that may not reflect preferences (Abdellaoui, 2000; Abdellaoui *et al.*, 2007) or have troublesome mathematical properties around extremes (Wakker, 2008). Next, time preferences were measured

2 This tool was developed in *Shiny*, an *R* package allowing the development of web apps. A demo version of the task is available at: https://referencepoints.shinyapps.io/Minecentive. Code is available on request, and the task can be adapted by any researchers, organizations or policymakers interested in tailoring incentives.

3 Such incentives in which individuals commit their personal funds are often referred to as deposit contracts. In the tool designed for this study, this option was called *Pre-committing*.

Table 1. Overview of the dimensions that could be edited to design tailored incentive schemes, with framing, options and parametrization.

Dimension	Framing	Options
Pre-commitment	"You can decide to pre-commit, by paying €100 and your employer will add €100. If you attain your weekly goals you will get this total amount of €200, but you will lose (a part of) your committed €100 if you don't attain it."	*Do you want to pre-commit?* Yes, I will pay for entry No
Timing	"For each week that you attain your goal you will rewarded. For example, if you attain your goals 8 out of 10 weeks, you will receive 80% of the reward. You can choose to receive all of your payout at the end of the 10–week period or to receive parts of this sum in weekly parts for each week you attain your goal. Obviously, not attaining your goals will mean you do not receive any payout that week."	*How often should your payouts be?* One payout (at week 10) Weekly payouts
Sequence	(Only shown if weekly payouts were selected) "If you decide on weekly payouts, payout amounts can be fixed for each week, starting low or increasing or the other way around. The slider below lets you select different structures."	*What should your payout structure be?* (Unbeknownst to respondents, each weekly reward was determined by multiplying the total available reward by a factor d_s, with: $d_s = (10 + b + r \times t)/100$, $t = 1, 2, \ldots 10$) Slider options corresponded with the following parametrizations: Option 1: strongly increasing, $b = -10$, $r = 2$ Option 2: increasing, $b = -5$, $r = 1$ Option 3: constant, b, $r = 0$ Option 4: decreasing, $b = 5$, $r = -1$ Option 5: strongly decreasing, $b = 10$, $r = -2$
Risk	"Instead of receiving a sure amount, you may also receive your payout in the form of a lottery. Picking a lottery will increase your possible reward, but also increase the risk of not receiving any reward. The slider below lets you select different lottery structures."	*Chance of payout could be adjusted from:* p = 1–100%. This led to a lottery which increased the (weekly) payout by a factor of $100/p$.

Table 2. Elicited economic preferences (including median and interquartile range), with the implication of modal (i.e., most frequently occurring) preferences and related dimensions of tailored incentives.

Parameter	Median (Q1–Q3)	n (%)	n (%)	n (%)	Implication of modal preferences	Ref.
Loss aversion (λ)[a]		$\lambda < 1$	$\lambda = 1$	$\lambda > 1$		
	1.61 (1.06–2.97)	22 (12%)	11 (6%)	149 (81%)	Monetary losses carry more weight than equally sized gains	Köbberling and Wakker (2005)
Utility curvature (α)		$\alpha < 1$	$\alpha = 1$	$\alpha > 1$		
Gains[a]	0.86 (0.58–1.11)	114 (62%)	7 (4%)	61 (33%)	Each extra dollar gained carries less weight	Abdellaoui *et al.* (2016)
Losses[a]	0.91 (0.70–1.18)	104 (57%)	7 (4%)	71 (39%)	Each extra dollar lost carries less weight	Abdellaoui *et al.* (2016)
Probability weighting (γ)		$\gamma < 1$	$\gamma = 1$	$\gamma > 1$		
Gains[a]	0.86 (0.76–1.39)	123 (67%)	4 (2%)	55 (30%)	Small (large) chances of gains are over-weighted (under-weighted)	Kahneman and Tversky (1979)
Losses[a]	1.00 (0.78–2.63)	88 (48%)	4 (2%)	90 (49%)	Small (large) chances of gains are over-weighted (under-weighted)	Kahneman and Tversky (1979)
Present bas (β)		$\beta < 1$	$\beta = 1$	$\beta > 1$		
Gains[a]	0.99 (0.91–1.00)	135 (74%)	5 (3%)	41 (22%)	Gains incurred now always carry more weight than those incurred in the future	Laibson (1997)
Losses[a]	0.99 (0.93–1.01)	101 (55%)	17 (9%)	64 (35%)	Losses incurred now always carry more weight than those incurred in the future	Laibson (1997)
Discounting (δ)		$\delta < 0$	$\delta = 0$	$\delta > 0$		
Gains[a]	0.01 (0.00–0.04)	21 (11%)	6 (3%)	155 (85%)	The positive value assigned to a dollar gained diminishes over time	Laibson (1997)
Losses[a]	0.00 (0.00–0.01)	66 (36%)	30 (16%)	86 (47%)	The negative value assigned to a dollar lost increases over time	Laibson (1997)

For definitions and implications of λ, α, γ, β and δ, see Online Supplementary Material.
[a]This distribution was different from that expected by chance, tested with χ^2 tests and a significance level of 0.05.

assuming a quasi-hyperbolic discounting model (Laibson, 1997), where present bias (for gains and losses) and a weekly discount rate (for gains and losses) were elicited.

Exploratory questionnaires

Besides completing tasks aimed at eliciting these economic preferences, subjects filled in a series of questionnaires aimed at exploring the association between various psychological measures and tailored incentives. Several questions and questionnaires were used to measure self-reported health behaviors (alcoholic drinks/cigarettes consumed per week, exercise behavior and body mass index), self-control (Tangney *et al.*, 2018), cognitive reflection (Toplak *et al.*, 2011) and personality (Francis *et al.*, 1992) (see Online Supplementary Material). These questionnaires were only filled in by subjects in the time remaining after they finished the main experiment, and hence were not completed by all subjects (see Table 3 for the number of complete observations per measure).

Results

All analyses are available on request and are reported without correcting for multiple testing.

Descriptive statistics

Table 2 (economic preferences) and Table 3 (demographics and psychological measures) show descriptive statistics for the sample. These results indicate that students generally were: non-smokers, moderate drinkers, engaging in regular exercise, loss averse, diminishingly sensitive to gains and losses, sensitive to extreme probabilities (i.e., inverse S-shaped probability weighting), present biased and not or slightly discounting monetary amounts on a weekly basis. However, the standard deviations reported in Tables 2 and 3 reflect the considerable between-subject heterogeneity that motivated this study.

Tailored incentives

The results of the tool for tailored incentives can be found in Table 4. A significant majority decided to pre-commit personal funds to increase rewards ($\chi^2(1,\ n = 182) = 22.51,\ p < 0.001$), and a near-even split existed in the sample for preferences for one or weekly payouts. Those preferring weekly payouts generally preferred slightly increasing or constant payouts. Lottery incentives were infrequently selected, with a negligible group (3 out of 163)

Table 3. Descriptive statistics for demographic variables and psychological traits measures.

Health behaviors	*n*	*M*	SD	Psychological measures	*n*	*M*	SD
Cigarettes (per week)	182	1.05	2.64	Trait self-control	163	3.13	0.58
Body mass index	182	21.85	4.24	Cognitive reflection	147	1.65	1.16
Alcohol (glasses/week)	182	7.91	9.40	EPQ – neuroticism	136	0.58	0.20
Exercise (days/week)	182	2.85	1.67	EPQ – extraversion	136	0.50	0.18
				EPQ – psychoticism	136	0.43	0.19
				EPQ – social desirability	136	0.52	0.23

Personality traits were defined and measured according to the taxonomy used in the Eysenck Personality Questionnaire (EPQ).

Table 4. Descriptive statistics for tailored incentive selection using the newly developed tool.

Dimension	Options	Count (%)
Pre-commitment ($n = 182$)	No	59 (32%)
	Yes	123 (68%)
Timing ($n = 182$)	One payout	85 (47%)
	Weekly payout	97 (53%)
Sequence ($n = 97$)	Strongly increasing	14 (14%)
	Increasing	37 (38%)
	Constant	31 (32%)
	Decreasing	11 (11%)
	Strongly decreasing	4 (4%)
Risk ($n = 182$)	1% (highest risk)	3 (2%)
	2–9%	0 (0%)
	10–39%	6 (3%)
	40–69%	40 (22%)
	70–99%	46 (25%)
	100% (no risk)	87 (48%)

selecting the lowest possible chance of winning and a large and significant majority preferring certain payouts rather than any of the other possible probabilities of payout ($\chi^2(34, n = 182) = 1397$, $p < 0.001$). The three most prominent tailored incentive schemes were: pre-committing with one certain payout (12% of the sample); pre-committing with weekly, constant payouts (8% of the sample); and pre-committing with weekly, slightly increasing payouts (8% of the sample).

Association between selected tailored incentives and economic preferences

Next, a series of analyses was performed to explore the association between the tailored incentives students selected and their economic preferences.

First, these associations were explored by means of t-tests (for *Pre-commitment* and *Timing* dimensions) and Spearman rank-correlation analyses (*Structure* and *Risk* dimensions) between individuals' choices on each dimension and the various measures obtained, which showed no consistent associations. For example, there were no significant differences between individuals who choose deposit contracts or not for: loss aversion, probability weighting, utility curvature, present bias, time discounting, health behaviors, cognitive reflection, personality and trait self-control (t-tests, all p-values > 0.08). A similar lack of evidence can be observed for *Timing* (t-tests, all p-values > 0.07), *Structure* (all Spearman ρ values < 0.15, p-values > 0.08) and *Risk* (all Spearman ρ values < 0.11, p-values > 0.15). The only exception was the parameter for present bias for losses, with those who chose one payout having stronger present bias for losses ($t(160) = -2.02$, $p = 0.04$).

Next, it was explored as to whether those who chose one of the most prominent tailored preference patterns differed on the obtained economic and psychological measures. We found no such differences for respondents pre-committing with one certain payout (t-tests, all p-values > 0.12). A similar lack of evidence is observed for those who chose to commit with certain weekly payouts, either constant (t-tests, all p-values > 0.12) or slightly increasing (t-tests, all p-values > 0.12). Several exceptions were observed: (1) those pre-committing with weekly constant payouts discounted losses at a lower rate ($t(160) = -2.02$, $p = 0.04$); and (2) those pre-committing with weekly, slightly increasing payouts had more concave utility curvature for gains, discounted both gains and losses to a lesser extent and had less pronounced present bias for losses (t-tests, all p-values < 0.03).

Finally, this lack of systematic association between the obtained measures and tailored incentives was confirmed by a series of multiple linear or logistic regression analyses, in which subject characteristics, economic preferences and psychological traits were included stepwise as predictors for each tailored incentive dimension (for model specifications used and regression results, see Online Supplementary Material).

Discussion

Heterogeneity in preferences for financial incentives for health behavior change has rarely been studied (one of the few examples being Halpern *et al.*, 2015),

and thus it is unclear who responds to financial incentives and why (Paloyo *et al.*, 2015). To provide policymakers with some support in the choice between different (behaviorally inspired) financial incentive schemes, this study explored the preferences of respondents themselves. More specifically, this study aimed to explore heterogeneity in the type of financial incentives individuals prefer and if the behavioral insights often used in practice to motivate the choice for a particular design are associated with these preferences.

Surprisingly, the findings of this study indicate a large majority of students would commit their own money to reach their exercise goals, whereas the work by Halpern and colleagues (2015) suggested uptake of such deposit contracts to be much lower. Furthermore, even though lottery incentives with small chances of receiving a relatively large sum have been used successfully (e.g., Volpp *et al.*, 2008; Haisley *et al.*, 2012; Kimmel *et al.*, 2012; van der Swaluw *et al.*, 2018), very few students selected incentives with low chances (<1–5%) of winning a prize for themselves. These tailored preferences were not systematically related to any of the behavioral insights often used to motivate the implementation of behaviorally inspired incentives in practice (or to any of the measured health behaviors and psychological measures). Hence, although autonomy is likely increased by allowing individuals full freedom to design their own financial incentives using a tool like the one developed for this study, the results reported here provide no insight into why individuals prefer particular incentive schemes and if this will improve cost-effectiveness. Before providing interpretations based on this null result and discussing the explanations for the lack of evidence, several methodological limitations deserve noting.

First, the preferences reported here are obtained from students and may not apply to the populations in which financial incentives are used to promote health behavior, such as individuals motivated to change their behavior (e.g., Halpern *et al.*, 2015; van der Swaluw *et al.*, 2018) or people in lower/middle-income countries (for a review, see Ranganathan & Lagarde, 2012). For example, census data show that the young and highly educated exercise more than other populations (CBS/RIVM, 2018), and students may thus need fewer incentives to go to the gym twice a week. Second, all preferences obtained in this study were for hypothetical outcomes. In other words, this study investigated the association between hypothetical financial incentives for exercise and economic preferences elicited over hypothetical monetary outcomes. Although earlier work has suggested that preferences for hypothetical and real outcomes are not qualitatively different (Camerer & Hogarth, 1999; Hertwig & Ortmann, 2001), generally the use of real outcomes is preferred in behavioral experiments in health, as hypothetical incentives may lead to increased measurement error (Galizzi & Wiesen, 2018). Third, the experimental setup and instructions used for this study could have had an

influence on the findings reported in this study. For example, students were instructed to tailor incentives for going to the gym twice in order to reach a weight loss goal and also explicitly told that they would know which incentives would motivate them. However, no further information was provided on their weight-loss goal, the nature of the activities they should (imagine themselves to) perform in the gym or how they should know what motivates them. As such, the instructions could have been open to alternative interpretations, which future work could remedy by using different instructions and focusing on individuals' own health-promotion goals. Furthermore, all measures obtained in this study were filled in by respondents only after they reported their preferences for tailored incentives. Without any counterbalancing procedures, this study could not be controlled for ordering effects, as, for example, found in Carlsson and colleagues (2012). However, economic preferences were generally in line with those found in earlier applications of the methods used in this study (Bruhin *et al.*, 2010; Abdellaoui *et al.*, 2016; Lipman *et al.*, 2019b), and no association was observed between these preferences and the incentives selected. Hence, it is unlikely that respondents aimed to be consistent between the two parts of the experiment.

This study reports an exploration of the economic preferences that influence the incentives individuals prefer and found none to be systematically associated with self-selected incentives. This null result can mean one of two things: (1) no such association exists; or (2) the methods used failed to capture this association between economic preferences and (tailored) incentives. One explanation for the former, as suggested by Halpern and colleagues (2015) for the low uptake of deposit contracts (which were the most effective incentive design in their study), is that respondents may lack the sophistication to select financial incentives that would benefit them the most (e.g., they have insufficient knowledge of their own preferences, as found by Hey & Lotito, 2009). This would explain why no association could be found between behavioral insights such as loss aversion and probability weighting and the incentive dimensions these constructs are hypothesized to amplify.

On the other hand, the null result reported in this study may also be explained by a lack of external validity of economic preferences or insufficient statistical power to detect small but relevant effects. For example, earlier work has questioned whether the elicitation of economic preferences has a bearing on decision-making in the field at all (Schram, 2005; Galizzi *et al.*, 2016; Galizzi & Navarro-Martínez, 2019). As such, one could question the usefulness of measuring economic preferences in the context of the provision of financial incentives. Nonetheless, Björkman Nyqvist *et al.* (2018) did find a strong association between risk preferences and lottery incentives for the uptake of secondary prevention in a field study in Lesotho. Compared to the

field study by Björkman Nyqvist *et al.* (2018), this study used hypothetical incentives and a relatively small sample. Hence, the smaller statistical power and possibly increased noise related to hypothetical incentives may explain why this large effect did not extend to the lab.

To conclude, this study has several implications for future research and policy. The descriptive results reported suggest that that preferences for financial incentives differ between individuals. Hence, governments or organizations aiming to use financial incentives could, for example, use this tool or a similar one to study these preferences in their target population as input for the design of their interventions. Furthermore, whether tailoring incentives improves their cost-effectiveness could be investigated. Such increased cost-effectiveness could, for example, occur as a result of increased motivation through enhanced autonomy or because a subgroup of sophisticated individuals select incentives that are especially beneficial to them. An alternative way forward, to be explored either in future research or policy, is to assign individuals to financial incentives that fit their economic preferences. However, although behavioral insights are often used to motivate one-size-fits-all, behaviorally inspired financial incentives, the theoretical or empirical basis for assigning individual-level tailored incentives is currently lacking.

Supplementary material

To view supplementary material for this article, please visit https://doi.org/10.1017/bpp.2020.21

Acknowledgments

Werner Brouwer, Arthur Attema and Jenny Kudymowa provided helpful comments on this manuscript.

References

Abdellaoui, M. (2000), 'Parameter-free elicitation of utility and probability weighting functions', *Management Science*, **46**: 1497–1512.

Abdellaoui, M., H., Bleichrodt, O., L'Haridon and D., Van Dolder (2016), 'Measuring Loss Aversion under Ambiguity: A Method to Make Prospect Theory Completely Observable', *Journal of Risk and Uncertainty*, **52**: 1–20.

Abdellaoui, M., H., Bleichrodt and C., Paraschiv (2007), 'Loss aversion under prospect theory: A parameter-free measurement', *Management Science*, **53**: 1659–1674.

Adams, J., E. L., Giles, E., McColl and F. F., Sniehotta (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.

Attema, A. and S., Lipman (2018), 'Decreasing impatience for health outcomes and its relation with healthy behavior', *Frontiers in Applied Mathematics and Statistics*. https://www.frontiersin.org/articles/10.3389/fams.2018.00016/full

Bhattacharya, J., A. M., Garber and J. D., Goldhaber-Fiebert (2015), *Nudges in exercise commitment contracts: a randomized trial*, National Bureau of Economic Research.

Björkman Nyqvist, M., L., Corno, D., De Walque & Svensson, J. (2018), 'Incentivizing safer sexual behavior: evidence from a lottery experiment on HIV prevention', *American Economic Journal: Applied Economics*, **10**: 287–314.

Bleichrodt, H., Y., Gao and K. I. M., Rohde (2016), 'A measurement of decreasing impatience for health and money', *Journal of Risk and Uncertainty*, **52**: 213–231.

Bruhin, A., H., Fehr-Duda and T., Epper (2010), 'Risk and rationality: Uncovering heterogeneity in probability distortion', *Econometrica*, **78**: 1375–1412.

Bryan, G., D., Karlan and S., Nelson (2010), 'Commitment devices', *Annual Review of Economics*, **2**: 671–698.

Camerer, C. F. and R. M., Hogarth (1999), 'The effects of financial incentives in experiments: A review and capital-labor-production framework', *Journal of Risk and Uncertainty*, **19**: 7–42.

Carlsson, F., M. R., Mørkbak and S. B., Olsen (2012), 'The first time is the hardest: A test of ordering effects in choice experiments', *Journal of Choice Modelling*, **5**: 19–37.

CBS/RIVM (2018), *Gezondheidsenquête/leefstijlmonitor*. Den Haag.

Deci, E. L. and R. M., Ryan (2008), 'Self-determination theory: A macrotheory of human motivation, development, and health', *Canadian Psychology/Psychologie Canadienne*, **49**: 182.

Francis, L. J., L. B., Brown and R., Philipchalk (1992), 'The development of an abbreviated form of the Revised Eysenck Personality Questionnaire (EPQR-A): Its use among students in England, Canada, the USA and Australia', *Personality and Individual Differences*, **13**: 443–449.

Galizzi, M. M. (2014), 'What is really behavioral in behavioral health policy? And does it work? *Applied Economic Perspectives and Policy*, **36**: 25–60.

Galizzi, M. M., S. R., Machado and R., Miniaci (2016), Temporal stability, cross-validity, and external validity of risk preferences measures: experimental evidence from a UK representative sample. *Cross-Validity, and External Validity of Risk Preferences Measures: Experimental Evidence from a UK Representative Sample (August 12, 2016)*.

Galizzi, M. M. and D., Navarro-Martínez (2019), 'On the external validity of social preference games: a systematic lab-field study', *Management Science*, **65**: 955–1453.

Galizzi, M. M. and D., Wiesen (2018), Behavioral experiments in health economics. http://eprints.lse.ac.uk/88155/1/Galizzi_Behavioral%20Experiments_Accepted.pdf

Giles, E. L., S., Robalino, E., McColl, F. F., Sniehotta and J., Adams (2014), 'The effectiveness of financial incentives for health behaviour change: systematic review and meta-analysis', *PLoS One*, **9**: e90347.

Giné, X., D., Karlan and J., Zinman (2010), 'Put your money where your butt is: a commitment contract for smoking cessation', *American Economic Journal: Applied Economics*, **2**: 213–35.

Haisley, E., K. G., Volpp, T., Pellathy and G., Loewenstein (2012), 'The Impact of Alternative Incentive Schemes on Completion of Health Risk Assessments', *American Journal of Health Promotion*, **26**: 184–188.

Halpern, S. D., B., French, D. S., Small, K., Saulsgiver, M. O., Harhay, J., Audrain-McGovern, G., Loewenstein, T. A., Brennan, D. A., Asch and K. G., Volpp (2015), 'Randomized trial of four financial-incentive programs for smoking cessation', *New England Journal of Medicine*, **372**: 2108–2117.

Halpern, S. D., R., Kohn, A., Dornbrand-Lo, T., Metkus, D. A., Asch and K. G., Volpp (2011), 'Lottery-based versus fixed incentives to increase clinicians' response to surveys', *Health Services Research*, **46**: 1663–1674.

Hertwig, R. and A., Ortmann (2001), 'Experimental practices in economics: A methodological challenge for psychologists? *Behavioral and Brain Sciences*, **24**: 383–403.

Hey, J. D. and G., Lotito (2009), 'Naive, resolute or sophisticated? A study of dynamic decision making', *Journal of Risk and Uncertainty*, **38**: 1–25.

Kahneman, D. and A., Tversky (1979), 'Prospect theory: An analysis of decision under risk', *Econometrica*, 263–291.

Kemel, E. and C., Paraschiv (2018), 'Deciding about human lives: an experimental measure of risk attitudes under prospect theory', *Social Choice and Welfare*, **51**: 163–192.

Kimmel, S. E., A. B., Troxel, G., Loewenstein, C. M., Brensinger, J., Jaskowiak, J. A., Doshi, M., Laskin and K., Volpp (2012), 'Randomized trial of lottery-based incentives to improve warfarin adherence', *American Heart Journal*, **164**: 268–274.

Köbberling, V. and P. P., Wakker (2005), 'An index of loss aversion', *Journal of Economic Theory*, **122**: 119–131.

Kullgren, J. T., A. B., Troxel, G., Loewenstein, L. A., Norton, D., Gatto, Y., Tao, J., Zhu, H., Schofield, J. A., Shea and D. A., Asch (2016), 'A randomized controlled trial of employer matching of employees' monetary contributions to deposit contracts to promote weight loss', *American Journal of Health Promotion*, **30**: 441–452.

Laibson, D. (1997), 'Golden eggs and hyperbolic discounting', *The Quarterly Journal of Economics*, **112**: 443–478.

Lipman, S. A., W. B., Brouwer and A. E., Attema (2019a), 'A QALY loss is a QALY loss is a QALY loss', *European Journal of Health Economics*, **20**: 419–426.

Lipman, S. A., W. B. F., Brouwer and A. E., Attema (2019b), 'QALYs without bias? Non-parametric correction of time trade-off and standard gamble weights based on prospect theory', *Health Economics*, **28**: 843–854.

Mantzari, E., F., Vogt, I., Shemilt, Y., Wei, J. P., Higgins and T. M., Marteau (2015), 'Personal financial incentives for changing habitual health-related behaviors: A systematic review and meta-analysis', *Preventive Medicine*, **75**: 75–85.

Mitchell, M. S., J. M., Goodman, D. A., Alter, L. K., John, P. I., Oh, M. T., Pakosh and G. E., Faulkner (2013), 'Financial incentives for exercise adherence in adults: systematic review and meta-analysis', *American Journal of Preventive Medicine*, **45**: 658–667.

Paloyo, A. R., A. R., Reichert, M., Reuss-Borst and H., Tauchmann (2015), 'Who responds to financial incentives for weight loss? Evidence from a randomized controlled trial', *Social Science & Medicine*, **145**: 44–52.

Patel, M. S., D. A., Asch, R., Rosin, D. S., Small, S. L., Bellamy, J., Heuer, S., Sproat, C., Hyson, N., Haff and S. M., Lee (2016), 'Framing financial incentives to increase physical activity among overweight and obese adults: a randomized, controlled trial', *Annals of Internal Medicine*, **164**: 385–394.

Ranganathan, M. and M., Lagarde (2012), 'Promoting healthy behaviours and improving health outcomes in low and middle income countries: a review of the impact of conditional cash transfer programmes', *Preventive Medicine*, **55**: S95-S105.

Schram, A. (2005), 'Artificiality: The tension between internal and external validity in economic experiments', *Journal of Economic Methodology*, **12**: 225–237.

Strohacker, K., O., Galarraga and D. M., Williams (2013), 'The impact of incentives on exercise behavior: a systematic review of randomized controlled trials', *Annals of Behavioral Medicine*, **48**: 92–99.

Tangney, J. P., A. L., Boone and R. F., Baumeister (2018), High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Self-Regulation and Self-Control*. Routledge.

Toplak, M. E., R. F., West and K. E., Stanovich (2011), 'The Cognitive Reflection Test as a predictor of performance on heuristics-and-biases tasks', *Memory & Cognition*, **39**: 1275.

Tversky, A. and D., Kahneman (1992), 'Advances in prospect theory: Cumulative representation of uncertainty', *Journal of Risk and Uncertainty*, **5**: 297–323.

van der Swaluw, K., M. S., Lambooij, J. J., Mathijssen, M., Schipper, M., Zeelenberg, S., Berkhout, J. J., Polder and H. M., Prast (2018), 'Commitment Lotteries Promote Physical Activity Among Overweight Adults—A Cluster Randomized Trial', *Annals of Behavioral Medicine*, **52**: 342–351.

Vashistha, A., E., Cutrell and W., Thies (2015), Increasing the reach of snowball sampling: The impact of fixed versus lottery incentives. *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing, ACM*, 1359–1363.

Volpp, K. G., L. K., John, A. B., Troxel, L., Norton, J., Fassbender and G., Loewenstein (2008), 'Financial incentive–based approaches for weight loss: a randomized trial', *JAMA*, **300**: 2631–2637.

Wakker, P. P. (2008), 'Explaining the characteristics of the power (CRRA) utility family', *Health Economics*, **17**: 1329–1344.

WHO (2009), *Global health risks: mortality and burden of disease attributable to selected major risks*, Geneva: World Health Organization.

Woerner, A. (2018), Overcoming Time Inconsistency with a Matched Bet: Theory and Evidence from Exercising. https://pdfs.semanticscholar.org/bb70/5026efc92e369d0c0d463b31c1b77675353f.pdf