

Do Nudges Reduce Borrowing and Consumer Confusion in the Credit Card Market?^{*}

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Abstract

We study nudges that turn out to have precise null effects in reducing long-run credit card debt. We test nudges across two field experiments covering 183,441 UK cardholders. Our first experiment studies nudges added to monthly credit card statements. Our second experiment studies letters and email nudges (separate from monthly statements) sent to cardholders who signed up to automatically pay the minimum required payment. In a follow-up survey to our second experiment, we find 96% of respondents underestimate the time it would take to fully repay debt if the cardholder only made the minimum required payment. The nudges reduce this confusion, but underestimation remains overwhelmingly common.

JEL Codes: D04, D18, G51.

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Introduction

Credit cardholders that persistently carry high levels of debt are profitable for lenders (e.g. Agarwal et al. 2015, Grodzicki & Koulayev 2021, Sakaguchi et al. 2022). As a result credit card lenders do not have incentives to educate or nudge cardholders in ways that might lead the cardholders to lower their debt levels (Financial Conduct Authority 2015). This potentially motivates financial regulators to require lenders to provide information or directions to borrowers to educate or nudge them about the economic cost of credit card debt.

Our paper presents two field experiments (i.e., Randomized Controlled Trials, or RCTs) covering 183,441 UK consumers across three lenders testing the effects of ‘nudges’ (Sunstein & Thaler 2008) encouraging credit cardholders to pay more than the minimum required payment and reduce their long-run credit card debt. These were run by the UK financial regulator – the Financial Conduct Authority (FCA) – in collaboration with UK credit card lenders, to directly inform policymaking.

Our nudges in both experiments have three key behaviorally-informed features. First, we *graphically* show the (long) time it would take to repay the cardholder’s balance if the cardholder only paid the minimum required payments every month and illustrate the payment value necessary to pay off their balance in one, two, three years (all assuming no further spending). Second, we use valenced language that explicitly recommends that consumers pay their debt down faster than they would by paying the required minimum payment. Third, we tell cardholders how to (easily) enroll in automatic fixed payments that exceed the required minimum payment. These three features make our nudges more aggressive than the informational disclosures required of US credit card lenders under the 2009 CARD Act, which had little, if any, real effects (e.g. Agarwal et al. 2015, Keys & Wang 2019).

Our first experiment, ‘Statement Nudges’, tests the effects of nudges added to monthly credit card statements. Our second experiment, ‘Automatic Minimum Payment Nudges,’ tests nudges sent via standalone letters or emails, separate from monthly credit card statements, to those who enrolled to pay only the required minimum payment due each month via ‘Autopay’ (called ‘Direct Debit’ in the UK) - this standalone communication is also noticeably different from the CARD Act nudges that appeared on monthly statements. In both experiments we included treatments varying information about interest costs of borrowing. The second experiment also tested the effects of reminders.

Our nudges fail to reduce long-run credit card debt. Our first experiment finds precise null effects of statement nudges on debt and all other outcomes examined after six completed

statement cycles. Our second experiment across three lenders finds standalone nudges did not reduce credit card debt after nine completed statement cycles - except for one treatment with a reminder at one lender and that result is not robust across outcomes and not replicated at the other lenders. Some lender-treatment combinations had small impacts indicating only 1-2 in 100 cardholders responded to the nudges by changing Autopay enrollments and being slightly less likely to only pay exactly the minimum required payment in some cases. We conducted a short follow-up survey to our second experiment, which only had a 2.9% response rate, finding overwhelming consumer confusion among respondents. 96% of respondents in the control group substantially underestimated how long it would take to repay a cardholder's balance if they only paid the required minimum payment. Our nudges partially reduced this underestimate but did not change behavior.

Our precisely-estimated null results contribute to a growing literature studying consumer responsiveness to nudges on financial behavior. Our results are consistent with the lack of consumer responses to credit card informational nudges in the US (e.g. Agarwal et al. 2015, Keys & Wang 2019) and Mexico (Seira et al. 2017). The inability of informational nudges to change existing behavior is also found in much simpler financial decisions, such as cash savings (Adams et al. 2021), and in settings with higher financial stakes, such as mortgage refinancing (Keys et al. 2016). While such informational nudges initially appear attractive to regulators, ex-ante tests such as those studied here enable regulators to avoid implementing policies that impose costs on firms without achieving desired policy aims.¹

In a broader set of domains, a variety of recent studies (e.g. meta studies by Jachimowicz et al. 2019 and DellaVigna & Linos 2022) have shown that nudges frequently have small effects (with defaults providing the most common channel for large effects). Even small effects of nudges can still be net beneficial if they outweigh the relatively low cost of implementation - which is typically a one-time fixed cost with limited variable costs (Benartzi et al. 2017, DellaVigna & Linos 2022). However, there is a growing view that behaviorally-informed nudges are insufficient to achieve policy goals on their own (e.g. Campbell 2016, Loewenstein & Chater 2017, Laibson 2020). For example, Guttman-Kenney et al. (2022) shows in a field experiment on credit cardholders that even a more intrusive nudge using choice architecture that is highly effective at changing proximate choices (e.g. automatic payment enrollment) is unsuccessful at changing more distal, material, economic outcomes (such as debt) due to offsetting consumer responses.

The paper proceeds as follows. Section I explains the motivation and designs of the two

¹Such an approach is in line with the discussion in Soll et al. (2013) that, given uncertainty in what actually changes credit cardholder behavior, it is desirable to test a variety of potential approaches through field experiments before implementing new regulations.

experiments. Sections II and III explain the data and empirical methodology for analysing these. Section IV presents the results of the experiments. Section V reports survey evidence to understand the automatic minimum payment nudges results. Finally, section VI offers a brief concluding discussion.

I Motivation & Design of Experiments

Section I.I explains the motivation behind our two experiments and section I.II their designs.

I.I Motivation

Experiment 1: ‘Statement Nudges’

The 2009 CARD Act required US credit card lenders to provide information to borrowers on the front page of their monthly credit card statements.² The Act prescriptively requires ‘Payoff Nudges’ (Agarwal et al. 2015) displaying information in a table (‘Schumer Box’) comparing the projected interest costs of credit card borrowing if the cardholder only makes the minimum payment to the interest costs of borrowing if the cardholder repays the debt in three years. This also shows the monthly payment amount cardholders would need to make to achieve repay debt in three years. All these calculations assume no further spending on the card. These use neutral language regarding the two scenarios. Difference-in-difference studies (Agarwal et al. 2015, Keys & Wang 2019) have shown this ‘Payoff Nudges’ causes slight bunching at the three year scenario but overall generated little, if any, change in repayment behavior - with an upper bound of \$57-62 million per year (small given the size of the US credit card market) but their confidence intervals indicate there may have been no effect.

Soll et al. (2013) concludes that alternative designs may be more effective replacements for the existing CARD Act, and would benefit from testing a variety of treatments through field experiments – something not possible in the US without a change in legislation. Our UK context provides an environment to test alternative information on statements without such legal constraints.

There are no existing requirements for UK credit card lenders to display any statement disclosures or nudges similar to those required by the US CARD Act and lenders did not voluntarily do so. The UK financial regulator (the FCA) wanted to test whether nudges on statements that went beyond the ineffective CARD Act designs would be effective in a UK setting: providing motivation for experiment 1: ‘statement nudges’.

²Credit Card Accountability Responsibility and Disclosure (CARD) Act of 2009

Experiment 2: ‘Automatic Minimum Payment Nudges’

Experiment 2 ‘automatic minimum payment nudges’ tests the effectiveness of nudges directed at a sample of cardholders that were enrolled into automatic minimum payments (a type of ‘Autopay’ in the US or ‘Direct Debit’ in the UK). Automatic minimum payments automatically pay the cardholder’s credit card bill each month by attempting to take a payment directly from the cardholder’s bank (‘checking’ in the US or ‘current’ in the UK) account subject to it having sufficient funds available.

The automatic minimum payment option may appear to be an attractive option to cardholders as it ensures they are meeting their payment obligation, but paying no more than that. However, by automatically making minimum or fixed payments each month a cardholder may become inattentive and not actively engage with their credit card debt and the interest costs they are incurring (Ausubel 1991, Sakaguchi et al. 2022). Interest costs are much less salient than other costly events such as missing a payment which result in fees and alerts and frequently prompt changes in consumer behavior (Gathergood et al. 2020). Only 1% of the balance is (typically) paid down by the minimum payment each month.

Cardholders with automatic minimum payments were chosen for this study because it is common for households to stick with this arrangement over the long-run (Financial Conduct Authority 2016) and thereby incur high interest costs (Sakaguchi et al. 2022). Of all UK cardholders making nine or more minimum payments in a year, 75% had automatic minimum payments (Financial Conduct Authority 2016). 43% of total interest and fees across UK credit cards is held by those on automatic minimum payments (Sakaguchi et al. 2022). Such borrowing patterns are profitable for lenders who therefore do not have incentives to encourage cardholders to pay down their debt more quickly (Financial Conduct Authority 2015). These cardholders do not receive information on the implications of their repeated minimum payments and thus their payment choices could reflect a lack of awareness.³ A pattern of repeated minimum payments may reflect present biased preferences and various forms of self-defeating financial procrastination (Laibson 1997, Meier & Sprenger 2010, Heidhues & Kőszegi 2010, Kuchler & Pagel 2021). Such findings motivated the FCA to test nudges specifically targeted to this group.

³Cardholders are sent a communication after six consecutive minimum payments but there are no detailed requirements for what information this communication should detail. It does not have to (and in the examples we saw did not) show the implications of minimum payments, costs incurred, or provide any specific guidance to the cardholder. Given the patterns of persistent minimum payments observed in the market this status quo communication does not appear to be a salient event.

I.II Nudge Designs

Before putting the experiments into the field the research was subject to institutional reviews at both the FCA and the lenders involved. All lenders participated voluntarily. Our nudge designs were informed by qualitative consumer research as well as feedback from lenders and consumer organizations to ensure cardholders would understand their content and give them the best chance of being effective in the field.

The nudges in both experiments are similar. Figure 1 shows the two nudge treatments tested in Experiment 1 ‘statement nudges’ - these were applied to the front page of cardholders’ monthly credit card statements. The control group received their statements without this nudge. The two treatments in Experiment 2 ‘automatic minimum payment nudges’ are standalone communications: Figures 2 and 3. The control group received no standalone communication. Experiment 1 had one lender while Experiment 2 had three lenders. All experiments were conducted between 2016 and 2018.

Our first treatment ‘Time to Repay’ (Figure 1, Panel A for Experiment 1 and Figure 2 for Experiment 2) shows the duration of time to repay debt under different payment scenarios. The second treatment ‘Time + Cost to Repay’ (Figure 1, Panel B for Experiment 1 and 3 for Experiment 2) adds projected interest cost information to the scenarios as making the financial stakes salient could increase cardholders’ responsiveness.⁴

Common Design Features Across Experiments

Our nudges have three key features common across both experiments and treatments. First, the key salient feature is a large, colourful, personalized graphic designed to attract attention to prompt cardholders to actively engage with their credit card debt. The graphical format was designed to be more accessible and impactful than the CARD Act’s tabular format. Participants in our qualitative research described it as ‘shocking.’ The graphic shows how long it would take to repay their outstanding credit card debt under a range of repayment scenarios: the repayment duration if only the required minimum payment is made; in addition, cardholders were shown payment amounts required to pay off their debt in one, two, and three years respectively. Multiple, short amortization scenarios were included to counter the unintended effect of the CARD Act’s single three-year repayment scenario leading some cardholders to reduce their payments to this amount - possibly due to cardholders interpreting the single scenario as a recommendation (Agarwal et al. 2015, Hershfield & Roesel 2015, Keys & Wang 2019). We do not display the minimum payment amount in pounds to prevent consumers anchoring to this value (Stewart 2009, Sakaguchi

⁴Raynard & Craig (1993) finds adding cost information can help consumers estimate loan durations. Relatedly, Chetty et al. (2009) shows that increasing the salience of taxes results in larger behavioral responses.

et al. 2022, Guttman-Kenney et al. 2018) or being confused about the magnitude of their required minimum payment currently due (e.g., if they read our nudges after receiving a subsequent statement).

Second, we use valenced language recommending that cardholders “clear you balance faster,” or identify “a quicker way to repay your balance,” or “set your goal to repay your credit card years faster.” This contrasts with the CARD Act’s neutral ‘informational’ language.

Third, we highlight an easy mechanism for cardholders to pay down their credit card debt. The mechanism is enrolling in ‘automatic fixed payment’ - which some consumers may not have been aware of.⁵ Automatic fixed payments automatically take the maximum of a fixed amount of the cardholder’s choosing (at the time of enrollment but this can be changed over time) and the minimum required payment. This automatic fixed payment option is especially straightforward for cardholders in Experiment 2 to switch to as they are already enrolled in Autopay and so have already input the required bank details and are familiar with how the Autopay process works.

Debt can be amortized far more quickly by using (sufficiently high) automatic fixed payments rather than automatic minimum payments. This is because while the minimum payment due typically declines with balances, a fixed payment stays the same. For example, a typical credit card balance of £1,000 would take 18 years and 6 months to pay off if only the minimum was paid each month (which would start around £25 and then decline to £5). However, by fixing the payment to £25 each month the repayment horizon would shrink to 5 years and 1 month, saving over £750 in (undiscounted) interest costs.

Design Differences Across Experiments

There are three differences across the two experiments. First, the samples are different. Experiment 1 excludes cardholders enrolled in any type of Autopay as we believed these to be the least likely to read statements; Experiment 2 targeted this group. After applying this and other basic exclusion criteria (see footnote for details) 29,683 cardholders were included in Experiment 1.⁶ Experiment 2 included 153,758 credit cards enrolled in automatic required minimum payments, which had been open for at least six months and had not recently recorded a debt repayment in full (see footnote for details of exclusions).⁷

⁵Additional details of the practical steps for how to change automatic payments were provided on the letters and with links in the emails - these were redacted from Figures 1, 2 and 3 to preserve lender confidentiality.

⁶Before randomization we excluded cards in arrears, forbearance, dormant, open for less than six months, enrolled in automatic payments, having repaid balance in full in the last three statement cycles or with balances below £50. Exclusion criteria for cards which were closed, entered arrears or become dormant were reapplied after randomization and before treatment.

⁷Before randomization we excluded cards in arrears, forbearance, dormant, open for less than six months,

Second, the personalization is different. Experiment 2 calculated scenarios personalized to each cardholder’s balance and card features. Lender’s infrastructure constraints necessitated that Experiment 1 used scenarios based on balances closest to a cardholder’s actual credit card balance rather than scenarios personalized to each cardholder’s precise balance and card features.

And finally, the frequency and mode of communication differed. Experiment 1 displayed the nudges on the front page of cardholders’ statements for six statement cycles (a credit card statement cycle is completed after the payment due date has passed - several weeks after the statement balance and payment due amount has been issued). Experiment 2 nudges were standalone communications for all three lenders. With Lenders 1 and 2 cardholders received the nudges via letters. With Lender 3 communications were sent via emails without any reminders. To increase readability on mobile devices the time to repay graphics for these emails are vertical rather than horizontal. It is useful to examine the effect of emails, as they are less costly than letters, which require postage and printing. If emails achieve similar effect sizes to letters, emails would be a far more cost effective policy.

In Experiment 2, with Lenders 1 and 2 we also tested the effectiveness of sending an extra reminder letter by randomizing treatment groups into reminder (‘Reminder: Time to Pay’ and ‘Reminder: Time + Cost to Repay’) and no-reminder sub-samples. We kept the design of the reminders consistent with the original communications (i.e., if you were in the ‘Reminder: Time to Repay’ treatment you received ‘Time to Repay’ in the first communication) but adjusted the drafting to refer to the earlier communication sent and re-calculated personalized scenarios using more recent statement balances. Reminders may be useful if cardholders want to take action after the first communication, do not get around to it, and find that the reminder prompts them to later do so.

II Data

We analyze our experiments using administrative data on credit card accounts merged with cardholders’ credit files gathered using the FCA’s statutory powers. Credit card data includes details from each card’s origination (e.g. opening dates, initial credit limits) and each monthly statement (e.g. statement balances, interest costs, automatic payment enrollment) including up to eleven pre-experimental statements and at least six and nine statements after Experiments 1 and 2 respectively started. We observe every payment made against these

not enrolled in automatic minimum payments, having repaid balance in full in the last three statement cycles or with balances below £50. Exclusion criteria for cards which were closed, entered arrears or became dormant were reapplied after randomization and before treatment.

statements including the date, amount and whether it was made via automatic or manual channels.

Credit files from a UK credit reference agency (CRA) enable us to monitor the effects of the experiments on the portfolio of credit cards held. This is important as it is common to have multiple credit cards with different providers; effects on one card might be offset by changing behaviors on other cards (Ponce et al. 2017, Gathergood et al. 2019*a,b*). Credit files contain monthly data at the credit product level showing balances, payments, credit limits and delinquency status. We also observe flags for whether a cardholder paid exactly the minimum payment. For two points in time – the month before the trial started and nine months afterwards – we observe credit risk scores and income estimates produced by the CRA (where available).

Our data shows average credit card balances are similar across Experiment 1 and Experiment 2’s Lenders 1 and 2 at around £3,500 before repayments but were higher for Experiment 2’s Lender 3 at £4,400 (See Online Appendix Table A1 for summary statistics). Across all three lenders in Experiment 2, just over three-quarters of cardholders paid only the required minimum in the month preceding the trial’s start. Across the three lenders 31%, 35% and 54% of cardholders paid only the required minimum for the entire twelve month period leading up to the start of the trial. The average number of required minimum payments in the last twelve months is high across the lenders: 8.2, 8.9 and 10.3. Accordingly, a minority of cardholders repaid their credit card statement in full in any cycle during the last twelve months: respectively, 34%, 26% and 17%.

We also designed a short, follow-up survey for Experiment 2 after analyzing results to help interpret our findings. We describe the survey along with its results in section VI.

III Empirical Methodology

Both experiments use an RCT design enabling us to identify the causal effects of the treatments. Our RCT methodology complements the difference-in-difference methodologies used in prior studies of the US CARD Act (e.g. Agarwal et al. 2015, Keys & Wang 2019).

We pre-registered our experiments at the FCA before analyzing data. Our pre-registration outlined the structure for analysis including the outcomes, regression specifications, and thresholds to judge statistical significance.⁸ These were identical for both experiments except the long-term effects of Experiment 1 were evaluated after six statement cycles (the ‘duration-of-time’ nudges were applied to statements for six cycles) whereas, for Experiment

⁸This pre-registration jointly covered the field experiments in Guttman-Kenney et al. (2022).

2, outcomes were evaluated after nine statement cycles (the last observation across all three lenders). We examined interim data after pre-registration but before nine statements were completed to inform potential policymaking.

We structured our analysis in three parts: primary, secondary and tertiary. This structure limits false positives due to multiple testing (Simmons et al. 2011). Primary analysis is designed to evaluate the effects of the experiments. Secondary analysis checks the robustness of the primary results and helps us develop hypotheses about mechanisms. Finally, tertiary analysis was designed after examining the data, including in response to feedback from presentations and reviewers, and is not how the experiment's effectiveness was evaluated.

The primary analysis highlights ten economic outcomes. The first six outcomes analyze only the card selected for the intervention/control: (1) paying exactly the minimum payment due; (2) paying the full balance due; (3) missing a payment (i.e., paying nothing or an amount less than the minimum due); (4) statement balance net of payments as a percent of statement balance (hence, normalized to create a variable bounded between 0 and 1); (5) borrowing costs (the sum of interest and fees) expressed as a percent of statement balance; and (6) new spending transactions (a measure of consumption) expressed as a percent of statement balance. The fourth measure is our preferred measure of credit card debt. The remaining four outcomes are based on the cardholders' full portfolio of credit cards observed in credit files: (7) the proportion of minimum payments; (8) the proportion of full payments; (9) the proportion of missed payments; and, (10) aggregated statement balances net of payments as a percent of aggregated statement balances. These ten outcomes were chosen following discussions with policymakers on which measures would be informative for regulation and which we could observe in data. We analyze Autopay enrollments as outcomes in secondary analysis - as Autopay choices are sticky over time, changes in these act as a proxy for cardholder attention to the nudge.

We construct an unbalanced panel with one observation for each cardholder (i) for each statement cycle (t) observed. This panel is unbalanced as some cards are closed during the trial. Our primary analysis is conducted separately lender-by-lender. We gain more precise estimates of the average treatment effects (ATEs) through the OLS regression specified in Equation 1. We also compare unconditional means of outcomes between control and treatment groups.

$$Y_{i,t} = \alpha + \sum_{k=1}^K \sum_{\tau=1}^T \delta_{k,\tau} (TREATMENT_{k,i} \times CYCLE_{\tau}) + X_i' \beta + \gamma_t + \varepsilon_{i,t} \quad (1)$$

Equation 1 includes a constant (α) and a vector of control variables (X_i') using information on the cardholder before the experiments began. The following time-invariant controls

were constructed for each card using data from the month preceding the experiment's start: Gender, Age, Age squared, Log Estimated Income, Credit Score, Unsecured Debt-to-Income (DTI) Ratio, Any Mortgage Debt, Log Credit Card Credit Limit, Credit Card Purchases Rate, Subprime Credit Card, Any Credit Card Promotional Rate, Any Credit Card Balance Transfer, Credit Card Open Date, Credit Card Statement Day, Any Credit Card Secondary Cardholder, and up to 11 lags of outcomes preceding the start of the trial. Fixed effects for the statement cycles (γ_t) are included in Equation 1.

$TREATMENT_{k,i}$ is a dummy for each treatment ($k \in \{1, K\}$) conducted with each lender. The treatments are: 'Time to Repay' and 'Time + Cost to Repay', with the control group being the omitted category. When analyzing the effect of the reminders for Lenders 1 and 2 we focus on post-reminder statement cycles with treatment groups: 'Time to Repay', 'Time + Cost to Repay', 'Reminder: Time to Repay', and 'Reminder: Time + Cost to Repay', with the control group being the omitted category. $CYCLE'_\tau$ is a vector of dummies for each statement cycle ($\tau \in \{1, \dots, T\}$).

Our parameter of interest is $\delta_{k,\tau}$. This shows the average treatment effect in percentage points of treatment k at τ statement cycles since the start of the experiment. We hypothesized that treatment effects will vary over time and we do not impose a functional form. Standard errors are clustered at the cardholder-level.

For Lender 3 in Experiment 2 there were some technical issues that delayed the start of the study. This resulted in the exclusion criteria being re-applied several months after randomisation and also excluding consumers who would be expected to repay their debt in less than three years. As a result not all consumers in the treatment groups received the nudge: 73.82% did. 100% of consumers in the control group did not receive the email (as originally intended). We account for this by modifying Equation 1 using an instrumental variables approach whereby assignment to a particular treatment group is an instrument for whether an individual actually received that treatment email. The main implication of this is that our estimates are less precisely estimated for this lender.

In line with Benjamin et al. (2018), we regard in our pre-registered analysis a p-value of 0.005 as the threshold for statistical significance but also highlight where results are 'suggestively significant' at the more traditional 0.05 and 0.01 levels. This 0.005 p-value reduces false positive rates and aligns hypothesis testing with Bayes factors of 14+ considered to be substantial evidence for a hypothesis. This approach is analogous to applying a Bonferroni or familywise error correction when testing multiple hypotheses at the traditional 0.05 significance level.

Allocation to treatment groups was generally balanced across covariates between control and treatment groups across both experiments (Online Appendix Table A2). We include

pre-registered controls in our regressions to recover balance and improve precision of our estimates. Regression results with controls are consistent with results comparing unconditional means.

IV Results

For brevity, we focus on the results of our pre-registered primary outcomes in this paper. Some secondary and tertiary analysis is also included; a complete report of our analyses can be found in our earlier working paper (Adams et al. 2018) and this paper’s Online Appendix.

IV.I Experiment 1: ‘Statement Nudges’ - Long-Term Effects

Both ‘statement nudges’ treatments tested in Experiment 1 have precise zero, long-run effects across our ten primary outcomes as evaluated after six completed statement cycles. These results are shown in Table 1 (Online Appendix Table A7 shows consistent results using t-tests from unconditional means). Such null results are consistent with the economically small effects of the CARD Act statement disclosures (Agarwal et al. 2015, Keys & Wang 2019).

We found no effects of the intervention changing the likelihood of paying off debt in full, making exact minimum payments, missing payments, costs of borrowing, new spending on cards, and credit card statement balance net of payments (i.e. long-run credit card debt). We found no effects on our primary outcomes measured in credit file data. Our tests were well-powered such that we can be confident that either there was no effect of either treatment or any effects are so small that they would not be economically meaningful. As our results were unambiguous we did not pursue more detailed analysis of this experiment except for a couple of simple robustness checks which also found precise zero effects (Online Appendix Table A6).

IV.II Experiment 2: ‘Automatic Minimum Payment Nudges’ - Effects On Autopay Enrollment

We examine the initial effects of Experiment 2 ‘automatic minimum payment nudges’ on automatic payment enrollment – a secondary outcome that acts as a proxy for cardholder attention to the treatment. We show initial effects from the second statement post-nudge because operational lags can mean a requested change mid-statement-cycle may not take effect until the following statement. Most requested changes occur in the first few days after the nudge was sent.

We find clear effects that are of similar magnitudes across the ‘Time to Repay’ and ‘Time + Cost to Repay’ treatments and precisely replicated across all three lenders. The treatment initially reduces automatic minimum payment enrollment by 0.9 to 2.0 percentage points two statement cycles after the nudges were sent. Automatic fixed payment enrollment increases by 1.1 to 1.6 percentage points. The cost information added in the ‘Time + Cost to Repay’ treatment has no additional effect. There is no discernible difference in estimates from Lenders 1 and 2 who sent letters compared to Lender 3 who sent emails (see Online Appendix Figure B1) and results remain similar after nine completed statement cycles (Online Appendix Table A9).

How should the sizes of such effects be interpreted? The effects may appear ‘small’ since the treatments are causing 1 to 2 in a 100 cardholders to change their automatic minimum payment enrollment. However, it is important to note that this is a group of inertial consumers; between 1% and 6% of cardholders switch to automatic fixed payments in our control group. In relative terms, the impact of the interventions appear large, though this may be misleading given the small base on which these percent changes are calculated: on average the intervention caused increased take up of automatic fixed payments by around 61-67% at Lender 1, 171-186% at Lender 2 and 19-26% at Lender 3 relative to each of their respective control groups.⁹ These results are somewhat encouraging when set against the low marginal costs of sending the nudges – particularly if they are sent via emails rather than letters.

IV.III Experiment 2 Results - Long-term Effects

We now examine the long-run effects of Experiment 2 ‘automatic minimum payment nudges’ on our primary outcomes. Figure 4 presents the estimated effects on our primary outcomes. Long-term effects are estimated after nine completed statement cycles. The Online Appendix reports regression estimates in Table A3, as well as robustness checks using other outcome measures (Table A9) and t-tests of unconditional means (Table A8).

We start by considering the long-term treatment effect on the likelihood of only paying the minimum. Figure 4, Panel 1 shows that these treatment effects are mixed - with either null or small effects across lender-treatment combinations. The ‘Time to Repay’ treatment appears somewhat effective for Lender 1 ($\delta_{k,9}$ estimate: -0.0144 with 95% C.I.: -0.0251, -0.0037) and Lender 3 ($\delta_{k,9}$ estimate: -0.0246 with 95% C.I.: -0.0420, -0.0071); these results are not significant at our pre-registered 0.5% threshold but are significant at the 1%

⁹In the control groups for Lenders 1, 2 and 3 respectively, 1.8%, 0.7% & 6.2% of consumers switch from automatic minimum payments to automatic fixed payments from the time of randomization to the second statement cycle post-treatment.

threshold. Estimates at Lender 2 are smaller ($\delta_{k,9}$ estimate: -0.080 with 95% C.I.: -0.0188, 0.0028) and insignificant at a 5% threshold. Across all three lenders the ‘Time + Cost to Repay’ treatment is never significantly different from the control group using a 5% threshold. Sending reminder nudges appears to help to reduce the number of cardholders only making minimum payments at Lender 2 ($\delta_{k,9}$ estimate: -0.0282 with 95% C.I.: -0.0391, -0.0173) but does not significantly do so at Lender 1 (Figure 4, Panel A) using a 5% threshold. Examining effects across the portfolio of credit cards observed in credit files (Figure 4, Panel 7) produces noisier estimates. The coefficients, which represent the causal effect on the share of cards only paying the minimum, are generally negative but small in magnitude; half of the coefficients are statistically significant using a 5% threshold.

Neither ‘Time to Repay’ or ‘Time + Cost to Repay’ treatments without reminders have statistically significant effects (5% threshold) on our other eight primary outcomes across three lenders (Figure 4). We find precisely estimated, zero effects on changing the likelihood of paying off debt in full, making minimum payments, missing payments, costs of borrowing, transactions on cards, and credit card statement balance net of payments (i.e. long-run credit card debt). These results are robust to alternative secondary outcomes measures. For Lender 2, ‘Time + Cost to Repay’ treatment we found an effect significant at the 5% not the 0.5% significance level on credit card statement balance net of payments ($\delta_{k,9}$ estimate: -0.0145 with 95% C.I.: -0.0274, -0.0016). However, this result was not robust - it was insignificant when an alternative secondary outcome measure of credit card debt was used (statement balance net of payments in £, shown in Online Appendix Figure B2 and Table A9) and effects also did not show up in other outcomes such as the portfolio of credit card debt in credit file data.

The earlier working paper version (Adams et al. 2018) contains tertiary heterogeneity analysis. This did not find clear patterns by covariates beyond suggestive evidence that the disclosures potentially affect cardholders with balance transfer credit card debt.¹⁰

There is limited evidence that one treatment with a reminder may have some real, long-lasting effects. At Lender 2 the ‘Reminder: Time to Repay’ treatment does significantly reduce our primary measure of credit card debt by 1.6% ($\delta_{k,9}$ estimate: -0.0126 with 95% C.I.: -0.0212, -0.0039) and increase the likelihood of repaying debt in full by 6.9% ($\delta_{k,9}$ estimate: 0.0113 with 95% C.I.: 0.0024, 0.0201 significant at 5% not the 0.5% level). However, we caveat these results as these findings were not replicated for this treatment at Lender 1. Furthermore, even for Lender 2 this result on debt was not robust - it was insignificant when an alternative secondary outcome measure of credit card debt (in £) was used and also did not show up in any other outcomes such as the costs of borrowing or the portfolio of credit

¹⁰See Online Appendix Tables A4 and A5.

card debt in credit file data.

Having observed these results we decided to conduct tertiary analysis pooling observations across Lender 1 and Lender 2 to increase the precision of our estimates. We estimate this using Equation 1 but adding in a lender fixed effect (see footnote for specification).¹¹ We did not pool Lender 3 given an IV rather than OLS method is used for estimating effects, the communications were sent via emails rather than letters, and their portfolio of cards were noticeably different compared to the other two lenders (Table 1).

This pooled analysis of Lender 1 and Lender 2 reveals how both the treatments reduced debt (statement balances net of repayments) during the early statement cycles (Figure 5, Panel A). The reduction peaked at £36.88 for ‘Time to Repay’ treatment and £59.45 for ‘Time + Cost to Repay’ treatment after four statement cycles. This temporary debt reduction equated to a reduction of 1.2% and 2.0% relative to the average debt in the control group.

Such a debt reduction was temporary. Why? A small proportion of people (under 0.5%) react to the nudges by making a manual payments during the first two statement cycles. Such manual payments are a one-off reaction and are not sustained over time: Figure 5, Panel B shows that the cumulative value of manual payments plateaus. We interpret this as the nudges bringing forward the timing of manual payments rather than increasing the cumulative amount of manual payments.

V Survey Evidence

Given the results of our nudge experiment we designed a survey, explained in section V.I, to test consumer understanding of minimum payments (V.II) and test the treatment effects of the nudges at improving understanding of minimum payments (V.III).

V.I Survey Design

After conducting primary analysis of Experiment 2, we designed a survey as tertiary analysis to help interpret our results. The survey was sent via email from Lender 2 to cardholders who had participated in this field experiment. Participation was incentivized through a prize draw and the invitation described the aim of seeking to understand the experiences of credit card users and the research involvement of the lender and the FCA. The email included the

¹¹We estimate: $Y_{i,t} = \alpha + \sum_{k=1}^K \sum_{\tau=1}^T \delta_{k,\tau} (TREATMENT_{k,i} \times CYCLE'_{\tau}) + X_i' \beta + \gamma_f + \gamma_t + \gamma_m + \varepsilon_{i,t}$. This pools data from Lender 1 and Lender 2 where γ_f and γ_m are lender and year-month fixed effects respectively.

subject line ‘Win £500! Help make credit cards better’.¹² We ran a small pilot to refine the survey format and do not use those responses for analysis. The full survey questionnaire can be found in Online Appendix (‘C: Survey Questionnaire’) with summary statistics shown in Online Appendix Table A10 (further discussion of this descriptive evidence can be found in Adams et al. 2018). This survey was conducted over a year after Experiment 2 began and achieved 1,713 responses which is a 2.9% response rate. This very low response rate raises substantial concerns about selection bias.

V.II Testing Consumer Understanding of Minimum Payments

We test cardholder’s expectations about minimum payments by presenting a hypothetical scenario based on a typical UK credit card statement balance (£1,029.90) and interest rate (18.9%) and asked respondents how long they expected it to take to pay off the debt entirely if only the required minimum payment is made each month and the card is not used for additional purchases (question in footnote).¹³ Respondents had a free text box to input their answer (in years and months) so as to not to steer them towards a particular response (Schwarz et al. 1985). The correct answer is 18 years and 9 months. This is a hard question and we do not expect respondents to get this precise number. Instead we are more interested in the distribution of responses – does it appear that many consumers’ expectations are broadly in the right ballpark. For example, do they expect it to take a few (1-3) years or 10+ years?

We find that cardholders are confused about the implications of credit card minimum payments. Among those who did not receive our nudges (the control group), 95.9% of respondents underestimate how long only paying the minimum would take to clear debt with 37.9% expecting full debt repayment within three years, 65.4% within 5 years, and 87.0% within 10 years (see Table 2). Our results are consistent with research findings on financial literacy reported by (Stango & Zinman 2009), Soll et al. (2013) Lusardi & Tufano (2015), and Seira et al. (2017).

Responding to the survey likely reflects selection on unobservable characteristics. We expect respondents, on average, to be more financially sophisticated and conscientious, and, if so, such selection means that we are finding widespread, material confusion even among a

¹²The prize draw offered two £500 Amazon gift vouchers and fifteen £100 Amazon gift vouchers. Due to UK marketing research regulations entry into this prize draw was not conditional on completing the survey.

¹³Imagine a credit card statement balance of £1,029.90 with an interest rate of 18.9%. If someone only repays the minimum each month and spends no more on the card approximately how long would you expect it to take them to repay? It doesn’t matter whether the answer you give is right or wrong. We just want to find out what people understand and the question after this one lets you indicate how confident you are in your answer.

subgroup one would expect to answer such questions relatively accurately.

The underestimates that we find are large and respondents report low confidence in their estimates: on average 4 out of 10 (where 1 is lowest confidence and 10 is highest confidence). Such a lack of confidence indicates how many consumers lack deep knowledge about the financial products they use (Lusardi & Mitchell 2014) and the challenges of overcoming this (Willis 2009). An earlier UK survey (Which? 2015) of consumers self-reporting to make minimum payments on credit cards found widespread confusion over what credit card minimum payments are: 48% regard the required minimum payment as a recommendation from their credit card provider, and 50% believe most people repay only the required minimum payment - whereas a quarter actually do (Financial Conduct Authority 2016).¹⁴

V.III Treatment Effects of Nudges on Understanding of Minimum Payments

In other domains, providing information has been effective at correcting biased beliefs and changing real behavior.¹⁵ A potential explanation for the lack of real effects of automatic minimum payment nudges is that consumers do not understand or remember the treatment. We test this hypothesis by splitting responses to our hypothetical question by control and treatment (pooling all treatments to increase power).¹⁶

We find statistically significant (5% threshold) effects of the treatment at reducing the average bias in the estimated time it would take to repay credit card debt. Figure 6 shows the CDF of responses for control compared to treatment and t-tests are displayed in Table 2. While 92.57% of the treatment group underestimate the amortization time (18 years, 9 months) it is a significant reduction from the 95.88% of the control group who underestimate the amortization time. The mean estimated duration is lower by 14 months in the treatment group (70.6 vs. 84.5 months), a 20% difference. Median changes are similar: lower by 13 months in the treatment group (47 vs. 60 months), a 28% difference. The treatment does not cause any statistically significant differences (p-value 0.3519) in confidence of respondents' answers with both control and treatment having mean and medians of 4 out of 10.

¹⁴More recent U.S. experimental research provides further evidence of cardholder confusion related to minimum payments (Hirshman & Sussman 2021).

¹⁵For examples, Jensen (2010) finds providing information on returns to schooling increase the amount of education received, Dupas (2011) finds providing information on HIV infection risk reduces teenage pregnancy and changes reported sexual behavior, Bursztyn et al. (2020) finds norms misperceived by Saudi Arabian husbands reduce female labor force participation and, of most relevance to our study, Bertrand & Morse (2011) shows providing information on payday loan borrowing costs reduces borrowing.

¹⁶Survey response rates are similar across treatments - an F-test finds survey response rates to be insignificantly different comparing the control and treatment groups (F-stat 0.2109, p-value 0.8098).

The treatment letters were sent over a year before the survey and thus these are long-run effects. There are no statistically significant difference between the treatments groups with and without reminders.¹⁷ We interpret these results to imply that consumers understand and remember our nudges but the resulting educational effects are insufficiently powerful to prompt changes in borrowing behavior.¹⁸

VI Concluding Discussion

Our experiments provide additional evidence that financial market regulators cannot rely on informational nudges to change consumer behavior (Campbell et al. 2011, Campbell 2016). We contribute to a growing literature documenting highly inelastic responses to disclosures and advice regarding the use of financial products. Our results are broadly consistent with the previously documented ineffectiveness of providing credit card information in the US (e.g. Agarwal et al. 2015, Keys & Wang 2019) and Mexico (Seira et al. 2017). The inability of information to change existing behavior is also found in much simpler financial decisions such as cash savings (Adams et al. 2021) and domains with substantially larger financial stakes such as mortgage refinancing (Keys et al. 2016). The effectiveness of payday lending disclosures (Bertrand & Morse 2011, Wang & Burke 2021) appears to be an exception – possibly explained by the disclosures being applied in-store at the point of credit application. Heterogeneous effectiveness of nudges and disclosures across consumers are important considerations for regulators. For example, Kulkarni et al. (2020) finds Chilean loan disclosures only reduce delinquencies for sophisticated borrowers, whereas, product standardization benefits unsophisticated borrowers, while Mrkva et al. (2021) finds effects of nudges vary by socioeconomic status.

Our second experiment shows few automatic minimum payment cardholders respond to our informational nudge and simultaneous call to action: almost all recipients of the intervention remain enrolled in the automatic minimum payment program. How else might regulators reduce cycles of repeat minimum payments? When designing this experiment we considered sending nudges via email with a one-click button to reduce frictions for changing automatic payments – results from another trial found this increases response rates (Financial Conduct Authority 2016) – but decided against such an approach due to its similarity to a phishing scam. Safer technology has since developed with push notifications on mobile apps. Such push notifications' have the potential to reduce action costs and thereby enable

¹⁷P-values [95% C.I.] are: 0.5890 [-7.74,13.63], 0.7371 [-0.05,0.06], 0.8443 [-0.06,0.05], 0.4911 [-0.02,0.04] respectively for expected months, expected < 3 years, expected < 5 years, expected < actual.

¹⁸See the online appendix for additional heterogeneity analysis of the survey results.

consumers to re-optimize almost effortlessly.

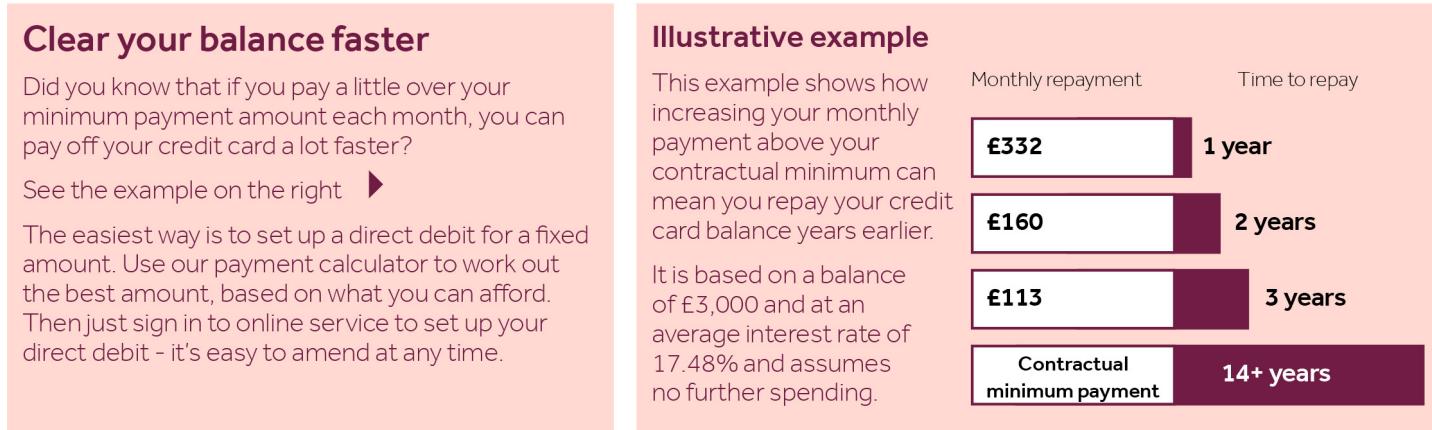
An alternative, more intrusive, nudge would use choice architecture to make it difficult to sign up for automatic minimum payments, paternalistically driving cardholders to use automatic fixed payments or automatic full payments. Guttman-Kenney et al. (2022) shows in a UK field experiment that even though such an intervention is highly effective at changing proximate choices (e.g. the intervention produces a sharp drop in automatic minimum payments enrollment) it proved unsuccessful at changing more distal, real, economic outcomes (e.g. credit card debt) due to offsetting consumer responses.

Most important human behavior is hard to substantially change, especially with light-touch nudges (e.g. DellaVigna & Linos 2022). There is a growing realization that nudges are unlikely to achieve large-scale behavior change (e.g. Campbell 2016, Loewenstein & Chater 2017, Laibson 2020), even though nudges remain one of the most cost effective tools that we have to move many types of behavior on the margin.

A Figures & Tables

Figure 1: Experiment 2 ‘statement nudges’: Design of (A) ‘Time to Repay’ and (B) ‘Time + Cost to Repay’ treatments

(A) ‘Time to Repay’



(B) ‘Time + Cost to Repay’

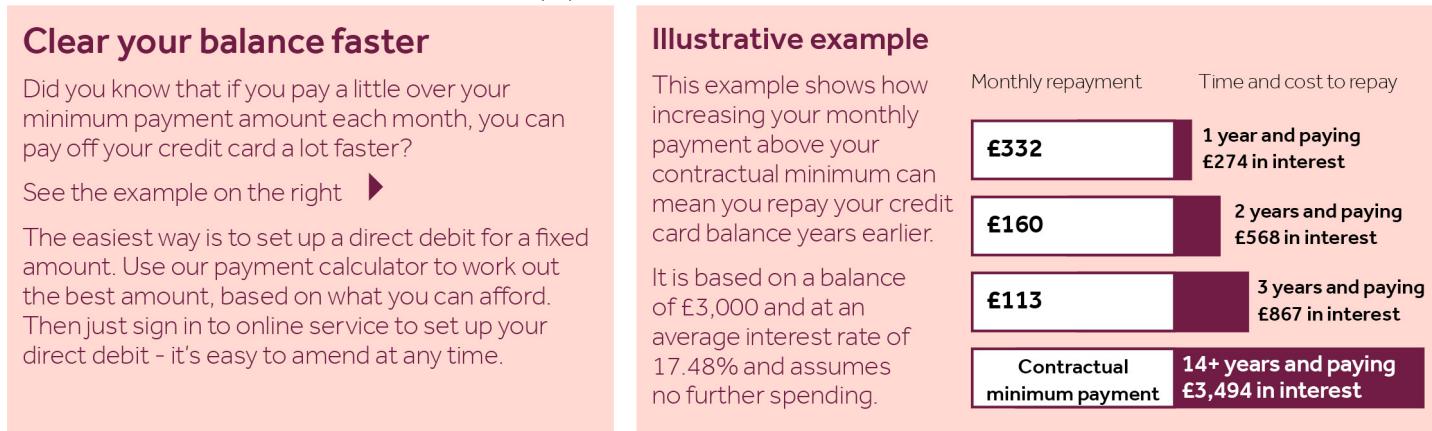


Figure 2: Experiment 2 ‘automatic minimum payment nudges’: Design of ‘Time to Repay’ treatments across lenders

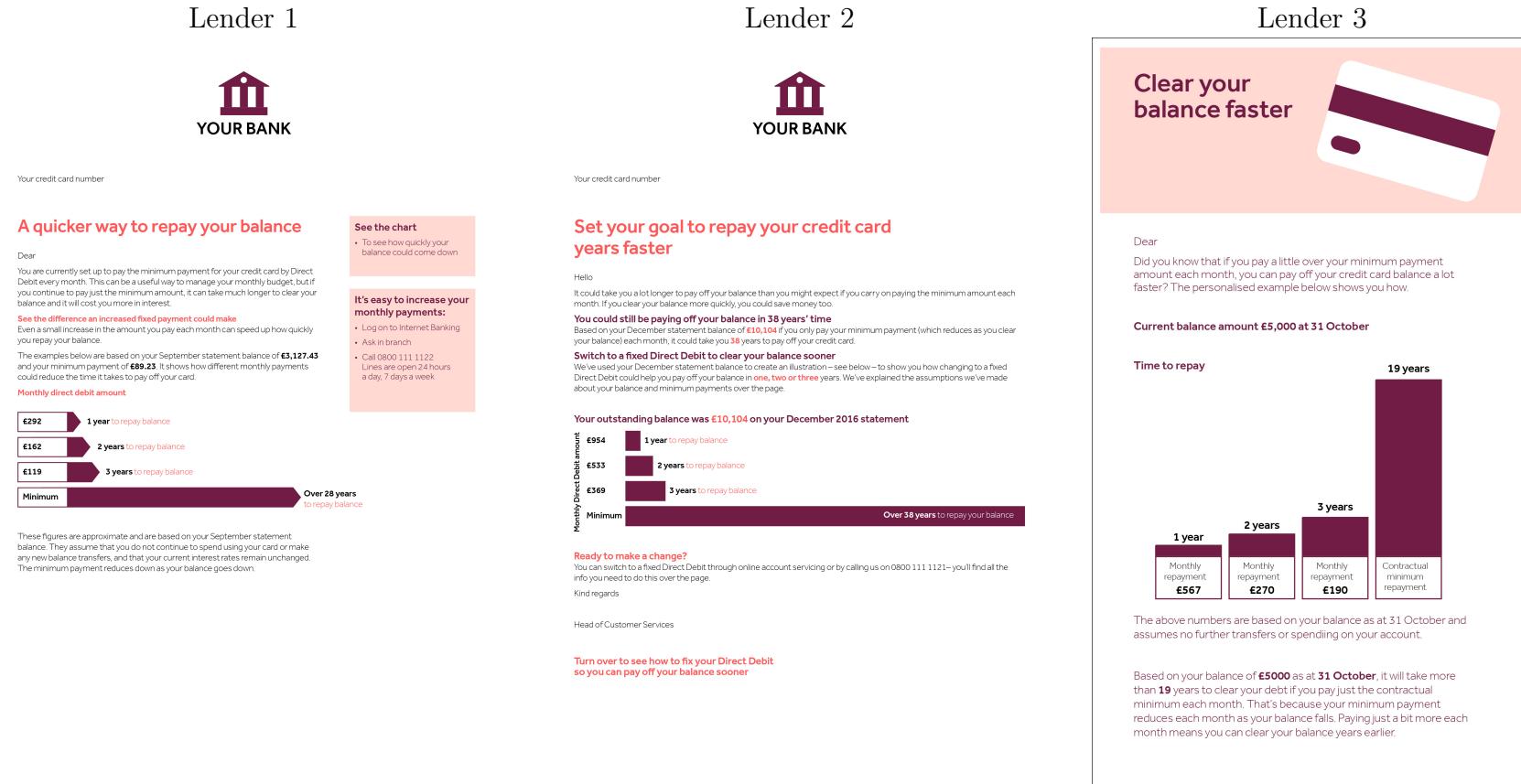


Figure 3: Experiment 2 ‘automatic minimum payment nudges’: Design of ‘Time + Cost to Repay’ treatments across lenders

22

Lender 1



Your credit card number

A quicker way to repay your balance

Dear

You are currently set up to pay the minimum payment for your credit card by Direct Debit every month. This can be a useful way to manage your monthly budget, but if you continue to pay just the minimum amount, it can take much longer to clear your balance and it will cost you more in interest.

See the difference an increased fixed payment could make

Even a small increase in the amount you pay each month can speed up how quickly you repay your balance.

The examples below are based on your September statement balance of **€3,127.43** and your minimum payment of **€69.23**. It shows how different monthly payments could reduce the time it takes to pay off your card.

Monthly direct debit amount



These figures are approximate and are based on your September statement balance. They assume that you do not continue to spend using your card or make any new balance transfers, and that your current interest rates remain unchanged. The minimum payment reduces down as your balance goes down.

See the chart

- To see how much you could save

It's easy to increase your monthly payments:

- Log on to Internet Banking
- Ask in branch
- Call 0800 111 1122. Lines are open 24 hours a day, 7 days a week

Lender 2



Your credit card number

Set your goal to repay your credit card years faster

Hello

It could take you a lot longer to pay off your balance than you might expect if you carry on paying the minimum amount each month. If you clear your balance more quickly, you could save money too.

You could still be paying off your balance in 38 years' time

Based on your December statement balance of **€10,104** if you only pay your minimum payment (which reduces as you clear your balance) each month, it could take you **38** years to pay off your credit card and you'll pay **€19,830** in interest costs.

Switch to a fixed Direct Debit to clear your balance sooner

We've used your December statement balance to create an illustration—see below—to show you how changing to a fixed Direct Debit could help you pay off your balance in **one, two or three** years. We've explained the assumptions we've made about your balance and minimum payments over the page.

Your outstanding balance was **€10,104** on your December 2016 statement



Ready to make a change?

You can switch to a fixed Direct Debit through online account servicing or by calling us on 0800 111 1121 – you'll find all the info you need to do this over the page.

Kind regards

Head of Customer Services

Turn over to see how to fix your Direct Debit so you can pay off your balance sooner

Lender 3

Clear your balance faster

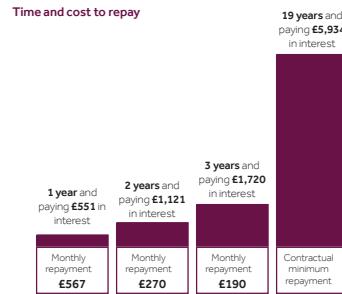


Dear

Did you know that if you pay a little over your minimum payment amount each month, you can pay off your credit card balance a lot faster? The personalised example below shows you how.

Current balance amount €5,000 at 31 October

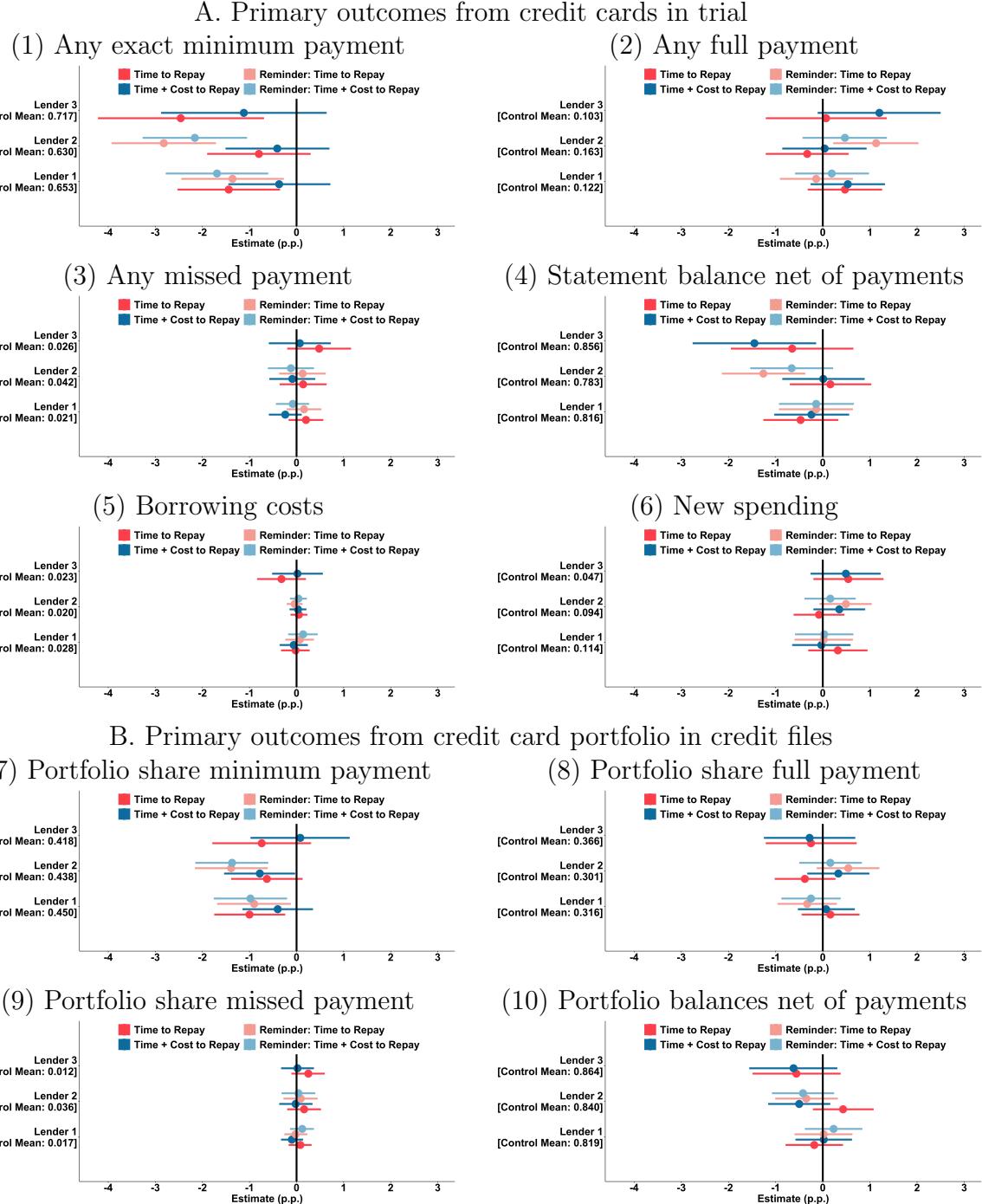
Time and cost to repay



The above numbers are based on your balance as at 31 October and assumes no further transfers or spending on your account.

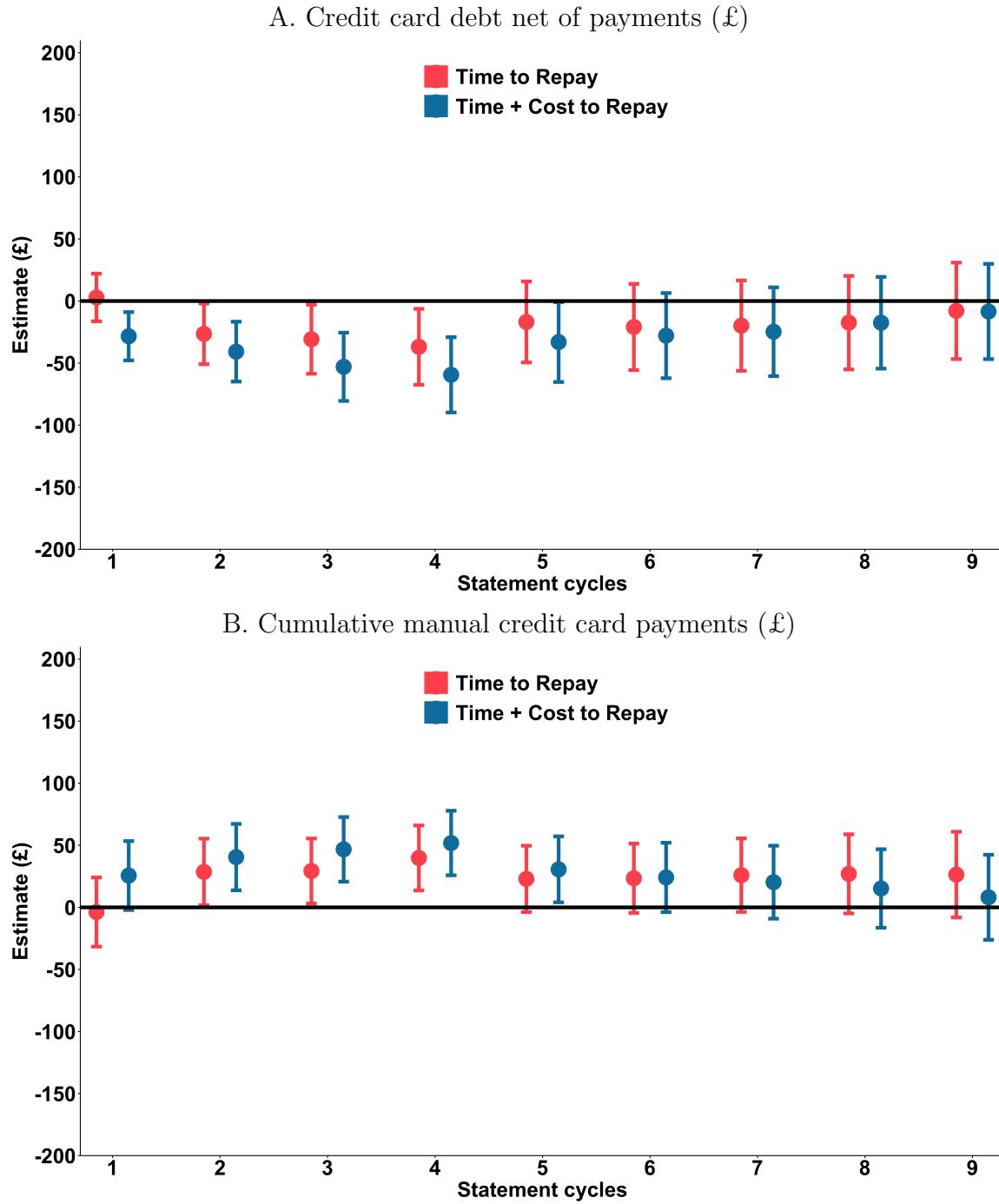
Based on your balance of €5000 as at 31 October, it will take more than 19 years to clear your debt if you just pay the contractual minimum each month. That's because your minimum payment reduces each month as your balance falls. Paying just a bit more each month means you can clear your balance years earlier.

Figure 4: Experiment 2 ‘automatic minimum payment nudges’: Average treatment effects (p.p.) on primary credit card outcomes after nine statement cycles



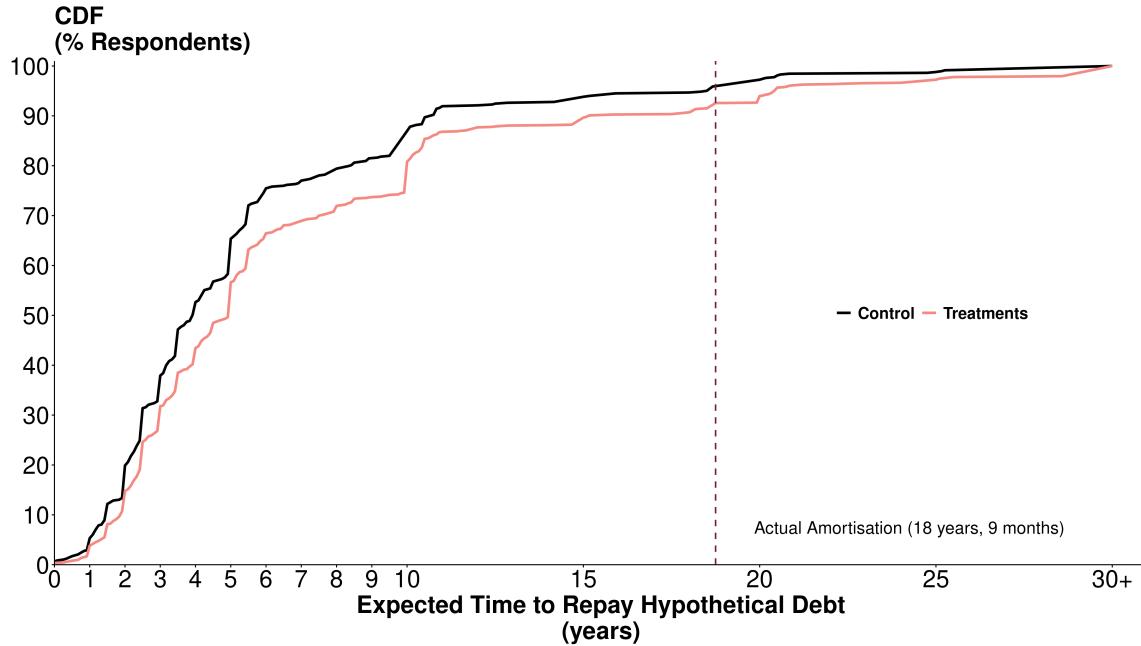
Notes: Estimates are $\delta_{k,9}$ from Equation 1 OLS regression that includes time fixed effects and pre-experiment control variables with standard errors clustered at card-level. Error bars show 95% C.I. Outcomes 4, 5 & 6 are measured as a % of statement balance and outcome 10 as a % of credit card portfolio statement balances.

Figure 5: Experiment 2 ‘automatic minimum payment nudges’: Average treatment effects (£) over time pooling Lender 1 and Lender 2



Notes: Estimates are $\delta_{k,\tau}$ from Equation 1 OLS regression (modified by pooling Lender 1 and Lender 2 and adding lender fixed effects) includes time fixed effects and pre-experiment control variables with standard errors clustered at card-level. Error bars show 95% C.I.

Figure 6: Experiment 2 ‘automatic minimum payment nudges’: Average treatment effects for survey respondents’ expectations of time to repay hypothetical credit card debt repayment scenario



Notes: CDF of responses to question: “Imagine a credit card statement balance of £1,029.90 with an interest rate of 18.9%. If someone only repays the minimum each month and spends no more on the card approximately how long would you expect it to take them to repay? It doesn’t matter whether the answer you give is right or wrong. We just want to find out what people understand and the question after this one lets you indicate how confident you are in your answer.” The correct answer is 18 years and 9 months. Survey responses were open-ended asking them to input years and months but for presentation we group 30+ years responses into a single category. N = 1,713 (Control: 583, Treatments: 1,130). ‘Treatments’ group aggregates all treatments: ‘Time to Repay’, ‘Time + Cost to Repay’, ‘Reminder - Time to Repay’ and ‘Reminder - Time + Cost to Repay’ into a single category.

Table 1: Experiment 1 ‘statement nudges’: Average treatment effects (p.p.) on primary outcomes after six statement cycles

Outcomes	Control Group Mean	Treatment	Estimate (s.e.)
(1) Any exact minimum payment	0.160	Time	0.0038 (0.0047)
		Time + Cost	-0.0052 (0.0046)
(2) Any full payment	0.178	Time	-0.0061 (0.0056)
		Time + Cost	0.0024 (0.0056)
(3) Any missed payment	0.059	Time	-0.0026 (0.0033)
		Time + Cost	-0.0001 (0.0033)
(4) Statement balance net of payments	0.750	Time	0.0045 (0.0053)
		Time + Cost	-0.0009 (0.0054)
(5) Borrowing costs	0.024	Time	-0.0013 (0.0018)
		Time + Cost	0.0007 (0.0019)
(6) New spending	0.087	Time	0.0070* (0.0035)
		Time + Cost	-0.0008 (0.0034)
(7) Portfolio share minimum payment	0.130	Time	-0.0026 (0.0028)
		Time + Cost	-0.0024 (0.0028)
(8) Portfolio share full payment	0.390	Time	0.0000 (0.0034)
		Time + Cost	-0.0025 (0.0034)
(9) Portfolio share missed payment	0.010	Time	0.0001 (0.0011)
		Time + Cost	-0.0007 (0.0010)
(10) Portfolio balances net of payments	0.808	Time	0.0020 (0.0038)
		Time + Cost	0.0019 (0.0038)

Notes: Statistical significance denoted at *** 0.5%, ** 1.0%, * 5.0%. Estimates are $\delta_{k,6}$ from Equation 1 OLS regression that includes time fixed effects and pre-experiment control variables with standard errors clustered at card-level (29,683 cards) shown in parenthesis. Outcomes 1-6 measured from credit cards in trial and 7-10 measured from credit card portfolio in credit file data.
26 Outcomes 4, 5 & 6 are measured as a % of statement balance and outcome 10 as a % of credit card portfolio statement balances.

Table 2: Experiment 2 ‘automatic minimum payment nudges’: T-tests of average treatment effects on survey respondents’ expectations of time to repay hypothetical credit card debt repayment scenario

Outcome	Mean (Control)	Mean (Treatments)	Estimate	95 % C.I.	P Value
Expected Months	70.57	84.53	13.96	[4.64, 23.28]	0.00337
Expected < 3 Years	37.91%	31.77%	-6.14	[-10.93, -1.35]	0.01211
Expected < 5 Years	65.35%	56.64%	-8.71	[-13.55, -3.88]	0.00042
Expected < 10 Years	86.96%	80.80%	-6.17	[-9.74, -2.59]	0.00074
Expected < Actual	95.88%	92.57%	-3.32	[-5.54, -1.09]	0.00352

Notes: “Imagine a credit card statement balance of £1,029.90 with an interest rate of 18.9%. If someone only repays the minimum each month and spends no more on the card approximately how long would you expect it to take them to repay? It doesn’t matter whether the answer you give is right or wrong. We just want to find out what people understand and the question after this one lets you indicate how confident you are in your answer.” The correct answer is 18 years and 9 months (225 months). Survey responses were open-ended asking them to input years and months but for presentation we group 30+ years responses into a single category. N = 1,713 (Control: 583, Treatments: 1,130). ‘Treatments’ group aggregates all treatments: ‘Time to Repay’, ‘Time + Cost to Repay’, ‘Reminder - Time to Repay’ and ‘Reminder - Time + Cost to Repay’ into single category.

References

- Adams, P., Guttman-Kenney, B., Hayes, L., Hunt, S., Laibson, D. & Stewart, N. (2018), ‘The conflict between consumer intentions, beliefs and actions to pay down credit card debt’, *FCA Occasional Paper No. 44* .
URL: <https://www.fca.org.uk/publication/occasional-papers/occasional-paper-44.pdf>
- Adams, P., Hunt, S., Palmer, C. & Zaliauskas, R. (2021), ‘Testing the effectiveness of consumer financial disclosure: Experimental evidence from savings accounts’, *Journal of Financial Economics* **141**(1), 122–147.
- Agarwal, S., Chomsisengphet, S., Mahoney, N. & Stroebel, J. (2015), ‘Regulating consumer financial products: Evidence from credit cards’, *Quarterly Journal of Economics* **130**(1), 111–164.
- Ausubel, L. M. (1991), ‘The failure of competition in the credit card market’, *American Economic Review* pp. 50–81.
- Benartzi, S., Beshears, J., Milkman, K. L., Sunstein, C. R., Thaler, R. H., Shankar, M., Tucker-Ray, W., Congdon, W. J. & Galing, S. (2017), ‘Should governments invest more in nudging?’, *Psychological Science* **28**(8), 1041–1055.
- Benjamin, D. J., Berger, J. O., Johannesson, M., Nosek, B. A., Wagenmakers, E.-J., Berk, R., Bollen, K. A. & Brembs, B. (2018), ‘Redefine statistical significance’, *Nature Human Behaviour* **2**(1), 6.
- Bertrand, M. & Morse, A. (2011), ‘Information disclosure, cognitive biases, and payday borrowing’, *Journal of Finance* **66**(6), 1865–1893.
- Bursztyn, L., González, A. L. & Yanagizawa-Drott, D. (2020), ‘Misperceived social norms: Women working outside the home in saudi arabia’, *American Economic Review* **110**(10), 2997–3029.
- Campbell, J. Y. (2016), ‘Restoring rational choice: The challenge of consumer financial regulation’, *American Economic Review* **106**(5), 1–30.
- Campbell, J. Y., Jackson, H. E., Madrian, B. C. & Tufano, P. (2011), ‘Consumer financial protection’, *Journal of Economic Perspectives* **25**(1), 91–114.
- Chetty, R., Looney, A. & Kroft, K. (2009), ‘Salience and taxation: Theory and evidence’, *American Economic Review* **99**(4), 1145–77.

- DellaVigna, S. & Linos, E. (2022), ‘RCTs to scale: Comprehensive evidence from two nudge units’, *Econometrica* **90**(1), 81–116.
- Dupas, P. (2011), ‘Do teenagers respond to hiv risk information? evidence from a field experiment in kenya’, *American Economic Journal: Applied Economics* **3**(1), 1–34.
- Financial Conduct Authority (2015), ‘Credit card market study: Interim report’.
- Financial Conduct Authority (2016), ‘Credit card market study: Annex 4 – behavioural trials’.
- Gathergood, J., Mahoney, N., Stewart, N. & Weber, J. (2019a), ‘How do americans individuals repay their debt? the balance-matching heuristic’, *Economics Bulletin* **39**, 1458–1467.
- Gathergood, J., Mahoney, N., Stewart, N. & Weber, J. (2019b), ‘How do individuals repay their debt? the balance-matching heuristic’, *American Economic Review* **109**(3), 844–875.
- Gathergood, J., Sakaguchi, H., Stewart, N. & Weber, J. (2020), ‘How do consumers avoid penalty fees? evidence from credit cards’, *Management Science* .
- Grodzicki, D. & Koulayev, S. (2021), ‘Sustained credit card borrowing’, *Journal of Consumer Affairs* **55**(2), 622–653.
- Guttman-Kenney, B., Adams, P., Hunt, S., Laibson, D. & Stewart, N. (2022), ‘The semblance of success in nudging consumers to pay down credit card debt’, *Working Paper* .
- Guttman-Kenney, B., Leary, J. & Stewart, N. (2018), ‘Weighing anchor on credit card debt’, *Financial Conduct Authority Occasional Paper No. 43* .
- Heidhues, P. & Kőszegi, B. (2010), ‘Exploiting naivete about self-control in the credit market’, *American Economic Review* **100**(5), 2279–2303.
- Hershfield, H. E. & Roese, N. J. (2015), ‘Dual payoff scenario warnings on credit card statements elicit suboptimal payoff decisions’, *Journal of Consumer Psychology* **25**(1), 15–27.
- Hirshman, S. D. & Sussman, A. B. (2021), ‘Minimum payments alter debt repayment strategies across multiple cards’, *Journal of Marketing* .
- Jachimowicz, J. M., Duncan, S., Weber, E. U. & Johnson, E. J. (2019), ‘When and why defaults influence decisions: A meta-analysis of default effects’, *Behavioural Public Policy* **3**(2), 159–186.

- Jensen, R. (2010), ‘The (perceived) returns to education and the demand for schooling’, *Quarterly Journal of Economics* **125**(2), 515–548.
- Keys, B. J., Pope, D. G. & Pope, J. C. (2016), ‘Failure to refinance’, *Journal of Financial Economics* **122**(3), 482–499.
- Keys, B. J. & Wang, J. (2019), ‘Minimum payments and debt paydown in consumer credit cards’, *Journal of Financial Economics* **131**(3), 528–548.
- Kuchler, T. & Pagel, M. (2021), ‘Sticking to your plan: The role of present bias for credit card paydown’, *Journal of Financial Economics* **139**(2), 359–388.
- Kulkarni, S., Truffa, S. & Iberti, G. (2020), ‘Removing the fine print: Standardization, disclosure, and consumer loan outcomes’, *Working Paper*.
- Laibson, D. (1997), ‘Golden eggs and hyperbolic discounting’, *Quarterly Journal of Economics* **112**(2), 443–478.
- Laibson, D. (2020), ‘Nudges are not enough: The case for price-based paternalism’, *AEA/AFA Joint Luncheon*.
- URL:** <https://www.aeaweb.org/webcasts/2020/aea-afa-joint-luncheon-nudges-are-not-enough>
- Loewenstein, G. & Chater, N. (2017), ‘Putting nudges in perspective’, *Behavioural Public Policy* **1**(1), 26.
- Lusardi, A. & Mitchell, O. S. (2014), ‘The economic importance of financial literacy: Theory and evidence’, *Journal of Economic Literature* **52**(1), 5–44.
- Lusardi, A. & Tufano, P. (2015), ‘Debt literacy, financial experiences, and overindebtedness’, *Journal of Pension Economics & Finance* **14**(4), 332–368.
- Meier, S. & Sprenger, C. (2010), ‘Present-biased preferences and credit card borrowing’, *American Economic Journal: Applied Economics* **2**(1), 193–210.
- Mrkva, K., Posner, N. A., Reeck, C. & Johnson, E. J. (2021), ‘Do nudges reduce disparities? choice architecture compensates for low consumer knowledge’, *Journal of Marketing* **85**(4), 64–84.
- Ponce, A., Seira, E. & Zamarripa, G. (2017), ‘Borrowing on the wrong credit card? evidence from mexico’, *American Economic Review* **107**(4), 1335–61.

- Raynard, R. & Craig, G. (1993), ‘Estimating the duration of a flexible loan: The effect of supplemental information’, *Journal of Economic Psychology* **14**, 317–35.
- Sakaguchi, H., Stewart, N., Gathergood, J., Adams, P., Guttman-Kenney, B., Hayes, L. & Hunt, S. (2022), ‘Default effects of credit card minimum payments’, *Journal of Marketing Research* .
- Schwarz, N., Hippler, H.-J., Deutsch, B. & Strack, F. (1985), ‘Response scales: Effects of category range on reported behavior and comparative judgments’, *Public Opinion Quarterly* **49**(3), 388–395.
- Seira, E., Elizondo, A. & Laguna-Müggenburg, E. (2017), ‘Are information disclosures effective? evidence from the credit card market’, *American Economic Journal: Economic Policy* **9**(1), 277–307.
- Simmons, J. P., Nelson, L. D. & Simonsohn, U. (2011), ‘False-positive psychology: Undisclosed flexibility in data collection and analysis allows presenting anything as significant’, *Psychological Science* **22**(11), 1359–1366.
- Soll, J. B., Keeney, R. L. & Larrick, R. P. (2013), ‘Consumer misunderstanding of credit card use, payments, and debt: Causes and solutions’, *Journal of Public Policy & Marketing* **32**(1), 66–81.
- Stango, V. & Zinman, J. (2009), ‘Exponential growth bias and household finance’, *Journal of Finance* **64**(6), 2807–2849.
- Stewart, N. (2009), ‘The cost of anchoring on credit-card minimum repayments’, *Psychological Science* **20**(1), 39–41.
- Sunstein, Cass, R. & Thaler, R. H. (2008), *Nudge: Improving decisions about health, wealth, and happiness*, Yale University Press.
- Wang, J. & Burke, K. (2021), ‘The effects of disclosure and enforcement on payday lending in Texas’, *Journal of Financial Economics* .
- Which? (2015), ‘Credit card briefing’.
- Willis, L. E. (2009), ‘Evidence and ideology in assessing the effectiveness of financial literacy education’, *San Diego L. Rev.* **46**, 415.