Patience Across the Payday Cycle*

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Abstract

Individuals often behave impatiently when making financial decisions, which can have long-term economic consequences. This paper proposes and tests that the timing of decisions relative to payday—which leads to strong cyclical fluctuations in liquidity for many individuals—influences the level of patience they have. In a large pre-registered online experiment, I ask participants to adopt a commitment device that binds them to being patient. Participants who make this decision eight days before their payday, rather than one day after payday, are 38% more likely to take up commitment. This is consistent with a mechanism where projection-biased agents have self-control problems. By documenting the importance of the timing of financial decisions relative to payday, this paper offers a new policy tool as well as new evidence on the behavioral dynamics that affect everyday savings and consumption choices.

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1 Introduction

We frequently face decisions that place our current desires in conflict with our long-term interests. These decisions can be small or large: should I watch TV or exercise? Should I interrupt my career to go back to school? Exercising requires effort in the moment but has payoffs in the future. Pursuing an education sacrifices a current income stream for higher earnings in the future. These are choices that have an *intertemporal* dimension, or in other words, that have consequences that span across different time periods. Intertemporal choices are especially important in the domain of household finance, where today's decisions about how to allocate household resources can have a large impact on future financial wellbeing.

Individuals often heavily discount the future when making such decisions. For example, someone might choose higher consumption today rather than saving for retirement,[1] or they might regularly borrow money through credit cards that they have to pay off at a high interest rate later.[2] These are examples of behaving *impatiently*. Economists describe impatience as a time preference: people prefer to receive benefits earlier and to defer costs until later. The theory of discounted utility is the underlying framework for most models that study these behaviors, with higher discount rates corresponding to greater impatience. Mortality effects, risk preferences, and myopia—the inability to accurately forecast the future—may all contribute to time discounting, but the large body of empirical work in this field indicates that these alone are not enough to explain the extent to which people discount delayed rewards (see for example the discussion in Cohen et al. 2020).[3]

In many policy settings, including in household finance, patience is often associated with more socially-optimal long-term outcomes. Policymakers already implement a variety of tools that target impatient behavior, and there currently exists a large literature and fruitful feedback loop between researchers and policymakers on more efficient ways of doing so.[4] These strategies fall into three broad categories. First, policymakers may require more patient decisions. The social security

[1] Previous work has shown that households have high propensities to consume out of increases in liquid wealth (see for example Shea 1995; Gross and Souleles 2001; Stephens Jr 2003; Parker et al. 2013; Broda and Parker 2014; Ganong and Noel 2019). This may partly explain why one-quarter of Americans have nothing saved towards retirement, and fewer than 4 in 10 think their retirement savings are on track. See ("Report on the Economic Well-Being of U.S. Households in 2019" 2019).

[2] In any given month, half of households maintain a balance on their credit cards (see Laibson, Repetto, and Tobacman 2007). With an average credit card balance of $6,194 (Experian) and interest rate of 16.88%, (Federal Reserve) this averages out to a payment of $1,045.55 annually.

[3] Along with the magnitude of discounting, there are a number of other empirical anomalities that have been documented in the literature. See Cohen et al. (2020) for an extensive discussion.

[4] There also exists a large literature on the normative question of *whether* social planners should be encouraging patient decision-making. See for example Sunstein and Thaler (2003) for a discussion on when it is appropriate for policymakers to intervene.

system is an example of this: Americans are required to pay into this fund throughout their years of employment, but in turn they receive a steady income at retirement. This is forced retirement savings, and it fills the gap for those who do not accumulate sufficient retirement savings on their own. Second, policymakers may try to *nudge* individuals towards more patient behavior by changing features of a decision task. This could be an employer increasing the default retirement savings rate to encourage higher savings, or highlighting the fee structure of investment funds to steer people towards low-cost funds. Many nudges have been shown to have large impacts on promoting more patient behavior in field settings (DellaVigna and Linos 2020). Finally, policymakers may offer *commitment devices*: mechanisms that individuals can use to restrict their future choice set in an effort to promote more future-oriented behavior in themselves. An example from the private market is the internet restriction software Freedom that allows users to restrict how much time they spend on certain websites. Importantly, commitment devices require agents to recognize that their future self will behave impatiently, and they seem to be rarely demanded in real-world markets (Laibson 2015).

In this paper, I propose and investigate a new contextual feature—the timing of decisions—that may have a meaningful influence on whether individuals make more patient financial choices. In particular, I investigate whether individuals are more or less willing to adopt a commitment device that binds them to being patient at certain points in their payday cycle. Understanding how commitment decisions vary across the payday cycle is important because timing within the payday cycle is an unavoidable part of any financial decision. There are many reasons to expect that these decisions may vary across the payday cycle. The payday cycle leads to large intra-month fluctuations in liquidity and in consumption for many households, especially ones that are credit-constrained or living paycheck to paycheck.[5] Previous work on the psychology of poverty shows that financial constraints affect psychological states (see for example Mullainathan and Shafir 2013; Haushofer and Fehr 2014; Bartos et al. 2018; Ong, Theseira, and Ng 2019). Therefore, being more financially constrained during the payday cycle might affect an individual's psychological state, and in turn affect how they make financial decisions. Participants in my study make a financial decision about the future. If individuals engage in projection bias—which is a self-forecasting error where individuals

[5]Previous work has found that not only liquidity but consumption across the payday cycle varies systematically, being highest directly after payday and tapering off throughout the rest of the payday cycle. In other words, people spend more when they first get their paycheck and run down their disposable income as their next paycheck draws closer, in a way that affects their consumption levels as well. This pattern has been documented in such contexts as social security income (Stephens Jr 2003; Mastrobuoni and Weinberg 2009), daily caloric intake data (Shapiro 2005), and expenditure surveys in the UK (Huffman and Barenstein 2005).

overestimate the extent to which their future tastes and preferences will resemble their current ones (Loewenstein, O'Donoghue, and Rabin 2003)—individuals may hold different views about the benefits to adopting a commitment device according to *when* in the payday cycle they are faced with the commitment decision, corresponding to changing levels of financial constraints.

I run a pre-registered online experiment with 1,229 individuals that offers participants the opportunity to adopt a commitment device. They can choose to receive an early payment or to commit to a later payment of equal magnitude. While all else being equal, people prefer money early, I motivate the later payment to participants as a consumption smoothing device: the later payment arrives three weeks into the cycle, when a cash influx may be beneficial to those running low on cash. I randomize participants into five treatment groups that vary according to when in their payday cycle they make the commitment decision. Previous work on the payday cycle does not predict when participants might feel the most cash-strapped. One option is the last day of their payday cycle, when their cash on hand is objectively the lowest. However, individuals may experience anticipatory utility from the knowledge that their next paycheck is arriving soon (Kőszegi 2010; Thakral and To 2020). In that case, participants may feel more cash-strapped some amount of time before payday, when they still need to stretch their money before the relief of payday comes. To accommodate this uncertainty around exactly when before payday this would occur, I choose a set of four different dates before payday.

I pre-registered the hypothesis that participants would experience projection bias and be more likely to adopt the commitment device some time before payday. I propose a novel theoretical mechanism: an interaction between projection bias and self-control. Projection bias on its own would not lead participants to choose the later payment—they would still prefer money earlier—but it may do so when combined with self-control problems, which I define in this paper as a gap between planned and actual decisions. In this study, the commitment device gives participants who have difficulty managing their paycheck across the month the opportunity to self-regulate. I suggest that asking at the right moment—at a time when participants have a higher subjective awareness of the liquidity pressures they will experience at the end of their cycle—leads them to recognize that they may benefit from the commitment device.

Consistent with this hypothesis, I find that the timing of the decision matters: while participants only choose to commit 30.5% of the time when making the decision the day after payday, participants commit 42% of the time when making the decision eight days before payday. This coincides with the point in the payday cycle when participants are most likely to say they are low on cash. This

11.5 percentage point difference in willingness to commit is statistically significant ($p < 0.01$) and economically meaningful, corresponding to a 38% increase in willingness to delay. This represents a large impact on intertemporal decision-making, similar to some of the largest effects in the nudge literature (DellaVigna and Linos 2020), and is therefore an important factor for policymakers, employers, and individuals to attend to when considering financial decisions that require foresight.

This paper contributes to the literature on motivating impatient agents as well as the broader literature on behavioral interventions in household finance. Previous research has shown a variety of tools to be effective. Default settings can have a dramatic effect on savings rates (Madrian and Shea 2001; Johnson and Goldstein 2004; Beshears et al. 2006; Choi, Laibson, and Madrian 2009), as can enforcing active choice (Carroll et al. 2009), and reducing transaction costs (see for example Currie 2004; Aizer 2007; Bettinger et al. 2012; Bhargava and Manoli 2015). Researchers have also studied the role of commitment contracts in motivating impatient agents in a variety of settings (see for example Ariely and Wertenbroch 2002; Ashraf, Karlan, and Yin 2006; Royer, Stehr, and Sydnor 2015; Schilbach 2019). This paper relates to these literatures by offering a new tool for promoting the take-up of financial commitment devices and promoting more patient financial planning in general. My results also show that there is demand for a consumption smoothing mechanism across the payday cycle.

It also contributes to the literature on how financial circumstances affect economic decision-making. Several strands of work have examined the relationship between poverty and financial decisions, including work that studies why low-income households engage in impatient behavior like repeatedly taking out payday loans or using lottery purchases as a savings vehicle (Lawrance 1991; Banerjee and Mullainathan 2010; Tanaka, Camerer, and Nguyen 2010; Spears 2011; Gloede, Menkhoff, and Waibel 2015; Bernheim, Ray, and Yeltekin 2015; Haushofer and Fehr 2019). Recent work on the psychology of poverty provides evidence that material scarcity uses up cognitive bandwidth and affects psychological states (Mullainathan and Shafir 2013; Haushofer and Fehr 2014; Bartos et al. 2018; Ong, Theseira, and Ng 2019). However, there is little evidence so far on how scarcity affects economic behavior (Kremer, Rao, and Schilbach 2019). Carvalho, Meier, and Wang (2016) study the effect of payday on cognitive function as well as risk and time preferences. Fehr, Fink, and Jack (2019) show that individuals who are more financially constrained are less likely to display an endowment effect when trading for goods. Kaur et al. (2020) show that individuals with more cash on hand are more productive at work. This paper adds to this early evidence that scarcity affects economic behavior.

The rest of this paper is laid out as follows: Section 2 presents the study design, Section 3 presents the main results and results by demographic groups, and Section 4 discusses potential mechanisms including the role of liquidity constraints and the role of beliefs. Section 5 concludes.

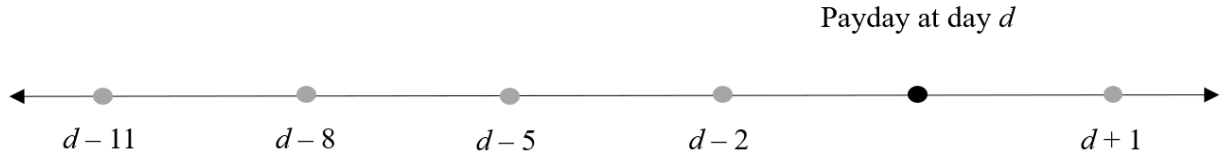
2 Study Design

In this section, I describe the main experiment. In Section 2.1, I give more detail on the timing of the payment options, and in Section 2.2, I give more detail on the timing of the treatment days. Implementation details are described in Section 2.3. Finally, full screenshots for the study are in the Appendix Section 6.1, and the full pre-registration is in Section 6.3.

The experimental protocol involves two parts, which take place on separate days on Amazon Mechanical Turk (MTurk). The first part elicits payday information and screens for participants who fit the selection criteria. The selection criteria are comprised of two requirements: participants must receive their paychecks monthly and they must have a main source of income that is not MTurk. I describe the motivation behind these design choices in Section 2.3.

All participants who fit these criteria are invited to participate in part two, the main experimental treatment, in which they are asked to make a commitment decision. Each participant is randomly assigned to take part on a particular day relative to their own payday d. There are five treatment days. One is the day after payday, and the other four are before payday. Each treatment day is spaced three days apart, up to eleven days before payday. Figure 1 shows the timing of each of these treatment groups relative to payday. The choice of treatment days is discussed in more detail in Section 2.2.

Figure 1: Experimental Timeline



Note: This figure displays the timing of the main experimental task in which participants are asked to make the commitment decision. The black circle indicates payday. Each grey circle indicates one of the days that subjects complete the task. These range from eleven days before payday to the day after payday.

On their assigned treatment day, participants receive an email that informs them a task is available on MTurk and asks them to complete it within 24 hours. In this task, they are faced with the commitment decision: they can choose between having a chance of receiving a bonus payment on the payday of a future payday cycle or three weeks into that payday cycle. This is how the decision is first presented:

> You have the chance to receive a $50 cash payment as a bonus for taking part in this study. Out of all the MTurk workers taking this study, 1% will randomly be selected to receive this cash payment. Your decision in Part 1 is to choose when you want to receive this payment.

The likelihood of receiving the bonus payment and the amount of money is the same regardless of what they choose. Given this, why might they demand a later, more patient decision? One reason relates to consumption smoothing: given that individuals frequently run out of money late in their payday cycle, they may desire the more patient decision in order to mitigate the hardship that can follow from running out of money late in their payday cycle. This is why their decision is framed in terms of consumption smoothing; they are told that many people have difficulty making their paycheck last across the month, in which case receiving an influx of cash later in the payday cycle may be beneficial to them. The framing specifically reads as follows:

> Many people run low on cash toward the end of the month. Setting aside money to receive towards the end of your paycheck may help prevent this. This decision will ask whether, for your own reasons, you would like to receive this cash payment later in your pay period rather than at the beginning of your pay period.

After the consumption smoothing framing, they are reminded of their payday dates, then faced with the commitment decision. The reminder and decision are described as follows:

> In the pre-screen for this study, you indicated that you will receive your monthly paycheck on _____ and on _____.
>
> Today, you have the choice of receiving the $50 bonus payment at the beginning of your pay period on _____, or later in your pay period on _____. Your choice will not affect your chance of receiving the bonus payment.

The empty spaces are filled with the details of their own payday information. To illustrate, imagine a participant taking this study in August who receives their paycheck on the first of every month and is assigned to treatment group $d - 11$. This person would make the main treatment decision eleven days before their payday—on August 21—and would see the following set of instructions:

> In the pre-screen for this study, you indicated that you will receive your monthly paycheck on 09/01/2019 and on 10/01/2019.
>
> Today, you have the choice of receiving the $50 bonus payment at the beginning of your pay period on 10/01/2019, or later in your pay period on 10/21/2019. Your choice will not affect your chance of receiving the bonus payment.

After participants finish the main commitment decision, they continue to another page where they complete a set of sociodemographic and financial questions. For full screenshots of the main experimental treatment in MTurk, see Section 6.1.2 in the Appendix. For pre-registration details, see Section 6.3.

2.1 Why do participants choose between two future payments?

When participants choose between the two payment options in the commitment decision, the only difference is the time cost of delaying income. Previous work indicates that individuals prefer payments earlier, even sometimes at cost to themselves (see for example Frederick and Loewenstein 2002).

Individuals in this study choose between two future payment options, each at least one month in advance, rather than between a payment now and a payment later. This design choice was made to remove present bias as a factor in their decision-making, in order to focus instead on how timing in the payday cycle influences financial decisions made about the future. In addition, having two future options removes theoretical issues that arise from money-now-versus-later studies, like the difference in perceived reliability of the researcher to deliver funds now versus in the future (see Cohen et al. 2020 for a discussion of this). This design choice makes the payment options more directly comparable.

Figure 2 shows timing of the the bonus payment options, both relative to payday and to when participants make their payment decision.

Figure 2: Payment Option Timeline

Note: This figure displays the timing of the payment options in the commitment decision. The black circles indicate payday. The grey circles on the left indicate when participants make the commitment decision. The early payment option is paid out at m+1, and the commitment option is paid out three weeks later, before m+2.

In other words, if a participant chooses to receive the bonus payment earlier, they receive it on the payday of a future payday cycle. If they choose to receive the bonus later, they receive it three weeks into that payday cycle.

2.2 Why elicit decisions at many points in the payday cycle?

The timing of the treatment days when participants are asked to make the commitment decision was chosen to cover the full range of days when the hypothesized effect could exist—when individuals may be more willing to take up the commitment device. My motivation for this paper was that changes in liquidity affect psychological states, which may in turn affect how individuals make future-oriented financial decisions. However, there is little prior evidence on how psychological states might vary across the payday cycle. Liquidity increases sharply at payday for many people, so it could be the case that individuals feel the most cash-strapped the day before payday, when their financial resources are lowest. However, another possibility is that people experience relief before payday that their paycheck is about to arrive. This would be consistent with a model of anticipatory utility where agents derive utility from an event before it occurs (see for example Kőszegi 2010; Thakral and To 2020). It is also consistent with evidence from the literatures on mental accounting and present-focused preferences, which indicate that people group their finances into categories and then use heuristics based on these categories to make financial decisions (for a review, see Zhang and Sussman 2018); in this way, individuals might incorporate an upcoming paycheck into the mental snapshot they have of their finances.

Someone who is drawing down their paycheck throughout the month might therefore start worrying about their ability to make it to the next payday sometime in the middle of their payday cycle, but might feel the relief of making it to the next payday once they get close enough. Thus,

the behavioral effects of payday on financial decision-making might happen some time before payday. To accommodate this possibility, I chose to test a range of dates starting eleven days before payday. Based on power calculations, I chose five treatment days, each three days apart.

2.3 Implementation

Subjects for this experiment were recruited on MTurk in June and July 2019 and participated through August. Recruitment followed the pre-registered design details.

In order to participate in the study, subjects were required to have an IP address in the United States, have completed at least 100 tasks on MTurk prior to this one, and received an 85% or better approval rating on average. In addition, the study included only MTurk workers who receive monthly paychecks and whose main source of income is not MTurk. This restriction was motivated by the existing evidence in household finance. Many behavioral biases are exacerbated by the cognitively difficult task of developing a long-term budget and sticking to it. Having access to more frequent sources of income can make consumption smoothing across time periods easier (Stephens and Unayama 2011; Aggarwal, Dizon-Ross, and Zucker 2020). Since MTurk workers get paid as they receive tasks, and therefore have a higher ability to smooth their income across the payday cycle than the average worker, I include only those MTurk workers who receive the bulk of their monthly income from a source other than MTurk. Section 6.1.1 in the Appendix details how these questions were asked.

3 Results

I collected data from 1,229 individuals. Descriptive statistics of the sample are described in Table 1. The sample was 63% female and the median participant was between 35-44 years of age, had a bachelor's degree, and made an income between $50,000 and $59,999. Only 33% of the sample could easily raise $2,000 in an emergency; 19% did not think they could raise it at all. The sample was balanced across treatment groups. See Table 7 in the Appendix for a balance table.

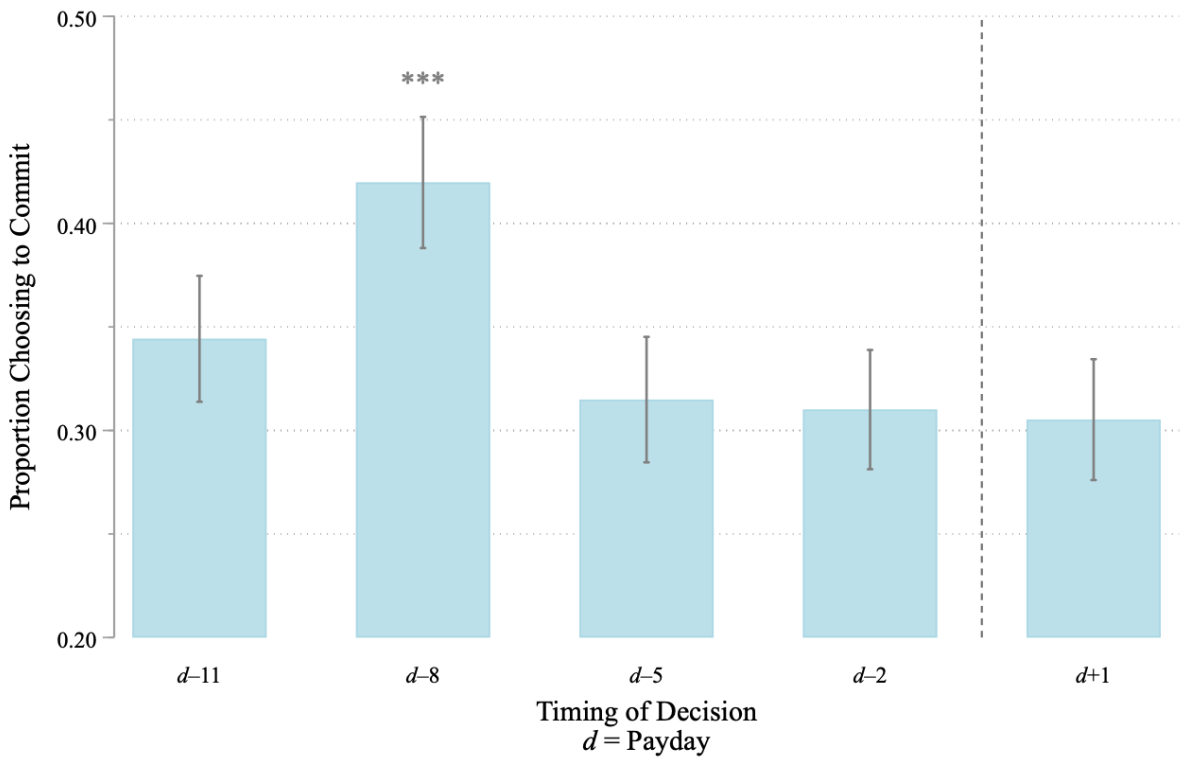
Table 1: Descriptive Statistics

Gender		*Income*	
Male	0.37	Less than $25,000	0.21
Female	0.63	$25,000 – $49,999	0.28
		$50,000 – $74,999	0.23
Age		$75,000 – $99,999	0.13
18-24	0.07	$100,000 – $249,999	0.15
25-34	0.30	$250,000 – $499,999	0.00
35–44	0.24	Over $500,000	0.00
45–54	0.13		
55–64	0.15	*Employment*	
65+	0.12	Employed Full Time	0.44
		Employed Part Time	0.14
Race		Unemployed and Looking	0.03
Caucasian	0.78	Unemployed and Not Looking	0.01
Hispanic, Latino, or Spanish origin	0.04	Student	0.03
Black or African American	0.09	Retired	0.14
American Indian or Alaska Native	0.01	Homemaker	0.03
Asian	0.06	Self-employed	0.11
Native American or Pacific Islander	0.00	Unable to Work	0.07
Other	0.02		
		Raise $2,000 in an emergency	
Education		Could raise easily	0.33
Less than a high school diploma	0.00	Would involve some sacrifices	0.31
High school degree or equivalent	0.07	Require something drastic	0.17
Some college, no degree	0.20	Don't think I could raise it	0.19
Associate's degree	0.10		
Bachelor's degree	0.39	*Available Credit*	
Master's degree	0.19	Median number of credit cards	3
Professional degree	0.01	Median total line of credit	$10,000
Doctorate	0.03		
		Low on Cash	
Marital Status		Not low on cash	0.36
Single	0.34	Yes or somewhat	0.64
Married or Domestic Partnership	0.51		
Widowed	0.03		
Divorced	0.12		
Separated	0.01		

3.1 Does the timing of the decision matter?

To test the main hypothesis—that patience in financial decision-making varies based on timing around payday—I compare participants who make a commitment decision after payday to those who made it before payday. These results are presented in Figure 3 and as a table in Table 2.

Figure 3: Proportion Choosing to Commit by Day



Note: * p < 0.1, ** p < 0.05, *** p < 0.01. This graph show the proportion of participants who choose to adopt a commitment device on each day. Participants are workers on MTurk who receive monthly paychecks from their main source of income. d refers to the day they receive their paycheck. Stars indicate the results of an equality of proportions test comparing each group before payday to d+1. The horizontal line indicates the average proportion delaying across all days.

30.5% choose to adopt a commitment device when asked to do so one day after payday. The proportion choosing to commit is roughly equal the day after payday and two to five days before payday, when 31.0% and 31.5% choose to commit, respectively. However, this proportion increases to 42.0% for people choosing eight days before payday, which represents a 38% increase in willingness to commit compared to $d+1$. This increase is non-monotonic and lowers to 34.4% eleven days before payday.

This difference between $d-8$ and $d+1$ is significant at the 1% level in an equality of proportions test. Since I test multiple treatments at once—four treatment groups before payday against the treatment group after payday—I run an F-test of joint significance and reject the hypothesis that all

Table 2: Proportion Choosing to Commit by Day

	(1) d+1	(2) d–2	(3) d–5	(4) d–8	(5) d–11
Proportion Choosing to Commit	0.305	0.310	0.315	0.420	0.344
Difference from d+1	-	0.005	0.010	0.115***	0.039
		(0.041)	(0.042)	(0.043)	(0.042)
Observations	249	258	235	243	244

Standard errors in parentheses

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Each column denotes the day relative to payday that participants make the commitment decision. *Proportion Choosing to Commit* describes the proportion of participants who choose to adopt a commitment device on that day. *Difference from d+1* shows the difference in willingness to commit between that day and d+1, as well as the results of an equality of proportions test comparing d+1 pairwise to each of the other treatment days.

treatment groups are equal at $\alpha = 0.05$. This result also passes a Bonferroni correction at $\alpha = 0.05$. Finally, I also re-run these results using randomization inference, which is a more reliable method of inference in multiple-testing procedures, and find the same levels of statistical significance (Young 2019). These results are presented in the Appendix Table 8.

It is important to note that MTurk workers inherently have access to a consumption smoothing mechanism through MTurk because they get paid as they complete tasks. Therefore, we would expect that results for other worker populations would be different; in particular, since the commitment device in this study provides a mechanism for consumption smoothing, estimates from this study may be more conservative compared to workers who do not have access to additional income in the middle of their payday cycle.

3.2 Is the timing result robust?

I run a series of robustness checks on this result. A potential concern is that participants' paydays might fall on the same day, and that the effects are therefore caused by day of the week or other incidental time-related factors. In fact, paydays were spread out across the sample: the most common payday date included only 6.5% of the sample. Table 3 columns 2, 3, 4, and 5 report the results subject to day of the week, week, month, and specific date controls.

I also check that the results are robust to observable participant characteristics in case randomization was not effective between treatment groups. Column 6 shows that the results are robust to a model that includes demographic controls.

Table 3: Robustness: Including Date Effects and Demographic Controls

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
d–11	0.039	0.049	0.047	0.036	0.065	0.039	0.070
	(0.042)	(0.044)	(0.046)	(0.043)	(0.047)	(0.042)	(0.047)
d–8	0.115***	0.116***	0.112**	0.112**	0.116**	0.105**	0.105**
	(0.043)	(0.044)	(0.046)	(0.044)	(0.047)	(0.043)	(0.047)
d–5	0.010	0.026	0.007	0.007	0.030	0.005	0.024
	(0.042)	(0.046)	(0.044)	(0.043)	(0.048)	(0.043)	(0.049)
d–2	0.005	0.009	-0.004	0.001	0.004	0.001	0.000
	(0.041)	(0.044)	(0.043)	(0.042)	(0.047)	(0.041)	(0.046)
Day of the Week Controls		X			X		X
Week Controls			X		X		X
Month Controls				X	X		X
Demographic Controls						X	X
Observations	1229	1229	1229	1229	1229	1229	1229

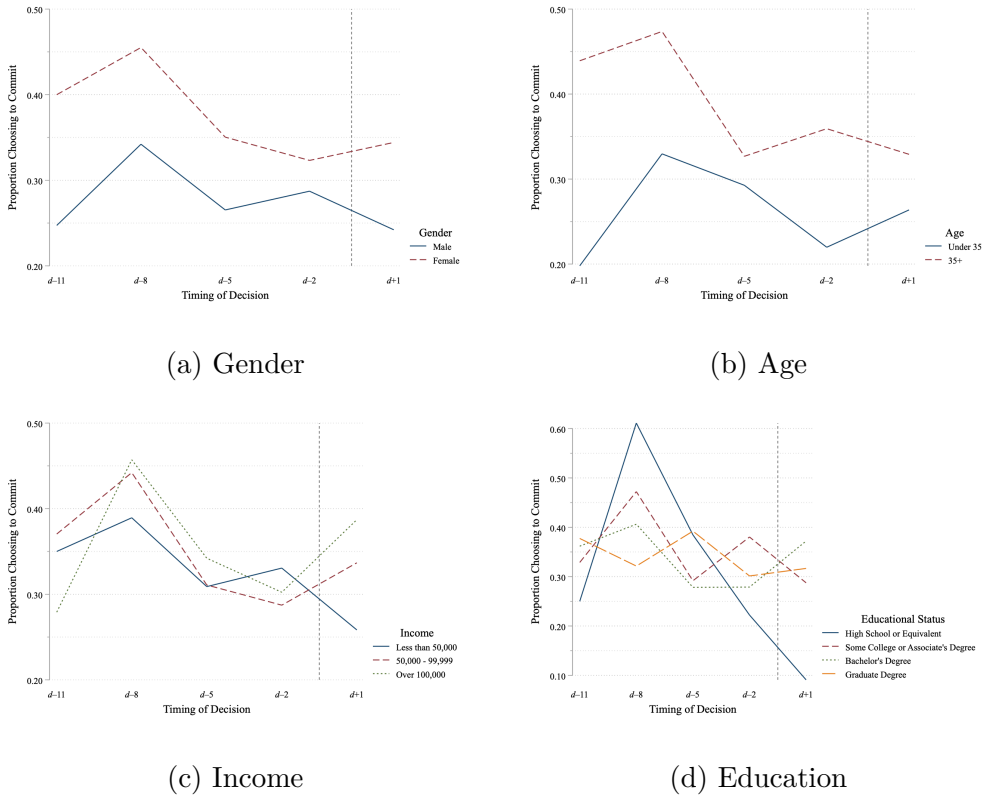
Standard errors in parentheses

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors are heteroskedasticity robust. Results are from OLS models with the binary decision to adopt a commitment device as the dependent variable. *Day of the Week* is an indicator for which day of the week a participant made the decision, Monday through Sunday. *Week* is an indicator for which week of the study a participant made the decision. *Month* is an indicator for which month of the study a participant made the decision. *Demographic controls* includes indicator variables for gender, age, income, and education level.

3.3 Are there heterogenous treatment effects by demographics?

An important question for policy is whether there are heterogeneous treatment effects. That is, does changing the timing of when individuals are asked to make financial decisions matter for some groups of people in particular? While my study was not powered to investigate heterogeneity, I nonetheless present the willingness to delay payment by treatment day for descriptive purposes. Figure 4 presents these results for each of the demographic characteristics I collected, which include gender, age, education level, and income.

Figure 4: Proportion Choosing to Commit by Demographic Characteristic



(a) Gender

(b) Age

(c) Income

(d) Education

Note: These graphs show the proportion of participants who choose to adopt a commitment device on each day by the indicated demographic group. Participants are workers on MTurk who receive monthly paychecks from their main source of income. d refers to the day they receive their paycheck.

Table 4 presents the regression results for models that include these demographic characteristics as covariates along with their interaction terms. Willingness to adopt the commitment device is

Table 4: Heterogeneity of Treatment Effect by Demographic Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
d–11	0.039	0.037	0.037	0.040	0.040	0.039	0.039	0.039	0.039
	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)
d–8	0.115***	0.108**	0.095	0.114***	0.114***	0.114***	0.114***	0.114***	0.113***
	(0.043)	(0.043)	(0.064)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)
d–5	0.010	0.013	0.013	0.008	0.009	0.010	0.010	0.010	0.009
	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)
d–2	0.005	0.003	0.003	0.002	0.003	0.005	0.005	0.005	0.002
	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)
Female		0.097***	0.093***						
		(0.027)	(0.030)						
Female * d–8			0.020						
			(0.073)						
Age (1-6)				0.027***	0.020**				
				(0.009)	(0.010)				
Age (1-6) * d–8					0.039*				
					(0.023)				
Income (1-7)						0.005	0.003		
						(0.010)	(0.011)		
Income (1-7) * d–8							0.009		
							(0.027)		
Education (1-8)								0.001	0.012
								(0.009)	(0.010)
Education (1-8) * d–8									-0.053**
									(0.025)
Constant	0.305***	0.245***	0.248***	0.306***	0.306***	0.305***	0.305***	0.305***	0.306***
	(0.029)	(0.033)	(0.034)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
Observations	1229	1229	1229	1229	1229	1229	1229	1229	1229

Standard errors in parentheses

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors are heteroskedasticity robust. Results are from OLS models with the binary decision to adopt a commitment device as the dependent variable and d+1 as the base level. *Age (1-6)* is a number from 1 to 6 that corresponds with younger to older age, demeaned by the average age. *Income (1-7)* is a number from 1 to 7 that corresponds with lower to higher levels of income, demeaned by the average level. *Education (1-8)* is a number from 1 to 8 that corresponds with lower to higher levels of education, demeaned by the average level.

significantly higher for women, who are on average 9.7 percentage points more likely to take up commitment than men. This represents an effect size similar in magnitude to the main treatment effect and does not depend on treatment day. Willingness to commit also increases slightly with age, and this result indicates that the treatment effect may be slightly more pronounced for older participants as well. Both of these results reflect similar results in prior research, which generally show that women and older individuals exhibit more patience in decision-making (for example Green, Myerson, and Ostaszewski 1999; Dittrich and Leipold 2014). There is no relationship between income and choosing to commit, which contrasts with my pre-registered hypothesis that individuals with lower incomes would be more likely to experience an effect from timing across the payday cycle. This could be due to the sample being comprised of MTurk workers, who are a self-selected group of individuals looking to make additional income. Finally, there is no level effect by education, but the coefficient on the interaction term indicates that the main treatment effect is more pronounced for those with less education. This also follows past work that shows that a variety of behavioral biases are exacerbated for those with lower education or cognitive ability (for example Benjamin, Brown, and Shapiro 2012).

4 Discussion

The purpose of this experiment is to examine whether timing influences impatience, but there are also interesting questions about the underlying mechanism that are relevant for future work. The purpose of this section is to help guide future work to examine why impatience might change across the payday cycle.

4.1 What is the role of liquidity constraints?

Liquidity and credit constraints play a large role in how households engage in financial decisions. Most relevantly to this study, households that do not have ready access to extra cash, or who cannot easily borrow against future money, have been shown to have higher discount rates (for example Pender 1996; Holden, Shiferaw, and Wik 1998; Dean and Sautmann 2014). However, my proposed mechanism is that liquidity problems during the payday cycle may cause an individual to have a higher subjective awareness of their self-control problems, which may *increase* their likelihood of making the more patient decision. To investigate this question in my data, I examine the relationship between willingness to commit and three proxies for liquidity constraints: lacking access to a credit

card, being unable to raise $2,000 in an emergency, and being low on cash while taking the survey. These results are shown in Table 5.

The results are somewhat puzzling: I do not find a higher willingness to commit for two proxies of liquidity constraints, contrary to what theory would suggest. However, I do find that respondents who say they are currently low on cash are 7.8 percentage points more likely to adopt a commitment device, a result that is highly significant ($p < 0.01$). This may be because this is the only proxy for liquidity constraints that asks the precise question about liquidity in the moment rather than overall levels of liquidity; that is, the only measure that fluctuates across the payday cycle, unlike the other two measures which stay constant. I explore this question in more detail in the next section.

4.2 What is the role of beliefs?

A possible mechanism for the main treatment result is that the payday cycle shapes beliefs about the trade-offs involved in making financial plans for the future. Since an individual's level of liquidity varies systematically with the payday cycle, this may affect how they value the future and how they perceive an opportunity for self-regulation. In particular, a person with high liquidity may project budgeting optimism onto later points in the payday cycle, believing they will not be in danger of running out of money. Similarly, a person with low liquidity may project financial insecurity onto the future, believing instead they might be in danger of running out of money. The person with low liquidity is therefore more likely to recognize that they could benefit from a commitment device that helps them budget across the month. In other words, my results are consistent with a model of projection bias that is terraced on self-control problems.

Projection bias occurs when "people exaggerate the degree to which their future tastes will resemble their current tastes," and affects how they view trade-offs between the present and the future (Loewenstein, O'Donoghue, and Rabin 2003). One example of this bias is that consumers purchase more convertibles in unexpectedly sunny weather, and are also more likely to trade in the vehicle quickly when the convertible was purchased in such weather (Busse et al. 2015). It is sometimes described as an intrapersonal empathy gap. This could be at work in my study's context: a person who makes the decision at a certain point in the payday may be more likely to empathize with their future self at that same point in the payday cycle. Those at the beginning of the payday cycle may be more likely to neglect the benefits of a late payment, whereas those who are making the decision late in the payday cycle may be more likely to identify with the consumption smoothing framing that describes how people may run low on cash towards the end of the cycle.

Table 5: Heterogeneity of Treatment Effect by Liquidity Constraints

	(1)	(2)	(3)	(4)
d–11	0.039	0.035	0.036	0.033
	(0.042)	(0.042)	(0.042)	(0.042)
d–8	0.115***	0.134***	0.114**	0.149**
	(0.043)	(0.046)	(0.046)	(0.065)
d–5	0.010	0.005	0.007	0.002
	(0.042)	(0.042)	(0.042)	(0.042)
d–2	0.005	0.002	0.004	-0.001
	(0.041)	(0.041)	(0.041)	(0.041)
No credit card		0.054		
		(0.044)		
No credit card * d–8		-0.140		
		(0.092)		
Could not raise 2,000			0.064*	
			(0.038)	
Could not raise 2,000 * d–8			0.004	
			(0.093)	
Low on cash				0.078***
				(0.030)
Low on cash * d–8				-0.064
				(0.074)
Constant	0.305***	0.301***	0.294***	0.261***
	(0.029)	(0.030)	(0.030)	(0.034)
Observations	1229	1229	1229	1229

Standard errors in parentheses

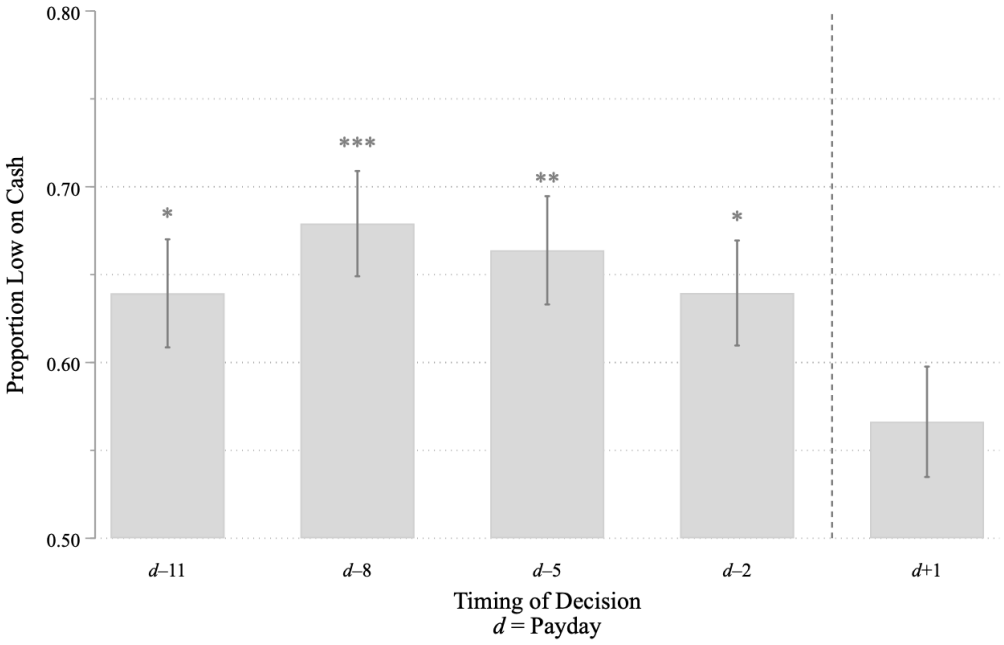
Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors are robust. Results are from OLS models with the binary decision to adopt a commitment device as the dependent variable and d+1 as the base level. *No credit card* is an indicator for not having a credit card. *Could not raise $2,000* is an indicator for not being able to raise $2,000 in an emergency. *Low on cash* is an indicator for answering "Yes" or "Somewhat" to the question, "Are you low on cash right now?".

After participants make the commitment decision, I give them the opportunity to explain how they made their decision in a free text box on the next page. Some participants describe how their financial perspective changes from the beginning to the end of the payday cycle, consistent with the hypothesis that the payday cycle shapes psychological states. For example, one participant, who chose to adopt commitment, writes, "if I receive too many funds at the beginning of the month, I feel overconfident/flushed with money and am more likely to spend money on frivolous things." Many participants who chose the late payment mention feeling cash-strapped towards the end of the payday cycle, saying for example, "I usually run short on cash towards the middle of the month," or, "the last week of the month is when I am broke." Some participants also specifically highlight that they are currently low on cash. One such participant reports:

> "Like the description on the previous page, I do tend to run low on money toward the end of the month. Even right now, at the end of this month, my family is struggling. Having that $50 come later would be a relief."

However, if the decision to adopt commitment were impacted by a subjective awareness of current liquidity pressures, why is the decision to adopt commitment highest at $d-8$ rather than $d-2$, when liquid resources are most likely to be at their lowest? As I describe in Section 2.2, I designed the study with several treatment days in the before-payday period because of the possibility that individuals' psychological states around payday might not exactly coincide with their cash on hand. In particular, individuals might experience anticipatory relief from payday close to when their paycheck actually arrives, and might feel the most financial stress earlier, when they still have to stretch their cash before payday arrives.

Figure 5: Low on Cash by Decision Day



Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. This graph show the proportion of participants who answered "Yes" or "Somewhat" to the question, "Are you low on cash right now?". d refers to the day they receive their paycheck. Stars indicate the results of an equality of proportions test comparing each group before payday to d+1.

Consistent with this possibility, participants in my study are most likely to agree to the question, "Are you low on cash right now?" at $d - 8$ (see Figure 5). I suggest that this question does not measure the objective amount of cash that participants have on hand, but rather that it requires a subjective assessment of how cash-strapped they feel. In this way, participants' answer to this question indicates that the most stressful part of the payday cycle may happen sometime around eight days before payday. According to my hypothesis, they may be projecting this financial pressure onto the future, leading them to recognize that they could benefit from the commitment device in my study—which gives them the opportunity to receive a cash influx right when they need it most.

However, this study was only designed to test whether payday influences patience, not to investigate or confirm the mechanism. Future research could be designed to test the mechanism, for example by manipulating the framing of the commitment device or exogenously influencing how cash-flush individuals are throughout their payday cycle.

5 Conclusion

This paper demonstrates that timing relative to payday affects individuals' patience when making financial decisions. Offering the chance to make a future-oriented decision at the right moment, when self-regulation is most salient, leads participants to the insight that it would be useful to delay a payment in order to benefit their future self. This result highlights the potential usefulness of timing as a tool when it comes to intertemporal decision-making: timing is an unavoidable feature of any decision task, and there are a variety of time-varying factors that may influence what people choose to do. It also highlights that there is demand for a consumption smoothing mechanism across the payday cycle. Policymakers can better promote financial health by paying attention to timing within the payday cycle as a behavioral policy tool, and aligning the timing of decisions and payment structures to acknowledge and accomodate these biases.

Further research can investigate other types of decisions that might also be affected by the payday cycle, including ordinary but consequential decisions like taking on new debt or choosing a retirement savings rate. It can also investigate the mechanism underpinning this effect further; if the payday cycle is indeed shaping beliefs about the trade-offs involved in financial decisions made for the future, this provides insight into the psychology of the payday cycle as well as a useful avenue for future interventions. Policymakers could then target impatience by focusing on beliefs. In particular, my proposed mechanism implies that policymakers could leverage current scarcity to help individuals better imagine future scarcity. Finally, more evidence is needed about the psychological changes that occur across the payday cycle, especially for those living paycheck to paycheck, to better understand how it affects financial planning decisions as well as how it affects other aspects of individuals' overall financial well-being.

6 Appendix

6.1 Experimental Instructions

Participants were recruited between June 1st and July 31st 2019 on Amazon Mechanical Turk (MTurk) as laid out in the pre-registration. Participants continued to participate in the second stage of the study through August 5, 2019. This section describes the study instructions in detail. Section 6.1.1 describes the pre-screen and section 6.1.2 describes the main experimental task in which participants make a commitment decision.

6.1.1 Pre-Screen

The study pool is restricted to applicants who live in the United States, have more than 100 approved Human Intelligence Tasks (HITs), and have a greater than 85% HIT approval rating. The pre-screen additionally narrows the study pool to individuals who do not make most of their income on MTurk and who receive paychecks monthly. Figure 6 and Figure 7 shows how the income questions are asked. Figure 8 and Figure 9 show how the paycheck questions are asked. The calendar display in Figure 9 is shown as many times as they indicate they would receive a paycheck in that month. The pre-screen questions are worded so as to not reveal the screening criteria.

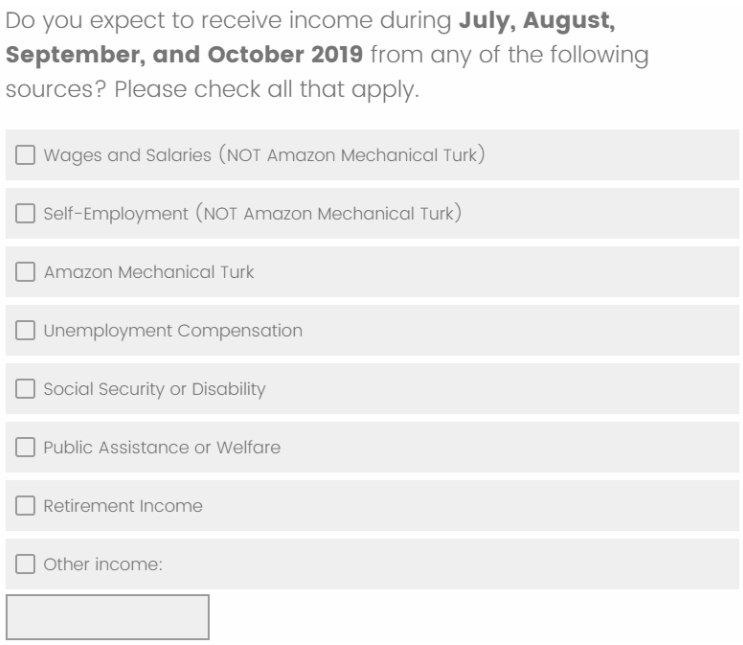


Figure 6: Pre-Screen Question #1

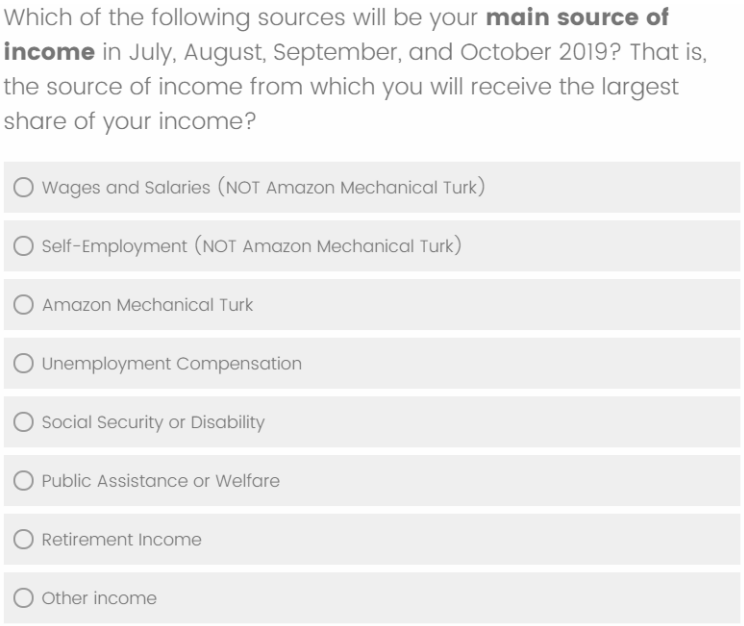


Figure 7: Pre-Screen Question #2

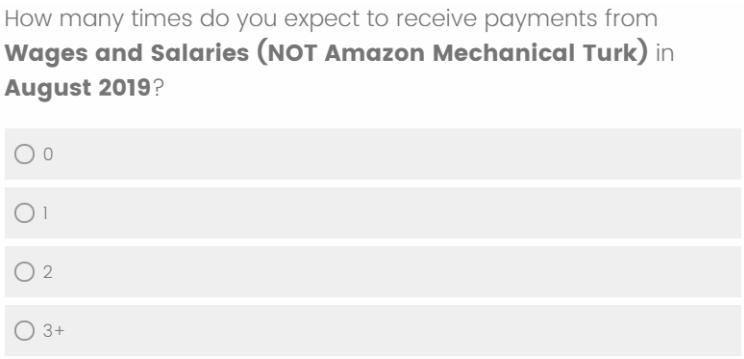


Figure 8: Pre-Screen Question #3

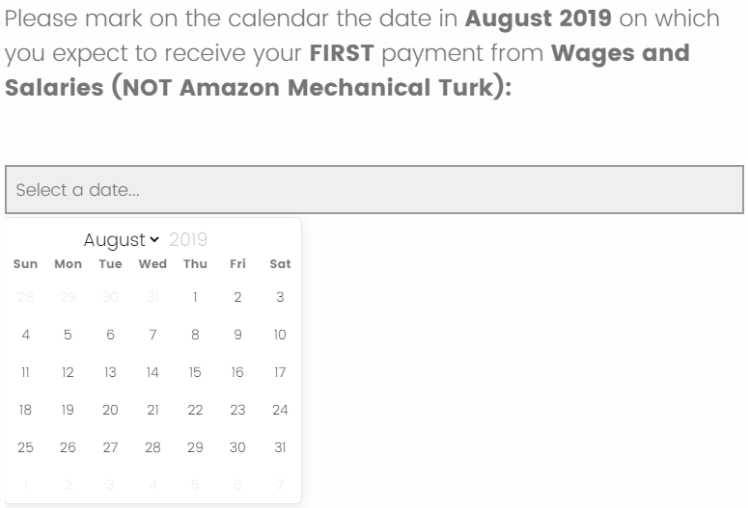


Figure 9: Pre-Screen Question #4

In total, I pre-screened 12,414 MTurk workers. Out of these, 1,690 met the screening qualifications and were randomized into treatment groups. From this group, 1,229 returned and completed the main experimental task, leading to a 27.3% attrition rate from stage one to stage two. See Table 6 for the number of participants assigned to each treatment group versus the number who ultimately enrolled.

Table 6: Attrition by Treatment Day

	Number assigned	Number enrolled
$d+1$	339	249
$d-2$	340	258
$d-5$	336	235
$d-8$	338	243
$d-11$	337	244

6.1.2 Main Experimental Task

The main experimental task appears for each participant on their assigned treatment day. They also receive an email reminder through MTurk that the second part is available for them to complete. The email text states:

> The academic survey you qualified for through a pre-screen is now up on MTurk. The

title is “Harvard Financial Decisions Study” and the requester name is “Holly”. It takes on average 7 minutes and has a guaranteed payment of $2. In addition, you have a chance of receiving a bonus of $50. It is important for our study that you take this within 24 hours of now. Every single person is valuable to our study so we strongly thank you for your participation! Please contact me if you have any questions: Holly at dykstra@g.harvard.edu.

Once participants navigate to the survey, they are presented with the introductory screen shown in Figure 10. Next, they face the commitment decision shown in Figure 11. In the study, the dates are filled in with the paycheck information each person supplied during the pre-screen.

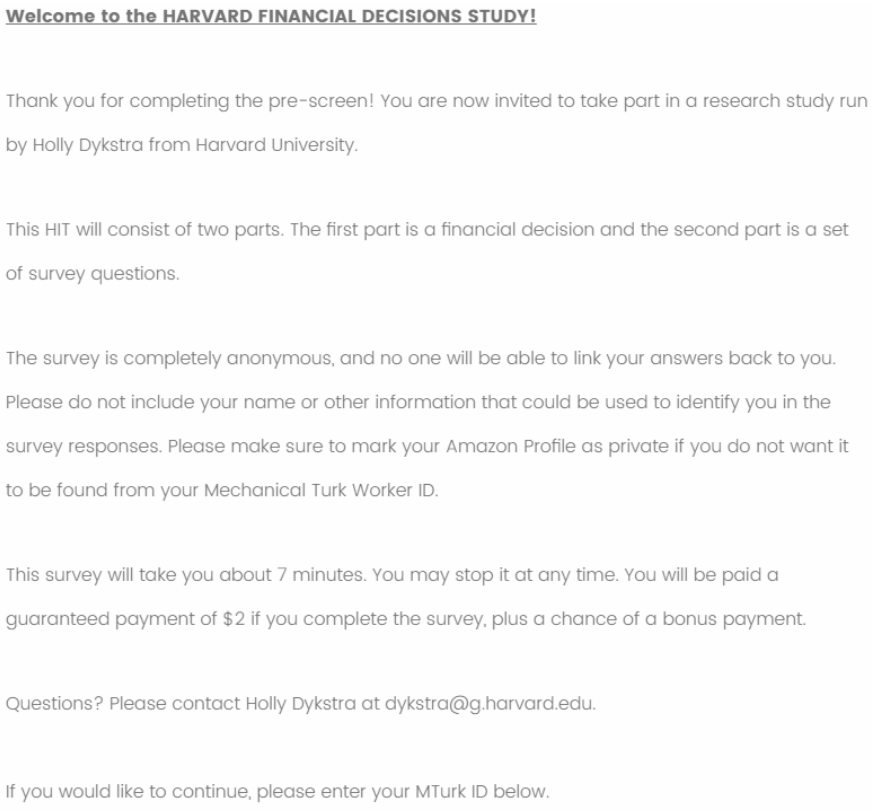


Figure 10: Introductory Screen

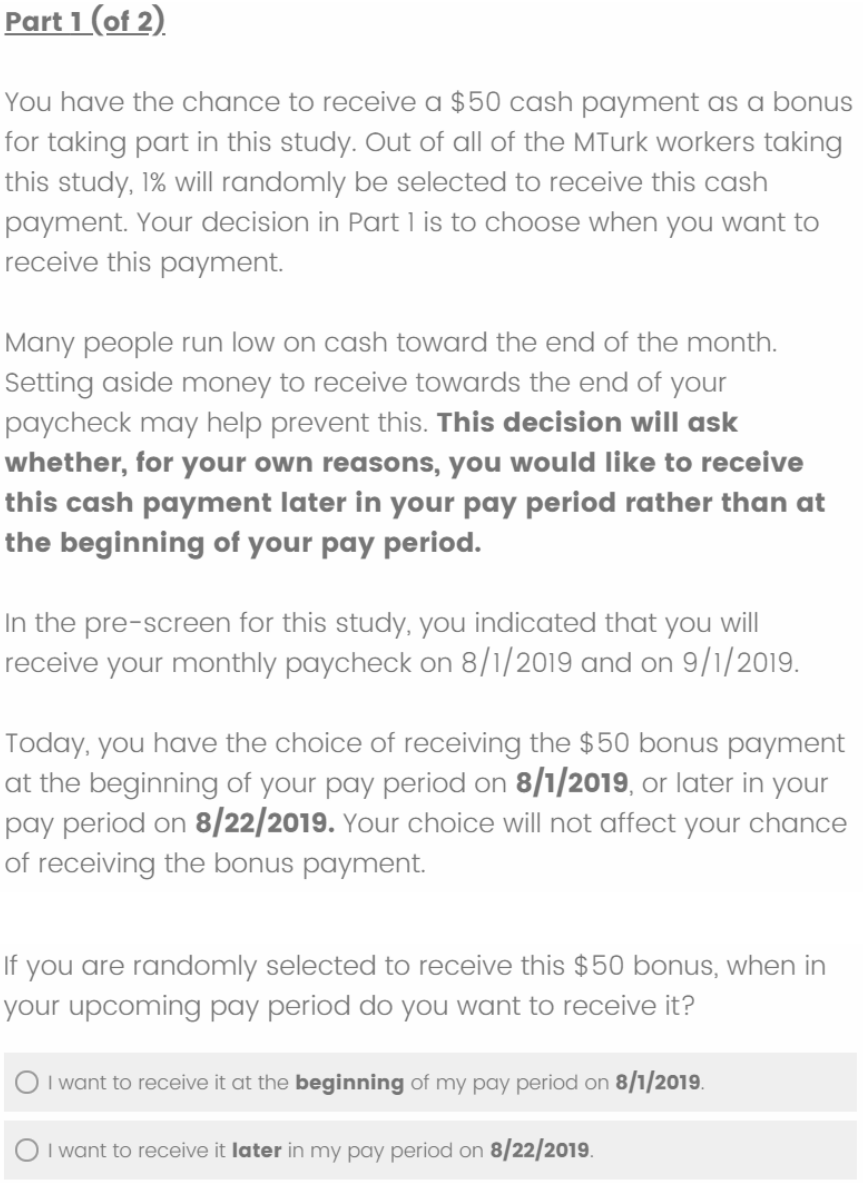


Figure 11: Commitment Decision

On the next page, they have the option of filling out a text box to explain how they made the commitment decision. Then, on the final page, they complete the survey by filling out a series of socio-demographic questions.

6.2 Additional Tables

Table 7: Balance Table by Treatment Day

Variable	(1) d–11 Mean/SE	(2) d–8 Mean/SE	(3) d–5 Mean/SE	(4) d–2 Mean/SE	(5) d +1 Mean/SE	F-test for joint orthogonality
Female	0.635	0.687	0.583	0.636	0.618	0.212
	(0.031)	(0.030)	(0.032)	(0.030)	(0.031)	
Age	42.180	42.366	42.579	43.264	42.237	0.908
	(0.905)	(0.880)	(0.906)	(0.868)	(0.895)	
Caucasian	0.775	0.811	0.779	0.771	0.767	0.785
	(0.027)	(0.025)	(0.027)	(0.026)	(0.027)	
Bachelor's degree	0.385	0.395	0.413	0.403	0.345	0.590
	(0.031)	(0.031)	(0.032)	(0.031)	(0.030)	
Married	0.500	0.490	0.498	0.519	0.518	0.954
	(0.032)	(0.032)	(0.033)	(0.031)	(0.032)	
Income $25,000-$49,000	0.238	0.276	0.285	0.279	0.301	0.611
	(0.027)	(0.029)	(0.030)	(0.028)	(0.029)	
Works full-time	0.422	0.453	0.438	0.473	0.418	0.717
	(0.032)	(0.032)	(0.032)	(0.031)	(0.031)	
Can raise $400	0.324	0.296	0.315	0.353	0.337	0.719
	(0.030)	(0.029)	(0.030)	(0.030)	(0.030)	
Number of Credit Cards	3.148	2.860	3.051	3.132	3.494	0.205
	(0.179)	(0.149)	(0.187)	(0.168)	(0.247)	
Amount of Credit	19275.295	22276.543	17022.566	22614.721	22174.900	0.313
	(2162.134)	(2811.209)	(1635.878)	(1793.782)	(2473.808)	
N	244	243	235	258	249	

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. This table shows the mean and standard error of each variable by treatment day. The last column shows the p-values of an F-test for joint orthogonality of each variable across all treatment arms.

Table 8: Randomization Inference Results: Proportion Choosing to Commit by Day

	(1) d+1	(2) d–2	(3) d–5	(4) d–8	(5) d–11
Proportion Choosing to Commit	0.305	0.310	0.315	0.420	0.344
Difference from d+1	-	0.005	0.010	0.115	0.039
Randomization-t p-values		(0.896)	(0.823)	(0.008)***	(0.351)
Observations	249	258	235	243	244

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Each column denotes the day relative to payday that participants make the commitment decision. *Proportion Choosing to Commit* describes the proportion of participants who choose to adopt a commitment device on that day. *Difference from d+1* shows the difference in willingness to commit between that day and d+1. *Randomization-t p-values* shows the randomization inference p-values of a t-test comparing each treatment day to d+1 based on 10,000 draws.

6.3 Pre-registration Details

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ASPREDICTED

PROJECTION BIAS IN FINANCIAL DECISIONS - June 2019 (#24265)

Created: 06/01/2019 08:37 PM (PT)
Shared: 04/24/2020 08:59 PM (PT)

This pre-registration is not yet public. This anonymized copy (without author names) was created by the author(s) to use during peer-review.
A non-anonymized version (containing author names) will become publicly available only if an author makes it public. Until that happens the contents of this pre-registration are confidential.

1) Have any data been collected for this study already?
No, no data have been collected for this study yet.

2) What's the main question being asked or hypothesis being tested in this study?
Projection bias will influence how individuals make financial decisions. In particular, when people who receive their monthly paychecks have the chance to delay a future bonus payment to help themselves consumption smooth over a pay period, their likelihood of doing so will non-monotonically increase at the end of their pay period when their financial resources are low and decrease again at the receipt of their next paycheck. Therefore, this effect will be pronounced for low-SES and credit-constrained individuals. I predict that participants with lower household income and more financial stress will be more likely to delay payment.

3) Describe the key dependent variable(s) specifying how they will be measured.
The rate of delaying a future bonus payment. In particular, each participant will have a 1% chance of receiving a $50 bonus payment. They choose between receiving the bonus payment at the beginning of a future pay period or 10 days before the end of that pay period. The pay period is at least one month in the future.

4) How many and which conditions will participants be assigned to?
Five conditions: when they make the decision: 11 days before their next paycheck, 8 days before their next paycheck, 5 days before their next paycheck, 2 days before their next paycheck, 1 day after their paycheck.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.
Linear regression predicting overall willingness to delay payment with dummy variables for the treatment groups and controlling for gender, household income, and financial well-being.

Pairwise comparisons and a chi-squared test of the proportion choosing to delay payment between each of the treatment groups. I will also report results controlling for gender, household income, financial-well being.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.
I will exclude any participants who indicate that they did not correctly enter their paycheck dates during the pre-screen or who do not answer the attention check question correctly.

7) How many observations will be collected or what will determine sample size? No need to justify decision, but be precise about exactly how the number will be determined.
I will enroll people until 1,500 people have participated or until July 31, 2019.

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)
I include additional questions and psychological measures for exploratory purposes including Cohen's Perceived Stress Scale, level of credit-constraint, self-report of being low on cash right now, and other demographic questions. I will investigate how these relate to willingness to delay payment as well as how they relate to household income and financial well-being.

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