Journal of Behavioral and Experimental Economics 82 (2019) 101457

Contents lists available at ScienceDirect

Journal of Behavioral and Experimental Economics

journal homepage: www.elsevier.com/locate/jbee

Can commitment contracts boost participation in public health programmes?

Manu Manthri Savani[1]

Brunel University London, Department of Social and Political Sciences, United Kingdom

ARTICLE INFO

Keywords:
Commitment device
Health behaviour
Field experiment
Behavioural public policy
Dual-self theory

ABSTRACT

Commitment devices aim to help people make better choices in the face of their inherent biases: they are voluntary strategies aimed at changing behaviours by introducing costs to your current self, to bring about gains for your future self. Adherence to a structured health intervention is an important part of achieving health goals, and may be improved by commitment devices designed to keep people on track with their health goals. A field experiment set in a public weight management programme tests whether a personal commitment device in the form of a contract with oneself, which relies solely on self-reputation costs, can raise weekly participation and completion of the programme. Results suggest the commitment contract can significantly improve attendance ($p = 0.05$) and completion rates ($p = 0.032$), with some suggestive evidence that the contract works especially well for people with more myopic health attitudes. Findings also suggest the commitment contract can substitute for, but does not necessarily add to, wider commitment features in the health programme; raising new questions around threshold effects and the theory underlying commitment devices.

1. Introduction

The influence of present-bias on inter-temporal choices is well established in the literature (Frederick, Loewenstein, & O'Donoghue, 2002; Loewenstein et al., 2012; O' Donoghue & Rabin 1999), and has been linked to a range of undesirable outcomes including weaker academic performance (Ariely & Wertenbroch, 2002), vulnerability to natural disasters (Kunreuther, Meyer, & Michel-Kerjan, 2013), and insufficient savings for retirement (Thaler & Benartzi, 2004). Many health choices involve trade-offs: the benefits of a higher quality and longer life may be felt years down the line, but rely on health investments, including costly self-restraint, at the present time. Empirical evidence associates present bias with under-investment in preventative health (Dupas, 2011), including weight management (Liu et al., 2014). Fan and Jin report that "a lack of self control capability is associated with poor eating and exercise behaviours, as well as an increase in obesity risk and BMI" (2013, p. 18). Individuals often identify an optimal course of action – the right diet, the right physical activity – but when the moment comes to put it into practice, they often delay or quit (Rogers et al., 2015); they are time-inconsistent (Strotz, 1955). Getting these intertemporal choices right is not easy, particularly in an obesogenic environment (Costa-Font et al., 2013).

Obesity remains a "widespread threat to health and wellbeing" in the UK (Department of Health, 2011, p. 5), despite a range of policy efforts, including changes to food retailing, unprecedented access to health information, long-running public health campaigns such as 'Change4Life', and the growth in digital health tools and wearable devices. The Health Survey for England 2017 reports that 64% of adults are now overweight or obese compared to 53% two decades ago, while the proportion of people who have a normal body mass index (BMI) has fallen from 45% to 34% during that time (Health Social Care Information Centre, 2015; NHS Digital, 2018). Better access to health information is not enough to improve individual decision-making (Downs, Loewenstein, & Wisdom, 2009). Behavioural science is increasingly being brought to bear on health policy (Perry et al., 2015), and are seen as an opportunity to address the biases linked to poor health choices.

Commitment devices are one amongst a menu of 'nudges' designed to tackle behavioural biases (Oliver & Ubel, 2014; Thaler & Sunstein, 2008), and are widely employed in the weight loss sector. A commitment device is any voluntary arrangement that restricts or binds future choices, to "fulfil a plan for future behaviour that would otherwise be

E-mail address: manu.savani@brunel.ac.uk.

[1] This work was undertaken with the support of UCL's Department of Political Science. My thanks to Peter John and Roland Kappe for their support and advice on this project, and to Albert Weale and David Torgerson. Participants at the LSE International Health Policy Conference, and the UK Faculty of Public Health Annual Conference provided useful comments on the study. My thanks also to two anonymous reviewers. Any errors are my own. I owe a debt of gratitude to staff at Camden Active Health team for hosting the fieldwork, in particular Verena Trend and Ian Reddington.

https://doi.org/10.1016/j.socec.2019.101457
Received 13 February 2019; Received in revised form 23 August 2019; Accepted 27 August 2019
Available online 28 August 2019

difficult owing to intra-personal conflict, stemming from, for example, a lack of self-control" (Bryan, Karlan, & Nelson, 2010, p. 672). These arrangements are taken up by the individual in the pursuit of some goal, with no strategic motives relating to others. The commitment device may take the form of an actual contract with a third party (Halpern et al., 2015), or it may be a more ad hoc arrangement created by individuals as a "promise to oneself" (Benabou & Tirole, 2004, p. 849).

Bryan et al. refer to 'soft' and 'hard' commitment devices, depending on whether they involve primarily a psychological or financial cost respectively (2010, p. 672), but note that this distinction is not strictly binary, as financial commitments may also have psychological costs to failure attached. Thaler and Shefrin's (1981) typology of commitment devices differentiated between methods to alter incentives and to alter opportunities. They also distinguish between external and internal rules, depending on whether the individual relies on some external assistance or applies personal, self-enforced rules. Informal commitment devices for weight management include strategies such as signing up to a running club, or sharing weight loss goals on social media. Commercial weight loss programmes incorporate reputational and financial commitment strategies in the form of publicising weekly weight readings to the group, and offering membership fees back if weight loss targets are met. Such features have been tested in public health programmes (Relton, Strong, & Li, 2011), and are advocated as valuable behaviour change instruments (Rogers, Milkman, & Volpp, 2014). Much of the empirical evidence focuses on financial commitment devices, or deposit contracts, that stake money on achieving an outcome; the individual earns their money back by meeting the goal. Such interventions have been found to support weight loss and smoking cessation, particularly in the short run (Gine, Karlan, & Zinman, 2010; Halpern et al., 2015; John et al., 2011; Volpp et al., 2008); with some evidence of both short and long term effects, for example on healthier food shopping (Mochon et al., 2016; Schwartz et al., 2014).

Commitment contracts that rely purely on reputational costs are relatively under-researched. The evidence base lacks conclusive answers on whether they work, for whom they might be important, and for what outcomes. For example, can these milder forms of commitment device affect more straightforward behaviour change goals around adherence and participation in weight loss programmes?

The prevalence of commitment devices in the weight management sector, their potential for promoting desired health behaviours, and the relatively weak evidence base, motivates this paper to ask: can reputational commitment devices promote behaviour change? The paper contributes to the behavioural economics literature on commitment devices, with novel experimental evidence on health behaviours and biases. Specifically, I examine the effects of a commitment contract on attendance and completion of a community weight management programme in the UK, and weight loss outcomes. The next section provides a more detailed review of the literature on reputational commitment contracts and health behaviours. Section 3 details the programme context and experimental design. Section 4 presents results. Section 5 discusses the findings that the commitment contract promoted attendance, and explores the relationship with weight loss. Section 6 concludes that self-reputational commitment contracts exert a positive influence on behaviour, and being cheap and straightforward to administer may be readily incorporated into health services. It is not yet clear they can effectively promote weight management outcomes, and further research is needed to identify how commitment contracts can be optimally designed and tailored to individual needs.

2. Theory

2.1. The planner–doer model

Maintaining sound health behaviours for long-term health requires a strategic deferral of rewards, which is challenging in the context of present bias and limited self-control. Cavaliere et al. find that the probability of being "overweight or obese increases when consumers are less future-concerned", and conversely a healthy BMI is "associated with a high orientation to the future" (2014, p. 135).

How might a commitment device change behaviour? Behavioural economics theory explains this as a rebalancing of intertemporal costs, bringing forward the incentive to invest in health now, rather than relegating the health investment decision to a later time. In their seminal article, "An Economic Theory of Self-Control", Thaler and Shefrin (1981) arrive at the same conclusion as Strotz's earlier treatment of the problem: a commitment strategy will address time inconsistency. Thaler and Shefrin however pose the issue as a principal-agent problem, and delve deeper into the individual's self-control problems. The individual is modelled as having two competing sub-selves, a "planner" and a "doer". The framework successfully combines the concepts of present bias (implicitly) and self-control (explicitly) to enrich our understanding of why we may set a plan for the future, and when the future arrives we delay, procrastinate, or quit.

Savani (2018) provides a more formal application of the planner-doer framework to health behaviours. The key premise is the divergence between the preferences of the myopic doer and the far-sighted planner, which sets the scene for an internal tussle on inter-temporal decisions. The myopia of the doer exaggerates the notion that humans tend to be present-biased, focused solely on the rewards available now, at the cost of any longer term thinking; there is no utility from delaying gratification because the doer only considers the present period. The planner, however, has a longer time horizon and a utility function that takes account of longer-term payoffs, and therefore recognises that costs now can pave the way for higher rewards later. Two important implications of the planner-doer model are, firstly, that such time inconsistency can be overcome through commitment strategies that change the doer's choices (Thaler & Shefrin, 1981, p. 398); and secondly, the desire to maximise long-run utility prompts the planner to demand such commitment strategies (Savani, 2018, p. 4). The way that commitment strategies elicit change in individual behaviour is to exert some costs to the doer sub-self continuing to act in a time-inconsistent way. These costs might arise through financial penalties, as in the case of deposit contracts, or they may take the form of reputational costs, as discussed further below.

2.2. Heterogeneous effects of commitment devices

A possibility arising the planner-doer model, and one that is not fully formalised in existing theory, is the potential for heterogeneity in how commitment devices might affect different people (Savani, 2018). Thaler and Shefrin discussed the plausibility of "individual rates of impatience" (1981, p. 403). The intuition of varying rates of time preference has a considerable history (Frederick et al., 2002). The field experimental literature on commitment devices is beginning to address the question of heterogeneous treatment effects directly. Nyer and Dellande (2010) use a personality trait to identify heterogeneous effects, finding that a public pledge on weight loss is more effective amongst those participants who were highly susceptible to normative influence. Royer, Stehr, and Sydnor (2015) also test for sub-group effects, reporting that baseline variables including gym membership, weight, gender and levels of exercise explain some of the variation in treatment effects of a commitment contract on exercise behaviour. These studies provide useful empirical pointers, but lack a theoretical grounding in a dual-self model that also explains the original need for a commitment device.

I argue that a key variable determining the effectiveness of a commitment device is the extent to which the planner-doer scenario applies within the individual. Empirical evidence demonstrates that people have different rates of time preference (Andreoni, Kuhn, & Sprenger, 2015), and recent data from the Health Survey for England reports that the degree of short-termism detected in health attitudes differs across

respondents (Robinson, 2012). People experience and exhibit degrees of myopia or far-sightedness when it comes to their health outlook and behaviours. Who are most likely to experience positive behaviour change from a commitment device? Perhaps it is those who would otherwise face the largest divergence between the doer's actions and the planner's health goals, in other words those who behave more in line with their doer sub-selves to begin with. People who are initially more myopic in their health attitudes are therefore expected to experience larger and positive effects on their behaviour from a commitment device.

2.3. Commitment devices for health behaviours

Commitment has been defined as the "pledging or binding of the individual to behavioural acts" (Kiesler & Sakumura, 1966, p. 349). The commitment makes an act less changeable. The magnitude of the commitment is associated with how publicly it is stated, because of an individual's desire to be consistent with what he has declared to others, and to avoid the personal and social disapproval that accompanies inconsistency. Nyer and Dellande (2010) find positive effects on weight loss when individuals display their pledge on a public noticeboard at the gym compared to those whose goals remain private.

Pledges do not have to be very public to be effective, indeed "individuals may not need the collaboration of other parties in order to self-regulate their behaviour" (Brocas, Carillo, & Dewatripont, 2003, p. 54). Making a commitment even to oneself may be sufficient to discipline short-term health impulses. A pre-written grocery list can serve as a guide to help the doer (walking around the shopping aisles) stay on track with the planner's dietary regimen (Au et al., 2013). The most informal type of reputational commitment device is a personal rule, which can range from rules of thumb and one-off resolutions ('no more chocolate today') to more active practices such as preparing written plans for healthier behaviour. A simple contract signed to oneself is another way of formalising a personal rule, taking a mental note and making it something more tangible.

The working definition of a commitment contract in this paper is any arrangement that relies solely on non-financial elements and has some element of ingrained formality, perhaps by being written down or through some verbal agreement with another person. This is in contrast with Rogers et al. (2014) who refer to commitment devices, commitment contracts and deposit contracts interchangeably. The argument put forward below isolates and tests the effectiveness of one particular type of commitment strategy: a commitment contract attached to self-reputational costs.

Self-enforcement relies on there being some short-term cost if the doer reneges on the planner's long-term goal; a 'psychological tax' that helps align the doer's and planner's incentives (Miller & Prentice, 2013). Such a cost can arise from the potential damage to individual's perception of themselves, as stated by Benabou and Tirole: "[people] see their own choices as indicative of 'what kind of person' they are"; such that a fear "of losing faith in oneself then creates an incentive that helps counter the bias toward instant gratification" (2004, p. 849), as exemplified by the doer sub-self. Following this logic, I argue that a commitment contract to oneself has the capacity to rein in momentary impulses and improve health behaviours, but this proposition is relatively untested.

2.4. Adherence to health programmes as an outcome itself

Existing work on commitment devices for health have largely focused on weight outcomes (John et al., 2011), smoking cessation (Gine et al., 2010) or physical activity outcomes (Royer et al., 2015), such as visiting the gym (Milkman, Minson, & Volpp, 2014). Studies have not tested the role of commitment strategies in promoting adherence to public health programmes. This is an important gap, because evidence shows that attendance and completion rates in weight management programmes are often lower than desired (Blane et al., 2017; Brown et al., 2015); that adherence has the potential to enhance weight management outcomes, for example through increased self-monitoring (Butryn et al., 2007; Peterson et al., 2014); and there is a need for more research on behavioural factors that affect dropout from weight loss interventions (Moroshko, Brennan, & Brien, 2011).

This paper contributes to the scholarly literature by asking two questions: can a personal commitment contract keep people on a weight loss programme for longer? And can a commitment contract keep more present-biased individuals on the programme for longer? Planner-doer theory implies that a commitment device increases the costs of deviating from a set plan, and so will encourage greater adherence to a structured weight loss programme. Individuals who would otherwise face a greater tussle between planner and doer may benefit most from a commitment contract that binds the doer's actions.

Hypothesis 1. A commitment contract will promote participation in a weight management programme.

Hypothesis 2. A commitment contract will generate larger treatment effects for individuals with myopic health attitudes

3. Study setting and experimental design

3.1. Population and programme context

The trial is set within a public weight loss service that was provided by the Local Authority's public health team in the London borough of Camden. Obese and overweight individuals resident in Camden were eligible for the 'Shape Up' service: a free, 11-week, group-based programme that sets a 5% weight loss target.[2] The target population for the study was Camden's Shape Up client base, who had already been screened for eligibility based on their body mass index (BMI) and home postcode, and entered the programme through self-referral or referral by a health professional. Groups met weekly at sessions facilitated by a Shape Up tutor, to learn about various aspects of weight loss and lifestyle such as portion sizes, taking account of food labelling, and physical activity. Tutors helped set weight loss goals (5% of initial body weight) at the start of the programme, recorded participants' attendance and weight, facilitated group discussion, and coached individuals on their food journals and weight readings. Under a normal Shape Up programme the population made no financial commitment, but may have been conscious of a mild reputational commitment to the tutor.[3]

3.2. Sample size, randomisation and recruitment

A total of 197 participants were recruited from 27 Shape Up groups over 2014–16, in line with ex ante sample size calculations. Clients were recruited face-to-face in one of the early weeks of the Shape Up programme they enrolled in (see Fig. 1).[4,5] The majority of participants were randomised in advance of recruitment using administrative records of registration, but in cases where these records were not up to date participants were randomly assigned to their experimental groups

[2] The 11-week course was designed by the non-profit organization Weight Concern.

[3] Clients chose Shape Up over other similar service providers, and knew from their first meeting that if they successfully completed the programme and achieved their goals they would be awarded free gym sessions at local leisure centres. The experiment focused on testing the effects of a commitment strategy and not the role of incentives in encouraging people to lose weight, and these incentives were common to all participants.

[4] The study was approved by UCL Ethics Committee in December 2013, project 4518/003. The study was registered at the AEA trial registry in November 2015, after the trial had begun but before data collection concluded.

[5] In line with CONSORT reporting standards (Schulz, Altman, & Moher, 2010).

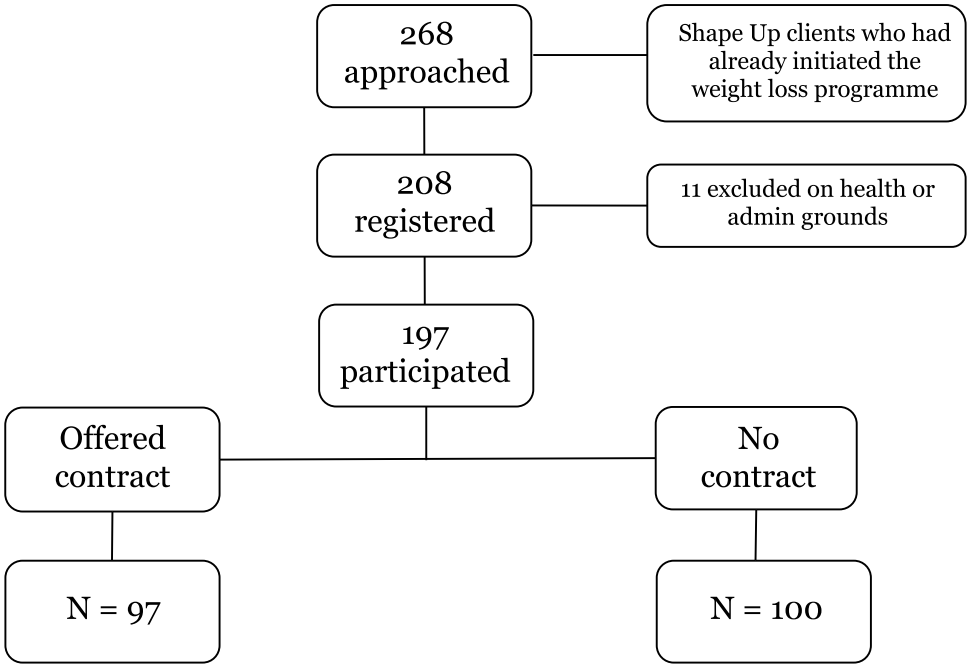

Fig. 1. Field experiment flowchart.

at the time of recruitment using a randomisation rule with a 50/50 treatment allocation probability. This ensured that willing and eligible participants were not excluded. Forty nine per cent were assigned to the treatment group (n = 97). Tutors were blind to participant status. Participants were recruited (and those in the treatment group offered the commitment contract) either during the introductory class or the next available class they attended.[6] A good balance was achieved in baseline covariates between the experimental groups (see Table 1).

3.3. Participant profile

The average participant was female (83% of the sample), obese (52%) and in their late 40 s. Starting BMI averaged 31.0 and ranged from 24.5 to 47.1, with 98% of participants found to be carrying excess weight (BMI > 25). A small proportion (6%) were severely obese (BMI of 40 or over). Routes on to the Shape Up programme included referral by a GP (32%), other health practitioner (38%), or self-referral (27%); and 31% had participated in a weight loss programme previously. There was a strong sense of motivation to lose weight – 83% of all participants stated they intended to live a healthy lifestyle over the following 12 months. Yet, dropouts and poor attendance were seen as key barriers to Shape Up programme effectiveness, and Camden were keen to increase their attendance and completion rates.

3.4. Intervention

The treatment group were offered a commitment contract (see Fig. 2) that they were invited to personalise by writing in their names, signature, and date. The wording of the contract was designed to make two distinct goals salient: participation in the programme to its completion, and achievement of the 5% weight loss target set for all clients in the programme. The contract was designed to have a degree of visual gravitas and formality, and was printed on card of A5 size that could be carried around in a handbag or satchel, or stuck on a fridge or wall. Participants who received the contract were advised to keep it somewhere they would see it on most days, and to discuss it with friends and family if they wished but not with the other group members. They signed the contract at the time of recruitment. The control group completed the baseline survey and, like the treated individuals, were asked to continue with the Shape Up programme as they normally would.[7] Recorded attendance and weight readings were gathered at the end of the course.

3.5. Data and empirical strategy

Participation was measured using two outcome variables: attendance rates and completion status of the programme. Completion status (a binary variable coded 0 or 1) was based on whether the participant attended until week 7 of the programme. This benchmark was derived from Camden's monitoring and performance indicators, and is in line with comparable benchmarks used for other weight management programmes (Logue et al., 2014). Shape Up group tutors routinely maintained a client register to monitor attendance, and collected end weight each week. Attendance rates were calculated by the number of sessions attended as a proportion of total sessions the individual could have attended, depending on when they joined the Shape Up group – while Camden aimed to have everyone join from the introductory week 0 class, some participants were signed up in weeks 1 and 2 depending on personal circumstances. By design, attrition was not a threat to the validity of the attendance and completion data.

A baseline survey collected data on individual characteristics such as age, gender, health behaviours and attitudes. Group characteristics controlled for tutor and proportion of group members who received the

[6] Participants only became aware of the trial (and commitment contract, for individuals assigned to the treatment group) once they attended a Shape Up class. The commitment contract did not affect the decision to attend the introductory session.

[7] Participants who received the contract took it away with them in an envelope along with their participant information sheet and consent form. Control group participants were given a copy of the consent form and information sheet in an A4 brown envelope to take away with them. Each participant therefore returned to the class with a brown envelope, whether they belonged to the control or treatment group, and this was a deliberate design feature to minimise the risk of contamination across groups and associated problems; such as the John Henry Effect, where control group members may have felt resentful they did not receive a contract (Glennerster & Takavarasha, 2013).

Table 1
Baseline variables by experimental group.

	N	Intervention group mean (1)	Comparison group mean (2)	Hypothesis test of (1) = (2), *p*-value
Starting weight	197	82.1	85.3	0.098
Body mass index (BMI)	190	30.7	31.3	0.276
Age	193	47.4	50.2	0.195
Female (%)	197	83.0	83.5	0.924
Myopic health attitudes (%)	197	58.8	49.0	0.169
Subjective wellbeing	190	6.4	6.3	0.805
Exercise (sessions per week)	197	1.63	1.27	0.088
Diet (fruit and veg portions	138	3.75	3.74	0.964
Prior weight loss programme (%)	197	30.0	33.0	0.652
Recent life change (%)	197	36.0	34.0	0.771
Takes part in other activities (%)	196	68.0	70.8	0.667
Self-referred to programme (%)	197	29.0	25.8	0.618
Attended introductory class (%)	197	68.0	65.0	0.653
Recruited in programme wk 1 (%)	197	52.0	50.5	0.835
Recruited in programme wk 2 (%)	197	34.0	34.0	0.998
Recruited in programme wk 3 (%)	197	14.0	15.5	0.772
Recruited in wave 1 (%)	197	28.0	29.9	0.769
Recruited in wave 2 (%)	197	32.0	29.9	0.750
Recruited in wave 3 (%)	197	40.0	40.2	0.976
Pre-randomised	197	73.0	71.1	0.770

Data is drawn from baseline surveys completed by all participants, except variable on diet which was taken from Shape Up starter survey administered by tutors. Hypothesis testing on group means using *t*-tests for continuous variables two-group proportion tests for binary variables. For further detail on recruitment waves and dates see Appendix Table A1. Pre-randomised participants were those who were registered and randomized in advance of recruitment. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Fig. 2. A commitment contract for health behaviour change.

contract -because treatment was randomly assigned at the individual level, groups varied randomly in the proportion of treated members. Further control variables take account of recruitment wave and seasonal effects. Camden collected data on initial behaviours around exercise sessions (per week) and diet (fruit and vegetable portions per day). This data is valuable but somewhat limited due to missing observations where tutors failed to collect the Shape Up 'starter surveys'. Missing administrative data for baseline exercise levels was provided by the trial's baseline survey, but missing data on baseline diet could not be gathered. Other baseline variables identified whether participants had previously taken part in any structured weight loss programmes, whether they had recently experienced major life changes, and whether they were undertaking other activities alongside the Shape Up programme in order to lose weight.

Initial health attitudes are a useful way of identifying individuals who are more likely to be dominated by their doer sub-selves, therefore exhibit time inconsistency, and be more likely to go off track with their health goals in the absence of a commitment device. To operationalise myopic health attitudes, the baseline survey incorporated a 19-item questionnaire from the Healthy Foundations Segmentation model (Williams et al., 2011), which was recently applied within the Health Survey for England to identify how health attitudes are associated with health outcomes (Robinson, 2012). The model identifies five health motivation groups, of which three groups are particularly susceptible to short-termist health attitudes. The analysis uses a binary variable to capture myopic health attitudes, which describes 54% of the sample.

An important administrative variable that is included is attendance at the introductory class that launched the 11-week programme. It focused on social introductions and building rapport with peers and the tutor – potentially forging a sense of reputational commitment to the tutors; explaining that Shape Up is about understanding themselves and their habits ("it's a lifestyle, not a diet" was a common refrain from tutors); reminding clients of the importance of regular attendance; and highlighting the programme incentives for completing the programme (including free gym passes). Overall 67% of participants attended the introductory class, and there were no significant differences between treatment and comparison group that might affect causal inference.

Group level dynamics might have played a role in participants' willingness to complete the programme, so the models incorporate variables on tutor and the proportion of participants in the group who also received a contract. The latter variable is particularly useful for investigating evidence of spillover effects – for example if the treatment raises performance, this could generate a more positive atmosphere and a virtuous circle of visible progress, fuelling motivation and further progress for all group members, not just the treated individuals.

Average treatment effects were isolated using the model below:

$$Y_i = \alpha + \beta^c . C + \sum_{j=1}^{J} \gamma_j . W_{ij} + \sigma . S + \varepsilon_i \quad (1)$$

Heterogeneous treatment effects were isolated using the model below:

$$Y_i = \alpha + \beta^c . C + \beta^{tr} . C . Trait + \sum_{j=1}^{J} \gamma_j . W_{ij} + \sigma . S + \varepsilon_i \quad (2)$$

Y is the outcome variable for attendance and completion rates in Eq. (1). Treatment status is captured by variable C, where $C = 1$ if the

participant is in the treatment group. The OLS estimator for β^C provides the average treatment effect (intent-to-treat) for the commitment contract on attendance. The probit estimator provides the average treatment effect from achieving completer status. The combined linear effect from OLS estimators on the treatment and treatment x trait interaction term is used to identify sub-group effects on attendance in Eq. (2). W is a series of individual covariates J, with coefficients γ_j as described in the summary of baseline data earlier. S is a series of administrative variables including tutor and recruitment wave (see Appendix for full details). Three regression models are run for each outcome: model 1 is a baseline model covering individual characteristics, initial health attitudes and behaviours; model 2 adds a binary administrative control variable for attendance at the introductory session; and model 3 adds a variable for initial diet, trading off explanatory power from initial behaviour for sample size due to missing baseline observations on diet. The hypotheses imply a positive and statistically significant value for β^C from models fit for Eq. (1), and a positive and statistically significant combined treatment and interaction term effect in Eq. (2).[8]

4. Results

The data supports hypothesis 1, that the commitment contract can raise adherence to the weight loss programme. Participants who were offered the contract recorded average attendance of 71% compared to 67% amongst the comparison group, and higher completion rates of 77% compared to 69% amongst the comparison group. Regression analysis indicates the commitment contract raises attendance rates by 7.5% ($p = 0.050$) in the baseline model. The average treatment effect size is similar in model 2, incorporating the binary variable for attending the introductory class, but not statistically significant ($p = 0.056$). Model 3 finds a statistically significant effect of the contract, raising attendance by 12% ($p = 0.003$), which is equivalent to one additional session of the 11-week course. With the caveat that the results are sensitive to model specification, Table 2 suggests a statistically significant causal impact from the commitment contract on participation.

The commitment contract boosts completion rates, and this finding is robust across model specifications (see Table 3). In the baseline model, the commitment contract raises the probability of completing the course ($p = 0.032$), with a marginal effect of 14% (rising to 19% in model 3). Model 2 indicates the importance of having attended the introductory class on subsequent participation in the programme. Model 3 suggests that the treatment effect was stronger for both completion and attendance rates amongst the sample of participants who provided dietary information; but the reasons for this are not clear. These participants were different to the rest only in that they were given the Shape Up starter survey by the tutors (the programme's own baseline survey, distinct from the research project's baseline survey). While this starter survey was intended for all Shape Up clients, organisational lapses meant that not everyone received a survey. With attendance at the introductory session and differences in tutors already controlled for, and the dietary variable itself not being statistically significant, the most plausible remaining interpretation is that the contract had a more positive effect when the programme elements were administered most consistently. The potential interactions between the programme elements and the commitment contract are discussed further in Section 5.

Tables 2 and 3 identify other variables correlated with participation: older people are more likely to have higher attendance and complete the programme, those who report higher levels of exercise at the baseline are also more likely to complete. There are no significant differences based on initial body mass index or gender. Self-referral might be expected to capture initial motivation, but is not significantly associated with participation rates. Myopic health attitudes at the baseline are also not significantly associated with either measure of participation.

Heterogeneous treatment effects are tested using the same three model specifications (see Table 4), and the combined linear effect of the treatment and interaction terms are reported below. The results provide mixed support for hypothesis 2, and are sensitive to model specification. In all three cases, the commitment contract improves attendance amongst people who initially reported more myopic health attitudes, but only in model 3 is this finding statistically significant ($p = 0.001$). Models 1 and 2 suggest the size of the effect is in line with average treatment effects reported in Table 2; however model 3 indicates a larger, positive effect from the commitment contract on those individuals exhibiting myopic health attitudes. The mixed findings indicate the need for further research on potential heterogeneous treatment effects amongst those most likely to be affected by present bias.

5. Discussion

The commitment contract generates significant and positive participation effects, enhancing adherence to the weight management programme. There is limited evidence to confirm heterogeneous treatment effects based on initial health attitudes, but the mixed results suggest this is a promising line of enquiry in future research. The findings prompt two further questions. The statistical analysis uncovered the importance of attending the introductory class, which was argued to have a potential commitment effect of its own. How did the commitment contract interact with this administrative variable, and did it have differential effects on participation amongst those who missed the introductory class? Secondly, while it is valuable to improve adherence to the weight loss programme, this is based on the assumption that adherence promotes weight management goals. So, did the improved attendance translate into greater weight loss?

5.1. The commitment contract as a substitute for other commitment elements

Incorporating a binary variable for attendance at the initial Shape Up class improves the explanatory fit of the statistical models for both attendance and completion outcomes. In both cases, attendance at the introductory class is positively associated with higher participation throughout the weight management programme. As discussed in section II, the first class was the opportunity for group members to meet, get to know each other and the tutor, and the content of the class was largely about motivating people to stick with the programme through to the end for the best results. The tutor's introduction would have been repeated in brief in the following weeks for newcomers, but more time was given to social introductions and discussing personal motivations for weight loss goals in the first class. Tutors would also have had more time to share their own background and personal journeys. For all these reasons, the introductory class was different to the rest, and this is borne out in the data.

If the first class aimed to generate a sense of togetherness, perhaps this was a form of commitment creation towards the tutor, the group, and to the programme itself; albeit not in the form of a commitment device as defined in this article. Participants who attended may have experienced an initial sense of commitment nevertheless; conversely, those who missed the meeting may have started the programme with a slight disadvantage as far as commitment goes. To investigate further, I examine whether the participation rates vary based on their having attended the introductory class.

Descriptive statistics suggest there is an interaction between the contract and attendance at the first class (Table 5). When a person missed the introductory class, and the encouragement it delivered to stick with the programme, they reported low attendance rates of just over 50% - unless they were randomly assigned a contract. Having a

[8] All statistical analysis was undertaken with Stata (v 12).

Table 2
Can a commitment contract boost attendance rates?.

	(1)	(2)	(3)
Received a commitment contract	0.075* (0.038)	0.071 (0.037)	0.123** (0.041)
Female	0.081 (0.052)	0.102* (0.051)	0.123 (0.068)
Age	0.004** (0.001)	0.005*** (0.001)	0.005*** (0.001)
Overweight	−0.044 (0.098)	−0.030 (0.108)	0.014 (0.141)
Obese	−0.079 (0.100)	−0.067 (0.110)	−0.012 (0.143)
Severely obese	−0.062 (0.124)	−0.041 (0.133)	0.011 (0.171)
Myopic health attitudes	0.016 (0.039)	0.027 (0.036)	0.011 (0.042)
Exercise	0.025 (0.014)	0.024 (0.014)	0.012 (0.016)
Prior weight loss programme	−0.004 (0.045)	−0.022 (0.041)	−0.034 (0.045)
Recent life change	0.053 (0.038)	0.039 (0.037)	0.021 (0.043)
Takes part in other activities	−0.065 (0.039)	−0.064 (0.039)	−0.065 (0.042)
Self referred to class	0.020 (0.044)	0.027 (0.041)	0.018 (0.042)
Group treatment intensity	−0.141 (0.189)	−0.182 (0.182)	−0.180 (0.205)
Controls for tutor	Y	Y	Y
Controls for wave	Y	Y	Y
Attended introductory class		0.135** (0.043)	0.127* (0.054)
Diet			0.007 (0.015)
Observations	192	192	136
Adjusted R^2	0.073	0.131	0.157

Group treatment intensity measures the proportion of group members who were randomly assigned a commitment contract. Controls applied for each of the eight tutors and three waves of participant recruitment. All results are OLS estimates. Column 1 reports a parsimonious model, column 2 includes administrative variable for attending the introductory class, and column 3 adds baseline diet. Further robustness checks indicate model specification 2 run on the sub-sample for column 3 generates similar results as column 3. Robust standard errors clustered at the level of the individual are in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3
Can a commitment contract boost completion rates?.

	(1)	(2)	(3)
Received a commitment contract	0.473* (0.220)	0.467* (0.222)	0.844** (0.293)
Female	0.316 (0.295)	0.428 (0.301)	0.626 (0.400)
Age	0.015 (0.008)	0.017* (0.008)	0.031** (0.010)
Overweight	0.153 (0.645)	0.328 (0.655)	1.226 (0.772)
Obese	−0.254 (0.647)	−0.095 (0.654)	0.721 (0.736)
Severely obese	−0.519 (0.768)	−0.371 (0.797)	0.305 (0.954)
Myopic health attitudes	0.171 (0.228)	0.228 (0.224)	0.379 (0.316)
Exercise	0.181* (0.089)	0.184* (0.093)	0.072 (0.107)
Prior weight loss programme	−0.009 (0.255)	−0.116 (0.256)	−0.098 (0.325)
Recent life change	0.448 (0.245)	0.400 (0.250)	0.258 (0.325)
Takes part in other activities	−0.403 (0.238)	−0.422 (0.241)	−0.593 (0.337)
Self referred to class	−0.103 (0.257)	−0.046 (0.263)	0.006 (0.338)
Group treatment intensity	−0.206 (1.031)	−0.298 (1.037)	−0.131 (1.303)
Controls for tutor	Y	Y	Y
Controls for wave	Y	Y	Y
Attended introductory class	.	0.689** (0.230)	0.855** (0.311)
Diet	.	.	0.120 (0.097)
Observations	192	192	136
Pseudo R^2	0.141	0.179	0.242

Statistical analysis as in Table 2, with Probit analysis on completion status. Column 1 reports a parsimonious model, column 2 includes the administrative variable for attending the introductory class, and column 3 adds baseline diet. Further robustness checks indicate model specification 2 run on the sub-sample for column 3 generates similar results as column 3. Robust standard errors clustered at the level of the individual are in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

contract boosts participation up to 71% for those who missed the introductory class (column 1). Regression analysis incorporating a binary variable 'missed initial class' as an interaction term with treatment status further indicates a statistically significant, combined linear effect of the contract and interaction term of 18% ($p = 0.018$).

There are limits to how far commitment contracts can increase attendance. Where a participant attended the class, and experienced the initial efforts to create a sense of commitment to the programme, the contract has little impact on their subsequent participation (column 2). Amongst those who did not receive a contract, attending the introductory class offsets any commitment gap and is associated with higher attendance of 75%. But, when the individual has received a contract, there is a marginal difference on their participation rates based on whether they attended the introductory class or not.

The results raise the possibility that the contract is able to plug a commitment gap (from not attending the initial class), but that it does not continue to enhance participation amongst those who have attended the initial class. In other words, the contract appears to work effectively as a substitute for other commitment elements in the weight loss programme, but not additively with these wider elements. These findings are exploratory in nature and rely on small samples, so cannot be used for reliable causal inference and extrapolation, but point towards fruitful future research enquiry; they also highlights gaps in our understanding of commitment devices, and points to the presence of threshold effects and substitution effects that are not well formalized in the available theoretical frameworks (Savani, 2018).

Table 4
Treatment effects on attendance for individuals with myopic health attitudes.

	(1)	(2)	(3)
Received a commitment contract	0.073 (0.054)	0.075 (0.051)	0.037 (0.054)
Contract x myopic health attitude	0.004 (0.072)	−0.007 (0.070)	0.147 (0.077)
Female	0.081 (0.052)	0.102* (0.051)	0.127 (0.067)
Age	0.004** (0.001)	0.005*** (0.001)	0.006*** (0.001)
Overweight	−0.043 (0.098)	−0.031 (0.110)	0.034 (0.127)
Obese	−0.079 (0.100)	−0.067 (0.111)	0.008 (0.129)
Severely obese	−0.063 (0.124)	−0.040 (0.134)	0.018 (0.157)
Myopic health attitudes	0.014 (0.055)	0.030 (0.050)	−0.056 (0.060)
Exercise	0.025 (0.014)	0.024 (0.014)	0.011 (0.016)
Prior weight loss programme	−0.004 (0.045)	−0.022 (0.041)	−0.043 (0.045)
Recently experienced life change	0.053 (0.039)	0.039 (0.038)	0.024 (0.043)
Takes part in other activities	−0.065 (0.039)	−0.064 (0.039)	−0.055 (0.042)
Self referred to class	0.020 (0.044)	0.027 (0.041)	0.006 (0.040)
Group treatment intensity	−0.141 (0.190)	−0.182 (0.183)	−0.144 (0.204)
Controls for tutor	Y	Y	Y
Controls for wave	Y	Y	Y
Attended introductory class	–	0.135** (0.043)	0.125* (0.053)
Diet	–	–	0.008 (0.015)
Linear combined effect of contract + interaction term	0.077 (0.051)	0.068 (0.051)	0.185*** (0.057)
Observations	192	192	136
Adjusted R^2	0.067	0.126	0.174

Heterogeneous treatment effects drawn from OLS analysis. Column 1 reports a parsimonious model, column 2 includes the administrative variable for attending the introductory class, and column 3 adds baseline diet. Further robustness checks indicate that model specification 2 run on the sub-sample for column 3 generates similar results as column 3. Robust standard errors clustered at the level of the individual are reported in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 5
The commitment contract and the introductory Shape Up class.

	Missed first class	Attended first class
Mean attendance rates	(1)	(2)
No contract	53% ($n = 35$)	75% ($n = 65$)
Contract	71% ($n = 31$)	72% ($n = 66$)
Difference	+18%	−3%

Table 6
Is the commitment contract a substitute for other commitment elements?.

Received a commitment contract	0.010 (0.040)
Contract *x* missed introductory Shape Up class	0.169* (0.086)
Female	0.104* (0.046)
Age	0.004** (0.001)
Overweight	−0.029 (0.095)
Obese	−0.069 (0.097)
Severely obese	−0.044 (0.118)
Myopic health attitudes	0.029 (0.035)
Exercise	0.022 (0.014)
Took part in a weight loss programme before	−0.012 (0.041)
Recently experienced a major life change	0.046 (0.037)
Takes part in other activities to stay healthy	−0.057 (0.039)
Self referred to class	0.022 (0.042)
Missed introductory Shape Up class	−0.214*** (0.058)
Group treatment intensity	−0.168 (0.181)
Controls for tutor	Y
Controls for wave	Y
Linear combined effect of contract + interaction term	0.179* (0.075)
Observations	192
Adjusted R^2	0.153

Statistical analysis as in Table 2 column 1, with OLS regression on attendance rates, incorporating binary variable on whether participant attended the introductory Shape Up class. Robust standard errors clustered at the level of the individual are in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

5.2. Commitment, adherence, and weight outcomes

While the contract has demonstrable effects on boosting participation in the weight management programme, adherence is valued largely as a stepping stone towards better health outcomes. Participation for the full course of the programme matters because it is expected to promote weight loss (Moroshko et al., 2011). The discussion below briefly examines the distribution of weight outcomes across participants; and what evidence there is for a positive relationship between attendance and weight loss.

The Shape Up programme routinely collects weight data. Given the practice for tutors to treat attendance to week seven as the benchmark to identify completers, final weight loss outcomes were taken from the latest reading available during the final four weeks of the programme. By this measure, 18% of observations lacked an outcome measure, which is in line with other weight loss studies (Elobeid et al., 2009).[9] Attrition is higher in the comparison group than the contract group (22% compared to 14%, $p = 0.169$). These attrition patterns create challenges for inferring a causal effect of the contract on weight outcomes (see Appendix Table A2). But the data does allow for descriptive analysis to explore the potential relationships between commitment, adherence and weight loss.

The comparison group reported average weight loss of 2.6% (of initial weight) against the treatment group's 2.8%, and the difference is not statistically significant ($p = 0.677$). The boxplot in Fig. 3 visualises this finding. This is puzzling, as we would reasonably expect that more commitment to the course would reflect in stronger weight management results. One explanation is that the design of this particular commitment device is strong enough to change tightly-specified behaviours (for example: 'I must go to the class this evening'), but too mild to bring about more complex changes that require multiple, complementary and sustained actions (such as: 'I must avoid high fat foods for three months').

Another explanation is that the contract is effective in promoting adherence to the programme, but the programme is not effective in delivering weight loss. This might be because the informational content did not influence dietary and exercise behaviours outside the

[9] Two alternative weight outcome measures were considered. Last observation or baseline observation carried forward measures were discarded due to the likely bias they would introduce, and the unjustified assumptions they would impose on weight loss performance in the absence of the Shape Up course. Secondly, weight loss outcomes from a narrower window in the final two weeks of the programme was considered, but attrition was significantly associated with this outcome measure (p = 0.012) as reported in Appendix Table A2.

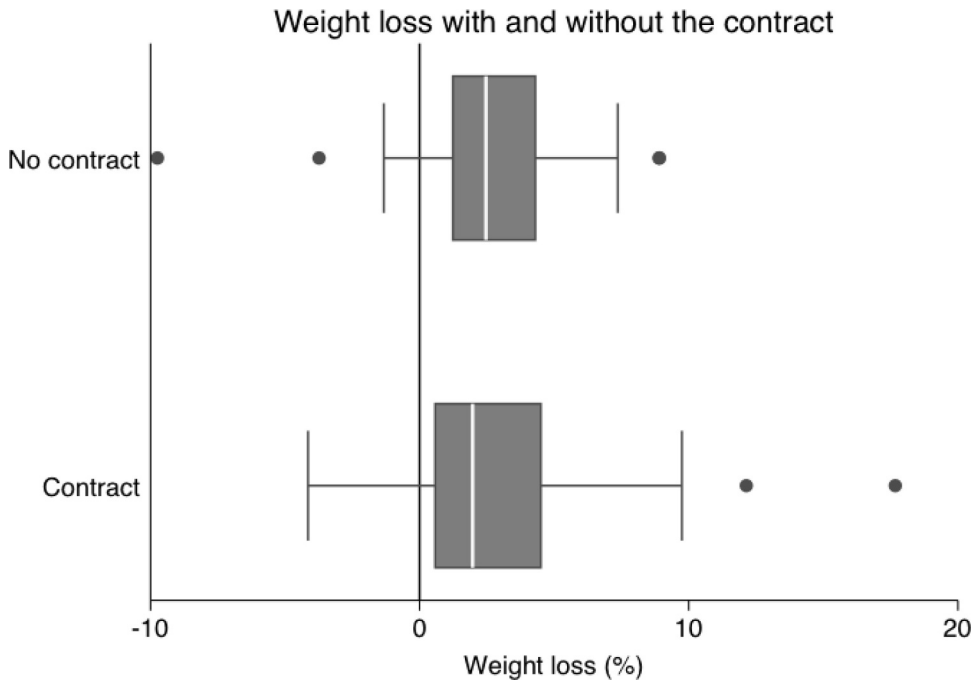

Fig. 3. Weight loss outcomes across experimental groups.
Notes: plot demonstrates median weight loss as a% of initial body weight, with dots representing outliers and whiskers representing 95% CI.

classroom. Fig. 4 offers some evidence against this explanation, as it suggests a modest but positive association between attendance and reported weight outcomes. Moral license effects might also affect weight performance overall: if by attending the class participants felt they had earned "moral credits" (Mullen & Monin, 2016, p. 367), whereby "engaging in positive behaviour may increase the likelihood of engaging in indulgent behaviour" (Chang & Chiou, 2014, p. 9), the net effect on health goals might have been undermined. Further statistical evidence is not available to assess these explanations, but these are promising questions for future research.

Fig. 3 raises two other important points. Firstly, it demonstrates the diverse range of weight loss outcomes across the participant sample: this is explicit evidence of heterogeneous experiences in weight management. Secondly, the contrast between the two box plots highlights a distinct likelihood of truncated outcome data, with fewer observations of weight gain in the comparison group. Plausibly, the commitment contract encourages people to return to the class week after week, and greater adherence therefore leads to a fuller spectrum of performance data at both ends. Administrative data is then better able to capture the true range of participant experiences, and this is why the intervention group boxplot reflects that some people lost a lot of weight, some lost a little, and some actually gained weight while on the programme (to the

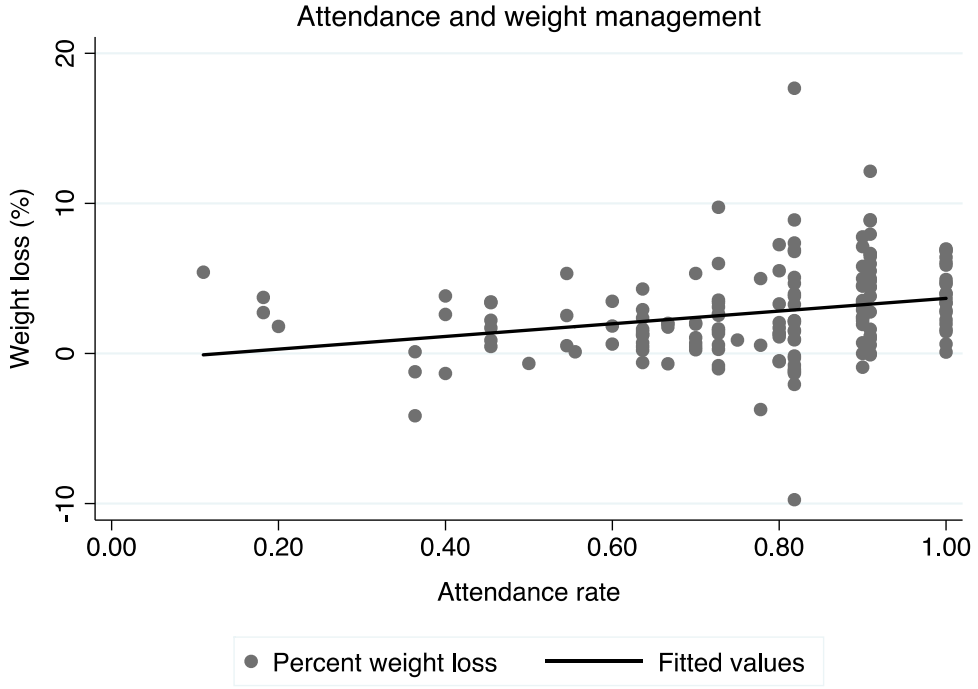

Fig. 4. Attendance and weight management outcomes.

left of the 'zero' reference line in Fig. 3). Participants in the treatment group returned to class, even when they were under-performing, and had their weight readings recorded; equally, they may have been more likely to return when performing well in order to have their progress recorded. Without the contract, however, comparison group participants may have been more likely to drop out of the programme altogether if they were under-performing against their weight loss target (hence the shorter left hand side whisker for the comparison group). Fig. 3 appears, then, to provide graphical evidence of the attrition bias that often affects studies measuring weight loss outcomes (Moroshko et al., 2011; Paloyo et al., 2014).

6. Conclusions

Commitment devices are recognised as potentially important tools to promote health behaviour. Yet personal commitment contracts, which rely solely on self-reputational costs, are under-researched. Theory predicts that even modest commitment devices can generate enough psychological tax to bring about behaviour change. A field experiment with participants in a group-based community weight management scheme tested this proposition by randomly assigning personal commitment contracts to participants. A limitation of the study is attrition on weight loss data, which precluded further analysis of the causal impact of the contract on health outcomes; and missing baseline data on initial dietary behaviours which was associated with some results being sensitive to model specification. Strengths of the study include the use of objective data to measure participation using administrative records, avoiding self-reported adherence; and the novel use of health attitudes data to proxy myopia in health decisions, and investigate the causal mechanism linking commitment contracts with behaviour change.

Attendance and completion rates were significantly higher amongst those who received a simple commitment contract, designed to act as a signed pledge to oneself to pursue their weight loss goals and complete the 11-week weight loss intervention. In line with the Thaler and Shefrin's (1981) planner-doer framework, and the arguments put forward by Benabou and Tirole (2004), these results indicate that a personal commitment contract was sufficient to promote adherence to an ongoing health management programme. More limited evidence indicated these positive effects might be stronger for participants expressing more short-termist health attitudes at the start of the study; but these sub-group effects are best interpreted as suggestive.

This paper contributes to the literature on commitment devices and health behaviour change by drawing out novel experimental insights on a relatively under-researched type of commitment device, and highlighting the limitations of theory to understand potential threshold and substitution effects of commitment devices. Mixed findings on the potential heterogeneous effects of commitment devices calls for further work to test this fundamental premise of the planner-doer framework – that commitment devices tackle present bias and myopic decision-making to deliver health benefits. Future research and theory development could usefully address these issues, and identify how diverse commitment strategies and inducements might be combined to deliver greater health impact. The results also contribute to the health psychology and public health literatures on adherence and weight management.

Positive treatment effects on attendance and completion rates justify a role for commitment devices in improving participation in public health programmes. The study demonstrates that personal commitment contracts are low-cost and easily administered to boost engagement with public health services; and further identifies a target group of individuals with relatively myopic health attitudes who may especially benefit from commitment devices that align short term actions with longer term health goals. These findings are therefore of interest to policy makers who may seek to add commitment contracts to the behaviour change toolkit. Further research could investigate the optimal design of commitment contracts that are tailored to individual needs, and qualitative follow up could shed more light on how commitment contracts are utilised and valued. Future studies could also consider other biometric data, more intensive follow-up on weight outcomes to minimise missing data, and behaviour and attitude indicators around diet and physical activity. This would help develop a comprehensive picture of how a commitment device can trigger behaviour change, and the potential for wider and unintended effects such as moral license.

Appendix (Tables A1 to A2)

Table A1 to A2

Table A1
Recruitment schedule.

Wave	Duration	Participants	Share	Groups	Tutors involved
1	January–March 2014	57	29%	1–9	1–5
2	April–August 2014	61	31%	10–19	1–6, 8
3	Sept 2015–March 2016	79	40%	20–27	1, 2, 5, 7, 8

Table A2
Factors associated with missing weight loss outcomes.

	Attrition at week 7	Attrition at week 9
Received a commitment contract	−0.420 (0.242)	−0.810** (0.247)
Female	−0.146 (0.336)	0.194 (0.300)
Age	−0.008 (0.009)	−0.015* (0.008)
Overweight	−0.643 (0.716)	0.053 (0.610)
Obese	−0.452 (0.731)	0.406 (0.622)
Severely obese	−1.002 (0.928)	−1.686 (1.004)
Myopic health attitudes	−0.089 (0.243)	0.103 (0.246)
Exercise	−0.185 (0.100)	−0.137 (0.084)
Recently experienced a major life change	−0.329 (0.255)	−0.306 (0.247)
Took part in a weight loss programme before	−0.084 (0.276)	0.465 (0.242)
Takes part in other activities to stay healthy	0.228 (0.262)	0.096 (0.242)
Attended introductory class	−0.793** (0.243)	−0.569* (0.248)
Referred by GP	−0.111 (0.278)	−0.006 (0.265)
Referred by other health professional	−0.231 (0.317)	−0.537 (0.291)
Referred by other	1.447 (0.822)	2.460** (0.860)
Group treatment intensity	0.271 (1.104)	0.225 (1.060)
Group during daytime	0.026 (0.398)	0.083 (0.383)
Group size	0.053 (0.050)	−0.028 (0.044)
Tutor 2	−0.398 (0.462)	−0.774 (0.433)
Tutor 3	−0.631 (0.434)	−1.501*** (0.423)
Tutor 4	−0.745 (0.666)	−1.952** (0.701)
Tutor 5	−0.723 (0.530)	−1.554** (0.477)
Tutor 6	0.701 (0.813)	0.496 (0.935)
Tutor 7	−0.113 (0.742)	−1.163 (0.631)
Tutor 8	−0.296 (0.473)	−0.946* (0.397)
Recruited to trial in week 2	0.034 (0.470)	0.070 (0.495)
Recruited to trial in week 3	0.242 (0.549)	0.103 (0.523)
Participant in wave 2	−0.167 (0.369)	0.165 (0.395)
Participant in wave 3	−0.204 (0.509)	0.669 (0.455)
Observations	192	192
Pseudo R^2	0.203	0.271

Probit estimates on attrition. Robust standard errors clustered at the level of the individual in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

References

Andreoni, J., Kuhn, M.A., Sprenger, C., 2015. Measuring time preferences : A comparison of experimental methods. Journal of Economic Behavior and Organization 116, 451–464. https://doi.org/10.1016/j.jebo.2015.05.018.

Ariely, D., Wertenbroch, K., 2002. Procrastination, deadlines, and performance: Self-control by precommitment. Psychological Science : A Journal of the American Psychological Society/APS 13 (2000), 219–224. https://doi.org/10.1111/1467-9280.00441.

Au, N., Marsden, G., Mortimer, D., Lorgelly, P.K., 2013. The cost-effectiveness of shopping to a predetermined grocery list to reduce overweight and obesity. Nutrition Diabetes 3 (6), 1–5. https://doi.org/10.1038/nutd.2013.18.

Benabou, R., Tirole, J., 2004. Willpower and personal rules. Journal of Political Economy 112 (4), 848–886.

Blane, D.N., McLoone, P., Morrison, D., Macdonald, S., O'Donnell, C.A., 2017. Patient and practice characteristics predicting attendance and completion at a specialist weight management service in the UK: A cross-sectional study. BMJ Open 7, 1–10. https://doi.org/10.1136/bmjopen-2017-018286.

Brocas, I., Carillo, J.D., Dewatripont, M., 2003. Commitment devices under self-control problems: an overview. In: Brocas, I., Carillo, J.D. (Eds.), *The psychology of economic decisions vol* 2. Oxford University Press, Oxford, pp. 231.

Brown, A., Gouldstone, A., Fox, E., Field, A., Todd, W., Shakher, J., Bellary, S., The, M.M., Azam, M., John, R., Jagielski, A., Arora, T., Thomas, G.N., Taheri, S., 2015. Description and preliminary results from a structured specialist behavioural weight management group intervention: Specialist Lifestyle Management (SLiM) programme. BMJ Open 5, 1–11. https://doi.org/10.1136/bmjopen-2014-007217.

Bryan, G., Karlan, D., Nelson, S., 2010. Commitment devices. Annual Review of Economics 2, 671–698. https://doi.org/10.1146/annurev.economics.102308.124324.

Butryn, M.L., Phelan, S., Hill, J.O., Wing, R.R., 2007. Consistent self-monitoring of weight: A key component of successful weight loss maintenance. Obesity 15 (12), 3091–3096. https://doi.org/10.1002/oby.20584/epdf.

Cavaliere, A., De Marchi, E., Banterle, A., 2014. Healthy – unhealthy weight and time preference. Is there an association? An analysis through a consumer survey. Appetite 83, 135–143. https://doi.org/10.1016/j.appet.2014.08.011.

Chang, Y.Y.C., Chiou, W.Bin, 2014. Taking weight-loss supplements may elicit liberation from dietary control. A laboratory experiment. Appetite 72, 8–12. https://doi.org/10.1016/j.appet.2013.09.021.

Costa-Font, J., Hernandez-Quevedo, C., McDonald, J.T., Variyam, J.N., 2013. Understanding healthy lifestyles: The role of choice and the environment. Applied Economic Perspectives and Policyiedomicives and 35 (1), 1–6. https://doi.org/10.1093/aepp/pps051.

Department of Health, 2011. Healthy lives, healthy people: A call to action on obesity in England. UK Department of Health.

Downs, J.S., Loewenstein, G., Wisdom, J., 2009. Strategies for promoting healthier food choices. American Economic Review 99 (2), 159–164. https://doi.org/10.1257/aer.99.2.159.

Dupas, P., 2011. Health behavior in developing countries. Annual Review of Economics 3 (1), 425–449. https://doi.org/10.1146/annurev-economics-111809-125029.

Elobeid, M.A., Padilla, M.A., McVie, T., Thomas, O., Brock, D.W., Musser, B., Lu, K., Coffey, C.S., Desmond, R.A., St-Onge, M.-P., Gadde, K.M., Heymsfield, S.B., Allison, D.B., 2009. Missing data in randomized clinical trials for weight loss : Scope of the problem, state of the field, and performance of statistical methods. PLoS ONE 4 (8), 1–11. https://doi.org/10.1371/journal.pone.0006624.

Fan, M., Jin, Y., 2013. Obesity and self-control: Food consumption, physical activity, and weight-loss intention. Applied Economic Perspectives and Policy 36 (1), 125–145. https://doi.org/10.1093/aepp/ppt034.

Frederick, S., Loewenstein, G., O'Donoghue, T., 2002. Time discounting and time preference: A critical review. Journal of Economic Literature 40 (2), 351–401. https://doi.org/10.1257/002205102320161311.

Gine, 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 (October), 213–235.

Glennerster, R., Takavarasha, K., 2013. Running randomized evaluations: A practical guide. Princeton University Press.

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 (22), 2108–2117. https://doi.org/10.1056/NEJMoa1414293.

Health Social Care Information Centre, 2015. HSE 2014 obesity and overweight adult trends. HSCIC, London.

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 (6), 621–626. https://doi.org/10.1007/s11606-010-1628-y.

Kiesler, C.A., Sakumura, J., 1966. A test of a model for commitment. Journal of

Personality and Social Psychology 3 (3), 349–353.
Kunreuther, H., Meyer, R., Michel-Kerjan, E., 2013. Overcoming decision biases to reduce losses from natural catastrophes. In: Shafir, E. (Ed.), The behavioral foundations of public policy. Princeton University Press, Oxford, pp. 398–413.
Liu, P.J., Wisdom, J., Roberto, C.A., Liu, L.J., Ubel, P.A., 2014. Using behavioral economics to design more effective food policies to address obesity. Applied Economic Perspectives and Policy 36 (1), 6–24. https://doi.org/10.1093/aepp/ppt027.
Loewenstein, G., Asch, D.A., Friedman, J.Y., Melichar, L.A., Volpp, K.G., 2012. Can behavioural economics make us healthier? BMJ 344 (May), e3482. https://doi.org/10.1136/bmj.e3482.
Logue, J., Allardice, G., Gillies, M., Forde, L., Morrison, D.S., 2014. Outcomes of a specialist weight management programme in the UK national health service: Prospective study of 1838 patients. BMJ Open 4, 1–8. https://doi.org/10.1136/bmjopen-2013-003747.
Milkman, K.L., Minson, J.A., Volpp, K.G.M., 2014. Holding the hunger games hostage at the gym: An evaluation of temptation bundling. Management Science 60 (2), 283–299.
Miller, D.T., Prentice, D.A., 2013. Psychological levers of behaviour change. In: Shafir, E. (Ed.), The Behavioral Foundations of Public Policy. Princeton University Press, pp. 301–309.
Mochon, D., Schwartz, J., Maroba, J., Patel, D., Ariely, D., 2016. Gain without pain: The extended effects of a behavioral health intervention. Management Science 63 (1), 58–72. https://doi.org/10.1287/mnsc.2015.2322.
Moroshko, I., Brennan, L., & Brien, P.O. (.2011). 'Predictors of dropout in weight loss interventions : A systematic review of the literature', (2), pp. 912–934. doi: 10.1111/j.1467-789X.2011.00915.x.
Mullen, E., Monin, B., 2016. Consistency versus licensing effects of past moral behavior. Annual Review of Psychology 67, 363–385. https://doi.org/10.1146/annurev-psych-010213-115120.
NHS Digital, 2018. Health survey for england 2017. the Health and Social Care Information Centre.
Nyer, P.U., Dellande, S., 2010. Public commitment as a motivator for weight loss. Psychology & Marketing 27 (1), 1–12.
O' Donoghue, T., Rabin, M., 1999. Doing it now or later. American Economic Review 89 (1), 103–124. https://doi.org/10.1257/aer.89.1.103.
Oliver, A., Ubel, P., 2014. Nudging the obese: A UK-US consideration. Health Economics, Policy, and Law (April), 1–14. https://doi.org/10.1017/S1744133114000103.
Paloyo, A.R., Reichert, A.R., Reinermann, H., Tauchmann, H., 2014. The causal link between financial incentives and weight loss: An evidence-based survey of the literature. Journal of Economic Surveys 28 (3), 401–420. https://doi.org/10.1111/joes.12010.
Perry, C., Chhatralia, K., Damesick, D., Hobden, S., Volpe, L. (2015).*Behavioural insights in health care: Nudging to reduce inefficiency and waste*. The Health Foundation, London. http://www.health.org.uk/sites/health/files/BehaviouralInsightsInHealthCare.pdf.
Peterson, N.D., Middleton, K.R., Nackers, L.M., Medina, K.E., Milsom, V.A., Perri, M.G., 2014. Dietary self-monitoring and long-term success with weight management. Obesity (Silver Spring) 22 (9), 1962–1967. https://doi.org/10.1002/oby.20807.
Relton, C., Strong, M., Li, J., 2011. The " pounds for pounds " weight loss financial incentive scheme : An evaluation of a pilot in NHS Eastern and Coastal Kent. Journal of Public Health (Oxford) 33 (4), 536–542. https://doi.org/10.1093/pubmed/fdr030.
Robinson, C., 2012. Healthy foundations segmentation. In: Health survey for England 2011. HSCIC, pp. 1–38.
Rogers, T., Milkman, K.L., Volpp, K.G., 2015. Beyond good intentions: Prompting people to make plans improves follow-through on important tasks. Behavioral Science and Policy 1 (2), 33–41.
Rogers, T., Milkman, K.L., Volpp, K.G., 2014. Commitment devices: Using initiatives to change behavior. JAMA : The Journal of the American Medical Association 311 (20), 2065–2066. https://doi.org/10.1001/jama.2014.3485.
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 (3), 51–84. https://doi.org/10.1257/app.20130327.
Savani, M.M., 2018. The effects of a commitment device on health outcomes: Reputational commitment and weight loss in an online experiment. International Journal of Applied Behavioral Economics 7 (4), 1–20. https://doi.org/10.4018/IJABE.2018100101.
Schulz, K.F., Altman, D.G., Moher, D., 2010. CONSORT 2010 statement: Updated guidelines for reporting parallel group randomized trials. Open Medicine 4 (1), E60–E68.
Schwartz, J., Mochon, D., Wyper, L., Maroba, J., Patel, D., Ariely, D., 2014. Healthier by precommitment. Psychological Science 25 (2), 538–546. https://doi.org/10.1177/0956797613510950.
Strotz, R.H., 1955. Myopia and inconsistency in dynamic utility maximization. The Review of Economic Studies 165–180. https://doi.org/10.2307/2295722.
Thaler, R.H., Benartzi, S., 2004. Save more tomorrow™: Using behavioral economics to increase employee saving. Journal of Political Economy 112 (S1), S164–S187. https://doi.org/10.1086/380085.
Thaler, R.H., Shefrin, H.M., 1981. An economic theory of self-control. Journal of Political Economy 89 (2), 392–406.
Thaler, R.H., Sunstein, C.R., 2008. Nudge: Improving decision about health, wealth and happiness. Penguin Books, London.
Volpp, K.G., John, L.K., Troxel, A.B., Norton, L., Fassbender, J., Loewenstein, G., 2008. Financial incentive–based approaches for weight loss. JAMA: The Journal of the American Medical Association 300 (22), 2631–2637. https://doi.org/10.1001/jama.2008.804.
Williams, B., McVey, D., Davies, L., MacGregor, E. (2011).'The healthy foundations lifestage segmentation: Research report no.1: Creating the segmentation using a quantitative survey of the general population of England.', (1), pp. 1–312.