Patience Across Payday: The Role of Scarcity in Commitment Decisions

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Abstract

Individuals often behave impatiently when making financial decisions for the future. This paper tests whether the timing of decisions relative to payday — which leads to temporary but recurring conditions of scarcity — influences their choice. In a large pre-registered experiment ($n = 1,229$), participants can 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 34% more likely to take up commitment. This coincides with when individuals experience the most financial scarcity, and provides evidence that intertemporal decisions are affected by current psychological states. (*JEL* C91, D14, D15, D91)

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1 Introduction

People often face decisions that place their current desires in conflict with their long-term interests. They might choose higher spending today rather than saving for retirement,[1] or regularly borrow money through credit cards that they have to pay off at a high interest rate later.[2] These are choices that have an intertemporal dimension, or in other words, that have consequences spanning across different time periods. In many intertemporal choice scenarios, people behave *impatiently* — by preferring smaller earlier utility gains to larger later utility gains — a trait that is often associated with worse long-run outcomes in household finance.

Impatient financial decision-making can be particularly harmful for lower-income households. Financial planning is a cognitively difficult task that requires a series of trade-offs between over different outcomes and time periods. The consequences are more serious for those who are credit-constrained and living paycheck to paycheck, whose daily consumption decisions represent a larger percentage of their disposable income — in other words, people who make financial decisions under conditions of *scarcity*. In addition to the mechanical relationship between the magnitude of consumption decisions and income, a recent literature has proposed that financial scarcity — defined as "having less than you feel you need" — also leads to psychological changes, including in attentional focus or cognitive function, that may affect decision-making (Mullainathan and Shafir, 2013; see also Haushofer and Fehr, 2014; Bartos et al., 2018; Ong, Theseira and Ng, 2019).

In this paper, I investigate these questions in the context of the payday cycle, to study whether the regularly recurring but temporary scarcity induced by the payday cycle affects whether individuals make patient financial choices. Payday leads to large intra-month fluctuations in liquidity and consumption for many people, especially those who are credit-constrained or lower-income. Previous work has found that not only liquidity but also

[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, 2002; 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 Canilang et al. (2020).

[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), these households make an average payment of $1,045.55 annually.

consumption varies systematically across the payday cycle, being highest directly after payday and tapering off through out the rest of the payday cycle. This consumption pattern often leaves consumers worse overall and suggests impatience — as when, for example, someone runs low on money by the end of the payday cycle in a way that affects their material or psychological well-being. Evidence for this explanation includes sharp declines in caloric intake and other non-durable consumption for food stamp recipients across the food stamp month, Social Security recipients across the Social Security month, Japanese pensioners across quarterly public pension payouts, as well as for a representative sample of UK households across payday cycles (Shapiro, 2005; Stephens Jr, 2003; Mastrobuoni and Weinberg, 2009; Huffman and Barenstein, 2005).

Within this context, I investigate whether timing around payday affects the take-up of a *commitment device*, a mechanism that allows someone who suspects they might be impatient in the future to restrict their future choice set so as to encourage the more future-oriented decision (for a review, see Bryan, Karlan and Nelson, 2010). The commitment decision involves choosing the timing of a possible bonus payment: either earlier, at the beginning of a future payday cycle or later, three weeks into that payday cycle, when participants might be running low on cash if they had not been successfully consumption smoothing. The payout and likelihood of receiving the payment is the same regardless of their choice. By choosing the commitment device, participants constrain their future choice set and lose out on the time value of money. If they predict that they will properly smooth their consumption over their payday cycle, ceteris paribus, they would not want to commit.

I pre-registered the hypothesis that individuals would be more likely to adopt this commitment device before payday, when they are experiencing financial scarcity, than after payday. While most of the literature on impatient choices focuses on the role of present bias — the tendency to prefer smaller rewards now over larger rewards anytime in the future — I hypothesize that scarcity in this setting affects decision-makers instead through their attentional focus, in the sense that current scarcity makes them more aware of the possibility of scarcity in the future. This relates to the behavioral economics literature on projection bias, in which individuals underestimate the extent to which their state might change in the future, and instead imagine themselves in the same state as they are in now (Loewenstein,

O'Donoghue and Rabin, 2003). Along these lines, I predict that someone in a state of financial scarcity before payday would be more likely to recognize that they might be impatient over the upcoming payday cycle — and that therefore, the commitment device would be beneficial for them — than if they were cash-flush after payday.

To test this, I run an experiment involving 1,229 individuals in a multiple-period study online. I randomize participants into five treatment groups that vary according to when in their payday cycle they make the commitment decision, one after payday and four before payday. I choose five treatment groups rather than just two (one before payday and one after) because scarcity theory is about the subjective perception of scarcity and its psychological consequences, and previous work on the payday cycle does not predict when exactly participants might perceive the most payday-induced scarcity. One possibility is that scarcity is experienced as highest the day before payday, when liquidity is objectively the lowest. However, it is also possible that anticipatory relief is experienced as payday approaches (see Zhang and Sussman, 2018), and that scarcity is experienced as highest some time earlier, when the approaching payday still feels far away. In this way, an objective measure of liquidity may be only a crude proxy for scarcity (see again Mullainathan and Shafir, 2013). To accommodate these possibilities, this study involves five different treatment days, each spaced three days apart, spanning eleven days before payday through the day after payday.

My results provide evidence for the latter scenario, that is, that individuals feel more cash-strapped when they still have to stretch their money before payday arrives: while participants are always more likely to report being low on cash before payday than after payday, this measure rises to a peak eight days before payday and falls again thereafter. While 57% report being low on cash the day after payday, 68% report being low on cash eight days before payday. I therefore find evidence that the perception of financial scarcity does not follow in lockstep with actual liquidity.

Consistent with the pre-registered hypothesis, the main treatment results reflect a similar pattern. Participants on average choose to commit 33.8% of the time, with participants more patient before payday. Like the results on financial scarcity, commitment peaks eight days before payday, when participants are 11.8 percentage points more likely to commit than the

day after payday. This difference in willingness to commit is statistically significant ($p < 0.05$) and corresponds to a 34% increase in willingness to commit.

This paper contributes to the literature on how financial circumstances affect economic decision-making. Despite much evidence about how scarcity affects psychological states, there are only a few studies that examine how real-world sources of scarcity affect economic decisions, due largely to the difficulty in identifying scarcity in an unconfounded way. This paper examines this questions in an everyday setting, and finds that timing around payday does indeed affect financial decision-making, suggesting that financial scarcity is a psychological state that affects how people value the future. This paper also contributes to the empirical evidence of projection bias and the emerging class of "field-in-the-lab" studies. A more detailed literature review can be found in Section 1.1.

1.1 Literature Review

This paper contributes to three sets of literature. The first is the literature on how financial circumstances affect economic decision-making, where several strands of work have examined the relationship between poverty and impatience, including why low-income households repeatedly take out payday loans or use lottery purchases as savings vehicles (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 financial scarcity uses up cognitive bandwidth and affects psychological states, examining measures of stress and cognitive function during periods of scarcity. (Mullainathan and Shafir, 2013; Haushofer and Fehr, 2014; Ong, Theseira and Ng, 2019). Other papers in this literature examine economic decisions after inducing study participants to think about poverty (Mani et al., 2013; Bartos et al., 2018).

However, there is little evidence so far on how real-world scarcity affects economic behavior (see the handbook chapter from Kremer, Rao and Schilbach, 2019). In a study of scarcity and workplace productivity, Kaur et al. (2021) show that manufacturing workers in India with more cash on hand are more productive at work. Fehr, Fink and Jack (2022), study the effect of financial constraints on the endowment effect in a sample of farmers in Zambia

before and after harvest. Harvest strongly affects their level of scarcity, and, similarly to this paper, they find that individuals who are more financially constrained make the more economically rational decision.

Finally, the most related study within the literature on financial circumstances and economic decision-making is Carvalho, Meier and Wang (2016), who also examine the financial scarcity caused by payday, looking at its effects on cognitive function as well as on laboratory measures of risk and time preferences. They find very few effects. In response, Mani et al. (2020) examine their results in detail, suggesting that these null results may be the result of specific design factors, which were conducted differently in this study. One factor is the number of days between payday and filling out the survey. While study participants in Carvalho, Meier and Wang (2016) are randomly assigned to complete their survey either before or after payday, they do not distinguish between different before-payday days; the before-payday group took the survey anywhere between ten days before to three days after payday. As this study demonstrates, the perception of financial scarcity before payday is sensitive to the specific day.[3] A second factor discussed by Mani et al. (2020) is whether someone has income from multiple income sources, which would enable better consumption smoothing if coming at different times. As is discussed in Section 2.3, all study participants in this study have at least MTurk income in addition to their main source of income; moreover, 31% of participants have an additional source of income as well. However, as expected, results are stronger when restricting to participants who only have one main source of income (see Table 1). Finally, I examine different outcome measures than Carvalho, Meier and Wang (2016): I look at the effect on the take-up of a commitment device that could help participants in a future payday cycle, whereas they examine the effect on general measures of cognitive function, time preference, and risk preference. It could be the case that the effects of financial scarcity on decision-making are domain restricted.

This paper also contributes to the empirical literature on projection bias. Empirical work in this field shows, for example, that consumers purchase more convertibles in unexpectedly sunny weather, buy more health insurance when air pollution is higher, or choose to work less

[3]In this study, 90% of subjects made the commitment decision on their assigned treatment day, and 100% of subjects did so within the three-day period between their assigned treatment day and the following one.

when they are currently tired; these are all examples of "hot states," visceral states that affect decision-making (Busse et al., 2015; Chang, Huang and Wang, 2018; Augenblick and Rabin, 2019). In this case, short-term changes in financial circumstances act as a change in state that leads some individuals to recognize that they may benefit from a commitment device. This directly relates to recent work by Zhang (2021), who suggests that many behaviors that we perceive as time preferences are, in fact, driven by projection bias. In her model, an agent perceives the value of investments in the future differently depending on whether they are currently in a good or bad state, which she calls *projective misperceptions*; she argues that when we ignore the role of these misperceptions, we misestimate the role of time preferences. I provide evidence that is the case.

Finally, this paper also contributes methodologically to an emerging class of experimental studies in the economics literature that incorporate real-world conditions into laboratory experiments, which can be understood as "field-in-the-lab" experiments. While these studies allow decisions to be fully observable — like in lab experiments — they are more ecologically valid, often improving the external validity of the experiment. While the experiment in this paper is conducted in a lab environment, the exogenous variation does not come from inside the lab, but instead from participants' actual own payday dates, and measures a financial decision that can affect their future month's finances. Other recent work that can be classified as field-in-the-lab include Kessler and Roth (2014), who study real organ donation registrations within a university lab connected to the Massachusetts Registry of Motor Vehicles database, and Grebe, Ivanova-Stenzel and Kröger (2021), who ask study participants to log into their eBay accounts inside their university lab to measure trading behavior.

2 Study Design

The experimental protocol involves two parts, which take place longitudinally 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. For the motivation behind the choice of treatment days, see Section 2.2.

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 low on money late in their payday cycle, they may desire the more patient decision in order to mitigate the hardship that can follow from running low on money late in their payday cycle. 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 commitment decision reads:

> 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.

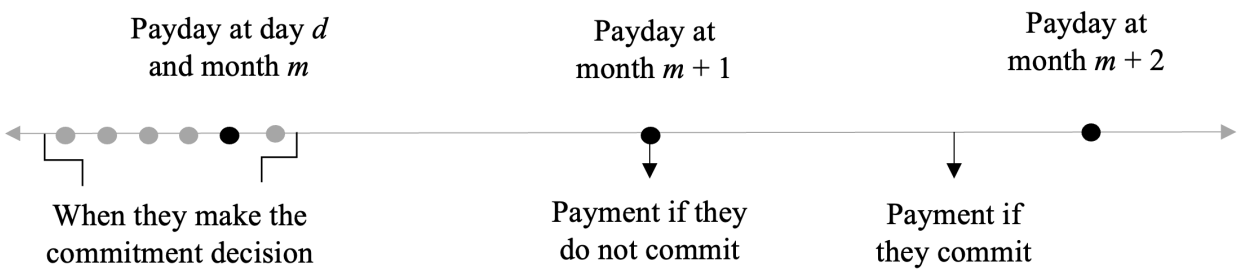
The underlined dates vary according to the study participant's own payday dates and treatment group. The example above imagines a participant taking the study in August who receives their paycheck on the first day of every month. If they were assigned to treatment group $d - 11$, they would be taking the study on August 21 and choosing when in their October payday cycle they would like to receive a possible 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 experimental protocol, see Section 7.1 of the Appendix.

2.1 Timing of the Commitment Decision Options

Figure 1 shows timing of the bonus payment options, both relative to payday and to when participants make their payment decision. If a participant chooses to receive the bonus payment earlier, they receive it on the payday of a future payday cycle, about one month in the future. If they choose to receive the bonus later, they receive it three weeks after that.

Figure 1: Treatment and Commitment Timeline



Note: This figure displays the timing of when participants are asked to make the commitment decision as well as the payment options available in the commitment decision. The black circles indicate paydays. The grey circles indicate the treatment days; each participant is asked to make the commitment decision on one of these days. The early payment option is paid out at m+1, and the commitment option is paid out three weeks later, before m+2.

This design of the bonus payment options was primarily made to remove present bias — the inclination to prefer a smaller present reward to a larger later reward — as a possible factor in their decision. I specifically invoke the commonly-used version of the model from Laibson (1997) and O'Donoghue and Rabin (1999):

$$U_t(u_t, u_{t+1}, ...) \equiv u_t + \beta \sum_{k=t+1}^{T} \delta^{k-t} u_k, \tag{1}$$

where $\delta \in (0, 1]$ and represents the standard future discount factor, and $\beta \in (0, 1]$ and represents present bias by differentiating any choices about the present from any choices about the future. For a fully present-biased agent, $\beta = 1$.

Present bias is usually implicated when people have difficulty consumption smoothing, including across the payday cycle (see, for example, Shapiro, 2005); valuing current consumption more highly than future consumption gives rise to repeated cases of "over"-consumption in the moment, which can lead to a cash- and credit-constrained person running low on money by the end of their payday cycle.[4] However, present bias would not predict a difference in

[4]I include the quotation marks around "over" to acknowledge the normative quality of this statement. Contrary to the budget-smoothing rational actor in traditional theory, it may be the case that (some) people prefer to consume more earlier in the payday cycle, even from the perspective of an agent who takes all time

treatment effect in this study aside from the effects of standard long-term discounting; both bonus payment options are at least one month in advance, well beyond when present bias, a behavioral bias about "now," is thought to act (see, for example, Balakrishnan, Haushofer and Jakiela, 2020). Instead, the only difference is the time cost of delaying income, which in this case would be very small.

Having two future options also removes other 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 (Cohen et al., 2020, see for a discussion of this). This design choice makes the payment options more directly comparable.

With the present bias channel closed, the research design leaves open the possibility that changes in financial scarcity will affect decision-making through projection bias, in which individuals overestimate the extent to which their future tastes and preferences will resemble their current ones. The most common formulation, from Loewenstein, O'Donoghue and Rabin (2003), is as follows:

$$E_0[u(x_t, s_t/s_0)] = \alpha u(x, s_0) + (1 - \alpha)u(x, s_t), \tag{2}$$

where $u(x, s)$ indicates the utility of taking action x given state s; the true value of taking the action at time t will be $u(x_t, s_t)$, but if someone projects their current state onto the future, they predict their future utility using their current state s_0. α represents the degree of projection bias, where $\alpha = 0$ indicates that the agent is predicting their future preferences accurately, whereas $\alpha = 1$ means they believe their future preferences will be identical to their current preferences.

Previous empirical work in this literature has shown that consumers purchase more convertibles in unexpectedly sunny weather, are willing to pay more for drug substitutes when currently drug-deprived, and want to complete fewer work tasks when tired from previous work (Badger et al., 2007; Busse et al., 2015; Augenblick and Rabin, 2019). Similarly, I propose that individuals will be more likely to take-up a commitment device when currently

periods into account. For example, as included in Thakral and Tô (2020)'s model, someone may receive a burst of utility from unexpected consumption. However, the fact that some participants in this study make different choices depending on timing in the payday cycle suggests that at least some people do not engage in their preferred budget smoothing.

experiencing financial scarcity. By projecting their current financial scarcity onto the future, a person will be more likely to recognize that the commitment device could be beneficial for them when they are low on cash than they are cash-flush after payday.

2.2 Timing of the Commitment Decision

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 might exist: when participants might perceive the most payday-induced scarcity, which in turn would affect their decision to take up the commitment device. Scarcity theory builds on the subjective perception of scarcity and its psychological consequences; the original definition by Mullainathan and Shafir (2013) is "having less than you feel you need." In this way, the perception of current cash on hand is what matters more than actual available liquidity, and as Mullainathan and Shafir (2013) also note, these can differ, so that income is at best a proxy for scarcity.[5] Despite this, however, most previous work measures scarcity in a way that neglects this subjective dimension (see the review paper by De Bruijn and Antonides, 2022, who also make this point).

However, there is little prior evidence on when people might experience scarcity most acutely during 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 when their paycheck is about to arrive.[6] In that case, people who draw down their paycheck throughout the month might start worrying about their ability to make it to the next payday some time before the end of their payday cycle. 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 spaced three days apart.

[5]Recent work shows that even wealthy people experience financial scarcity. Kaplan, Violante and Weidner (2014) describe the"wealthy hand-to-mouth," households with sizeable amounts of illiquid assets who nonetheless live paycheck-to-paycheck.

[6]This would be consistent with evidence from the literature 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.

2.3 Implementation

Subjects for this experiment were recruited on MTurk in June and July 2019 and participated through August. The experimental protocol followed the pre-registered design details. The pre-registration is available in Appendix Section 7.4.

In order to participate in the study, subjects were required to have an IP address in the United States, to have completed at least 100 tasks on MTurk prior to this one, and to have received an 85% or better approval rating on average. In addition, the study included only MTurk workers who (1) received monthly paychecks and (2) whose main source of income was not MTurk. These restrictions were motivated by the existing evidence in household finance. First, 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, in which case budgeting across a monthly payday cycle might be more difficult than, say, a biweekly payday cycle (Stephens and Unayama, 2011; Aggarwal, Dizon-Ross and Zucker, 2020). Second, since MTurk workers get paid as they receive tasks, they have a higher ability to smooth their income across the payday cycle than the average worker. To mitigate the effect of this ability on their consumption patterns, I only included those MTurk workers who received the bulk of their monthly income from a source other than MTurk.

In the email that participants receive on their assigned treatment day, I ask them to complete the task within 24 hours. The content of this email can be found in Appendix Section 7.1.2. The task, however, remained open for a total of three days, or in other words, until the next treatment group window began.

3 Results

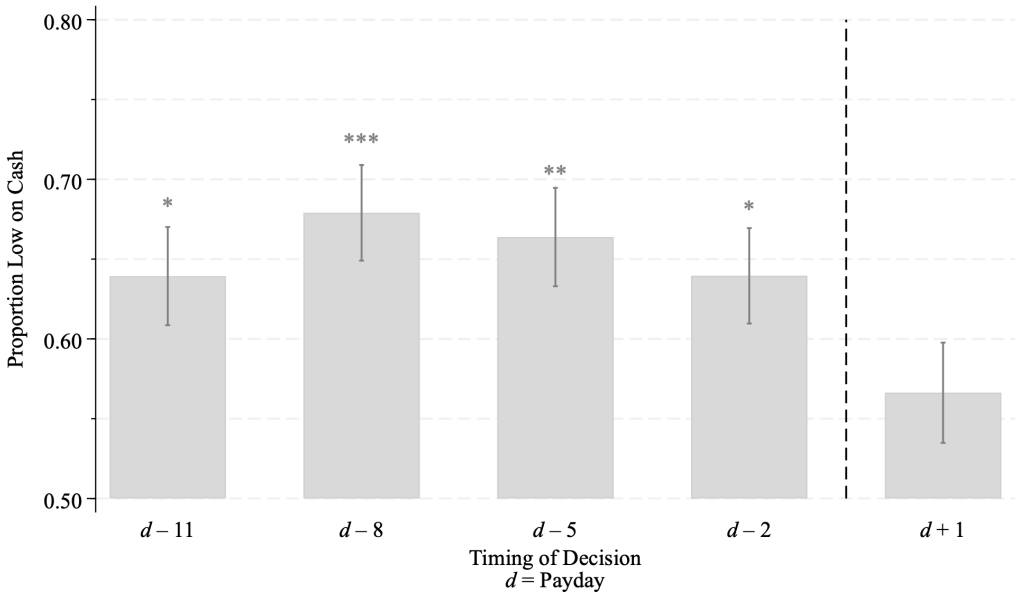
I collected data from 1,229 individuals. The sample was 63% female and the median participant was between 35-44 years of age, had a bachelor's degree, and had an annual household income between $50,000 and $59,999. Only 33% of the sample said they could easily raise $2,000 in an emergency; 19% did not think they could raise it at all. See Appendix Section 7.2 for more descriptive statistics as well as a balance table, which shows that observable characteristics

were broadly balanced across treatment groups.

3.1 When do participants feel cash-strapped?

To investigate whether participants are currently experiencing financial scarcity, I ask the question, "Are you low on cash right now?" Results are shown in Figure 2.

Figure 2: Low on Cash by Day Relative to Payday



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.

Participants are more likely to report they are low on cash at all points before payday, and most likely to do so at $d-8$. While 57% are low on cash the day after payday — notably, the majority of the sample — this proportion rises slowly in the days before payday, peaking eight days before at 68% ($p < 0.01$). It falls again at the furthest day out we observe, $d-11$.

Why does this happen 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 the subjective experience of financial scarcity does not

need to correspond one-to-one with the objective amount of liquidity on hand. In particular, a person might feel the relief of an upcoming payday as it approaches and experience scarcity more acutely when they still have to stretch their resources for some time. In this way, these results indicate that study participants experienced scarcity most acutely around eight days before payday.

3.2 Does the timing of the decision matter?

To test whether the decision to adopt a commitment device varies based on timing around payday, I run an OLS regression with the binary choice to commit as the dependent variable, comparing those who make the decision after payday to the before-payday treatment groups. These results are presented in Table 1. All columns include time controls to ensure that the results are driven by day relative to payday rather than other time-related effects.[7] Without any controls, the full sample average willingness to commit is 33.8%. Columns (1) - (3) use data from the full sample, while columns (4) - (6) restrict to those with only one source of income other than MTurk.

As predicted, willingness to commit is higher before payday than after payday. Looking at individual treatment groups, commitment rises slowly from the day after payday through two and five days before payday, but not in a way distinguishable from zero. It peaks at eight days before payday, when individuals are 11.8 percentage points more likely to commit ($p < 0.05$), representing a 34% increase in willingness to commit compared to $d + 1$. The level falls again further out from payday. These results reflect the same pattern as the low on cash data, with the time of highest commitment coinciding with the time of most financial scarcity.

In columns (2) and (3), I test whether the results are robust to a durable measure of financial well-being as well as demographic characteristics, as laid out in the preregistration. For overall financial well-being, I use the Consumer Financial Protection Bureau's (CFPB) Financial Well-Being Scale, which is a ten–question survey that yields a measure ranging from 0 to 100, with a higher score indicatin better financial-wellbeing. Results showing heterogeneity by age, gender, income, and education level can be found in Appendix Section 7.2.

[7]Payday dates were quite heterogeneous: the most common payday date included only 6.5% of the sample.

Table 1: Commitment by Day Relative to Payday

	Full Sample			One Source of Income		
	(1)	(2)	(3)	(4)	(5)	(6)
$d-11$	0.060	0.055	0.064	0.103	0.099	0.111
	(0.047)	(0.047)	(0.047)	(0.054)	(0.053)	(0.053)
$d-8$	0.118	0.115	0.102	0.162	0.161	0.156
	(0.047)	(0.047)	(0.048)	(0.056)	(0.057)	(0.058)
$d-5$	0.038	0.034	0.029	0.041	0.040	0.040
	(0.048)	(0.047)	(0.048)	(0.056)	(0.056)	(0.056)
$d-2$	0.001	-0.001	-0.008	0.013	0.018	0.028
	(0.046)	(0.045)	(0.046)	(0.054)	(0.053)	(0.054)
Financial Well-Being		-0.048	-0.058		-0.056	-0.071
		(0.013)	(0.016)		(0.016)	(0.019)
Constant	0.345	0.344	0.328	0.311	0.288	0.178
	(0.073)	(0.071)	(0.094)	(0.094)	(0.091)	(0.123)
Demographic Controls			X			X
Observations	1229	1229	1229	842	842	842

Standard errors in parentheses

Note: Standard errors are heteroskedasticity robust. Results are from OLS models with the binary decision to adopt a commitment device as the dependent variable. All columns include time controls for day of the week, week, and month. The first three columns include the full sample, while the last three columns restrict the sample to only those participants who have one source of income aside from MTurk income. *Financial well-being* indicates the invididual's score from the CFPB Financial Well-Being Scale, and has been standardized to have a mean of 0 and a standard deviation of 1. *Demographic controls* includes indicator variables for gender, age, income, race, marital status, and education level.

Columns (4) - (6) look at the same results in a restricted sample that includes only those participants with just one source of income aside from MTurk income, who make up 69% of the sample. As discussed in Section 1.1, this is the group of participants with the fewest consumption smoothing options in their payday cycle, who might therefore experience the highest payday-related liquidity shocks. As would be expected, the general pattern looks similar, and the treatment effect increases for this group: individuals who make the decision eight days before payday are 16.2 percentage points more likely to adopt the commitment device.

Additional robustness checks can be found in Appendix Table 5 and Table 6. Results look similar using the raw data without any controls, and hold using equality of proportions tests comparing each group before payday and the group after payday. 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 treatment groups are equal at $\alpha = 0.05$. The effect at $d - 8$ also passes a Bonferroni correction at $\alpha = 0.05$. Finally, I re-run these results using a randomization inference procedure, and find the same levels of statistical significance (Young, 2019).

After participants made the commitment decision, I gave them the opportunity to explain how they made their decision in a free text box on the next page. Even though this question was optional, 81% of respondents wrote a response. Out of those who responded, many made clear they understood the costs to waiting longer for money: 54% of those who chose not to commit expressed some kind of a pure preference for money sooner, including some who mentioned the time value of money; respondents who chose not to commit also mentioned their regular expenses happening at this time (23%), a budget they follow (18%), or a variety of other reasons, like a pressing need or a one-time item. Those who did choose to commit overwhelmingly appreciated that receiving the money later might confer an additional benefit, with 93% of those who wrote a response indicating that the timing would be beneficial to them. Some provided additional reasons why this might be the case, including 38% who explicitly described a lack of money, 14% who mentioned a budget, and 10% mentioning that this is when unexpected shortfalls tend to crop up. 2.5% of all respondents said that the timing did not matter or they chose randomly. Taken as a whole, these responses indicate

that participants understood the decision and considered their choice carefully.[8]

4 Discussion

As predicted in preregistration, I find that the likelihood of adopting a commitment device increases in the before-payday period and coincides with when study participants experience the most financial scarcity, consistent with the hypothesis that individuals project their current financial scarcity onto the future.

However, in the preregistration, I also predicted that this effect would be more pronounced for households with low household income or credit constraints, which I do not find. This could be because the sample is comprised of MTurk workers, who are a self-selected group of workers doing online tasks for additional income, making them more likely to be cash-strapped than the general population; additional evidence for this is the large proportion of people reporting being low on cash and the low number who would be able to raise $2,000 in an emergency. Generally speaking, I do not have large enough heterogeneity in my sample to be able to estimate differences by demographic subcategory with confidence.

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

4.1 Other Intertemporal Hypotheses

This paper has discussed the role of projection bias as a driver of behavior in this setting. But could other theories of intertemporal choice also matter? Aside from projection bias, there are three main intertemporal phenomena that might resemble impatience: habit formation,

[8] I developed categories based on a reading of a sample of responses. ChatGPT 3.5 Turbo then coded each response as belonging to one or more of these categories, with a random sample check by me for accuracy.

news utility, and anticipatory utility (see O'Donoghue and Rabin, 2015 for a discussion). As described below, these hypotheses either do not make a prediction in this setting or are inconsistent with the study results.

Habit formation or, similarly, a preference for consistency, suggests that consumption utility depends on past consumption, so that an agent only gradually adjust consumption to income shocks. In the payday cycle, this would suggest more consumption smoothing across the payday cycle, so that we would not expect changes before and after payday, and the commitment device would not be helpful.

News utility suggests that people experience gain-loss utility when they receive information that changes their beliefs about future consumption (see Kőszegi and Rabin, 2009). Participants in this study may experience an immediate utility gain from the prospect of the future bonus payment. Theory suggests this would affect their current consumption like present bias, with a higher propensity to consume out of current cash. If we think that this prospect would also affect their decisions about the future, it would affect all treatment groups equally, and not explain a difference between treatment groups.

Anticipatory utility formalizes the idea that individuals care about future utility flows. In this setting, individuals may derive anticipatory utility from the prospect of a bonus payment. While the impact of anticipatory utility on intertemporal choice is relatively unexplored, Thakral and Tô (2022) present a model where agents who receive a windfall will experience more anticipatory utility the longer they have to wait for it, which has an acclimatization effect that results in more patient decisions. This, however, is inconsistent with the results in this study: while the before-payday agents — who must wait longer for the bonus payment — are more patient on average, they are not more patient in a monotonic way. Instead, as expected in the pre-registration, I find a parabolic relationship between time and patience, with a maximum at the time of highest scarcity.

5 Conclusion

This paper shows that timing relative to payday affects patience about the future, and in particular, that individuals are more likely to take up a commitment device when they

are currently experiencing financial scarcity. In this way, offering the chance to make a future-oriented decision at the right moment leads study participants to the insight that it would be useful to delay a payment in order to benefit their future self.

This result has policy implications. Many people experience monthly swings in liquidity due to the payday cycle, and the passing of a few days can make the difference between someone making a patient or an impatient financial choice. This could have consequences for major one-off decisions, like choosing a retirement savings rate or deciding on a loan repayment plan. This study suggests that individuals and policymakers should pay attention to how changes in financial scarcity, even if temporary, might affect their valuation of the future, and that timing relative to payday is an important factor to consider. Finally, these results also indicate there is demand for a consumption smoothing mechanism across the payday cycle.

A limitation of this study is that it was run in a stylized environment, making it difficult to understand what the magnitude of this effect might be in other settings. The commitment device in this study provided a mechanism for those who experience scarcity during the payday cycle to smooth their consumption; however, the study sample involved MTurk workers, who — though selected for receiving the majority of their income through a monthly paycheck — nonetheless had access to a consumption smoothing device through the MTurk platform, on which they can be paid task by task. The effect might therefore be larger in a similar setting without access to consumption smoothing, and, of course, different in other contexts. Future work can investigate how the payday cycle affects decisions in more natural settings, such as banking environments.

Finally, these results suggest that harnessing current financial scarcity might be a useful tool for individuals and policymakers to use to promote future-oriented decision-making. Financial planners already use results from the psychology and economics literature to design such interventions: Merrill Lynch, for example, used a "Face Retirement" tool that displayed an aged rendering of users' faces in order to encourage them to better imagine their future selves. Likewise, this study suggests that experiencing current scarcity helps people better imagine and, therefore, better prepare for future scarcity.

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7 Appendix

Contents

7.1 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 7.1.1 describes the pre-screen and section 7.1.3 describes the main experimental task in which participants make a commitment decision.

7.1.1 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 3 and Figure 4 shows how the income questions are asked. Figure 5 and Figure 6 show how the paycheck questions are asked. The calendar display in Figure 6 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.

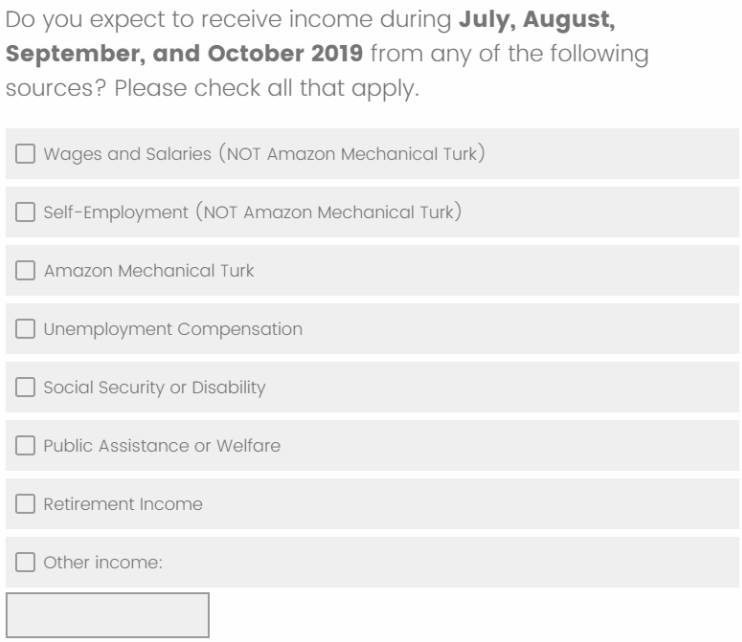


Figure 3: Pre-Screen Question #1

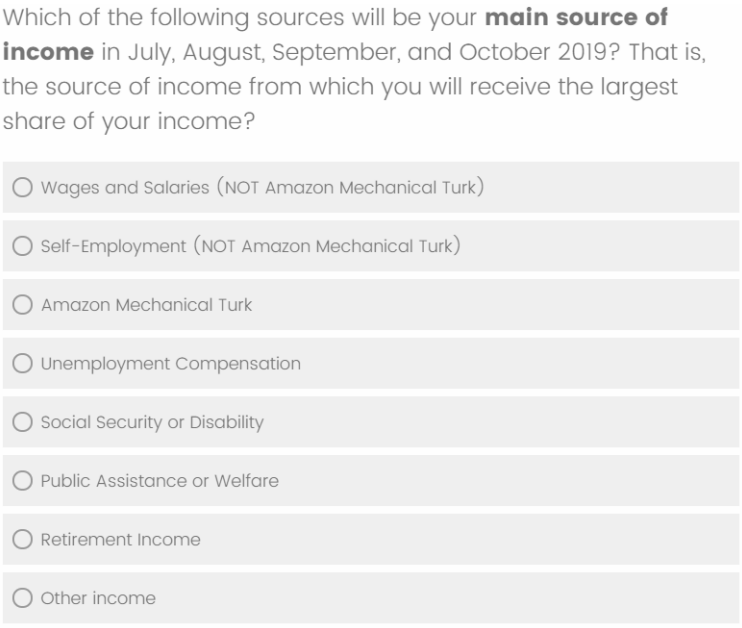


Figure 4: Pre-Screen Question #2

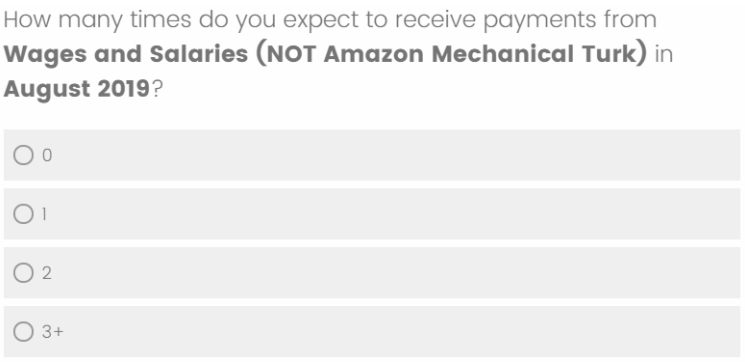


Figure 5: Pre-Screen Question #3

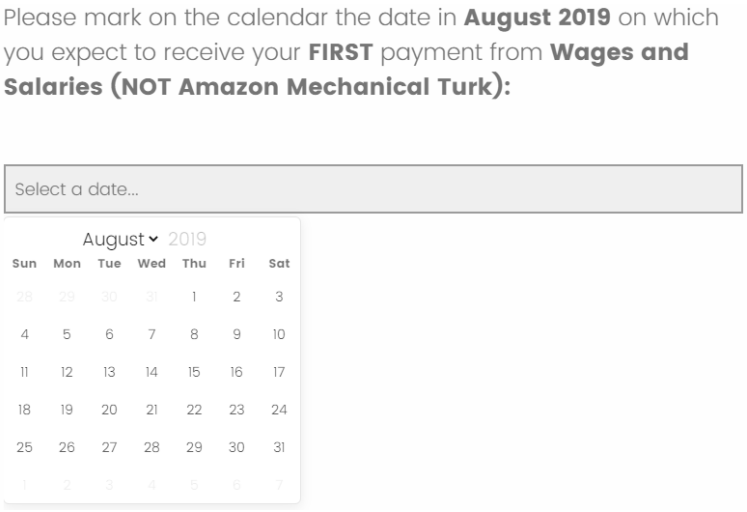


Figure 6: Pre-Screen Question #4

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 2 for the number of participants assigned to each treatment group versus the number who ultimately enrolled.

Table 2: Attrition by Treatment Day

	Number assigned	Number enrolled
$d+1$	339	249
$d-2$	340	258

	Number assigned	Number enrolled
$d-5$	336	235
$d-8$	338	243
$d-11$	337	244

7.1.2 Invitation Email

Subject: Harvard Financial Decisions Study! $2 for 7 minutes plus chance of bonus
Body: The academic survey you qualified for through a pre-screen is now up on MTurk. You can search for it using the title "Harvard Financial Decisions Study" or the requester name "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.

7.1.3 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 7. Next, they face the commitment decision shown in Figure 8. In the

study, the dates are filled in with the paycheck information each person supplied during the pre-screen.

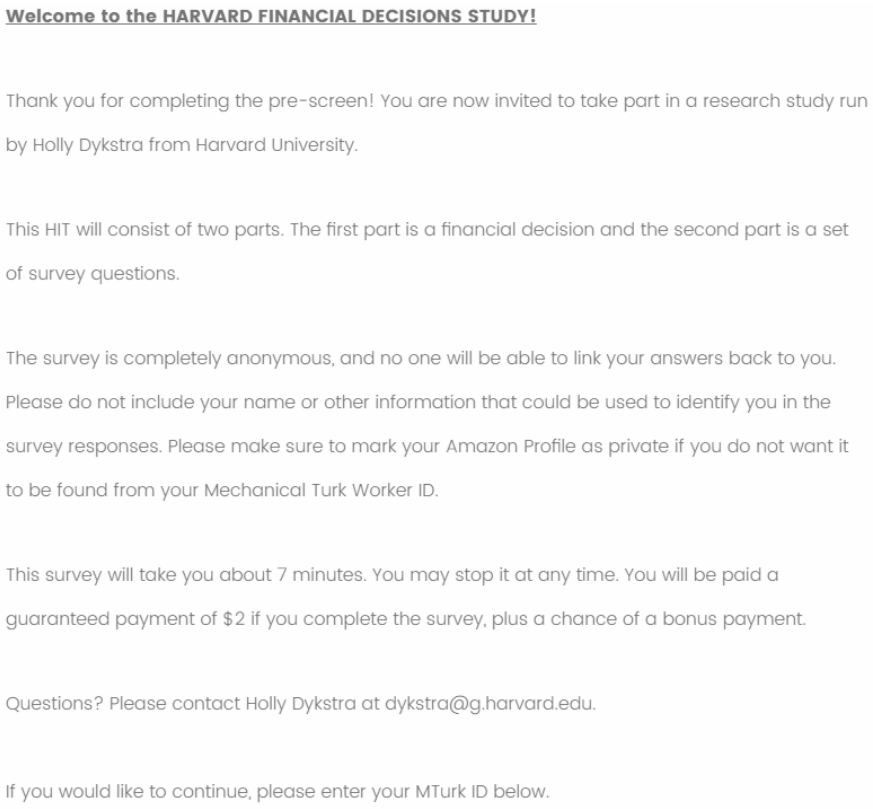


Figure 7: Introductory Screen

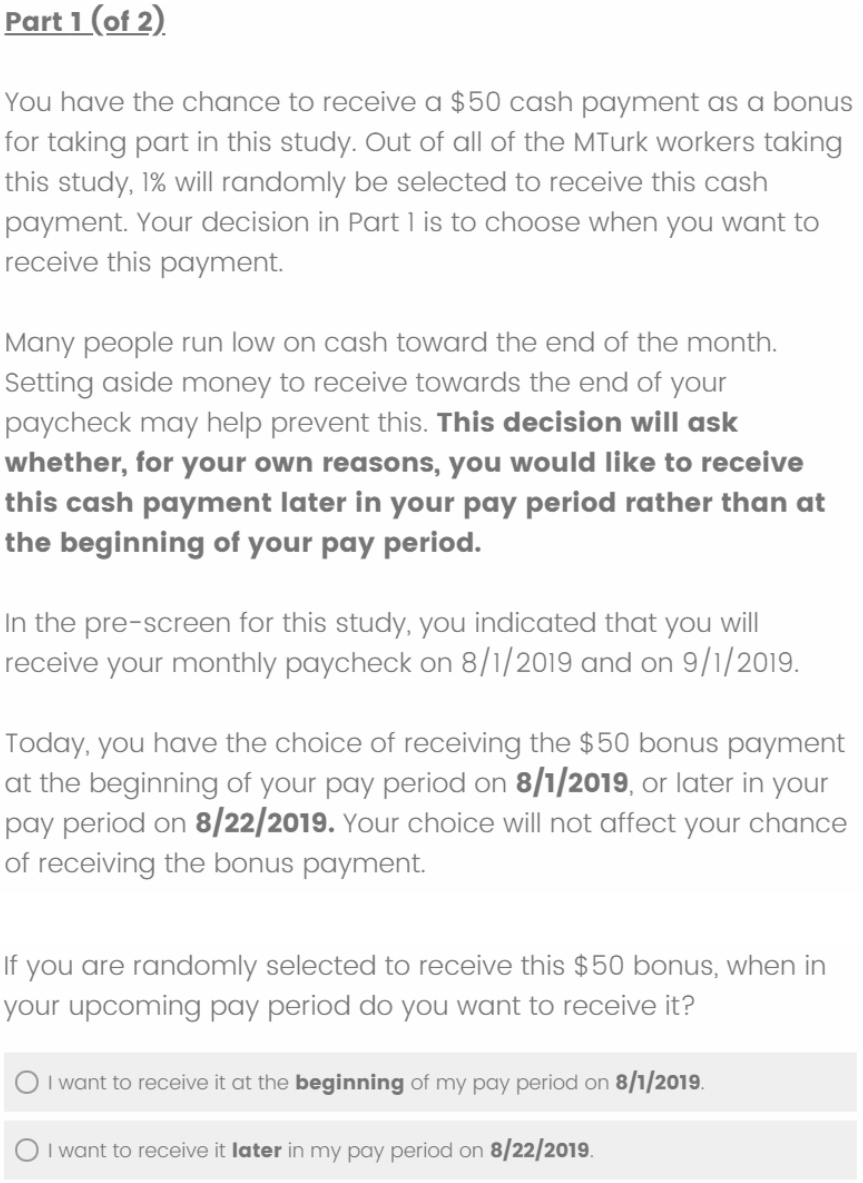


Figure 8: Commitment Decision

On the next page, participants 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 sociodemographic questions.

7.2 Additional Tables

Table 3: 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 and/or Ethnic Group		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		

Table 4: 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 \$2,000	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: 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 5: 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: 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 $d+1$. Standard errors indicate the results of an equality of proportions test comparing each group before payday to $d+1$.

Table 6: Randomization Inference Results: Proportion Choosing to Commit by Day

	(1) $d+1$	(2) $d-2$	(3) $d-5$	(4) $d-8$	(5) $d-11$
Without controls					
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)
With time controls					
Proportion Choosing to Commit	0.345	0.345	0.382	0.462	0.405
Difference from $d+1$	-	0.001	0.038	0.118	0.060
Randomization-t p-values		(0.985)	(0.438)	(0.012)	(0.194)
Observations	249	258	235	243	244

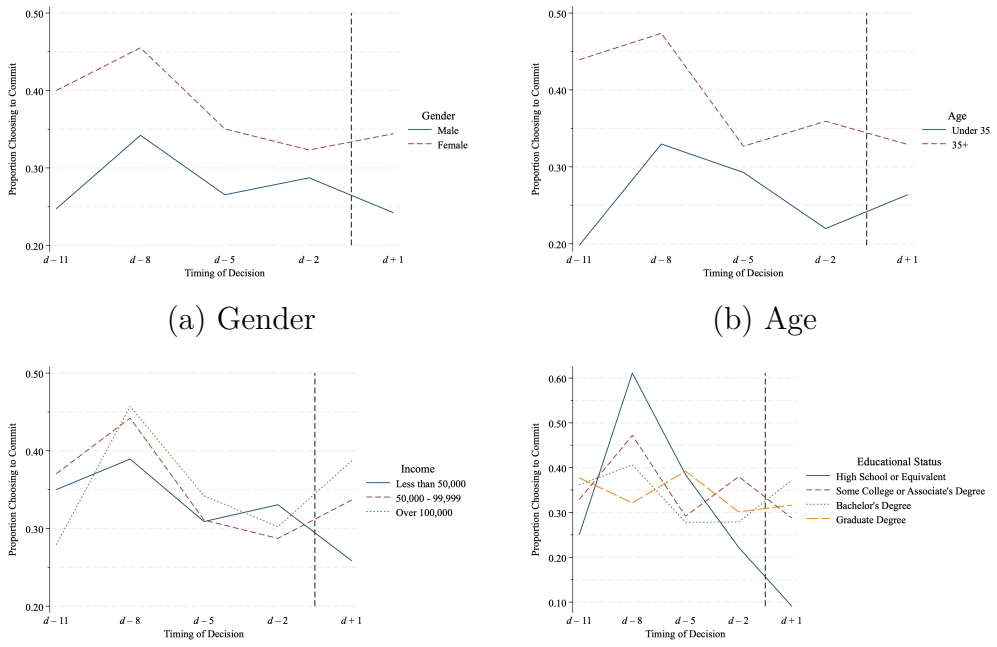
Note: Each column denotes the day relative to payday that participants make the commitment decision. *Proportion Choosing to Commit* describes the proportion of participants who choose to adopt a commitment device on that day. *Difference from d + 1* shows the difference in willingness to commit between 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 (using the procedure from Young, 2019). The first set of results includes no controls, while the second set includes time controls for day of the week, week, and month.

7.3 Heterogenous Treatment Effects

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 fully powered to investigate heterogeneity, I present the willingness to commit by treatment day for descriptive purposes. Figure 9 presents these results graphically by treatment day for gender, age, education level, and income, while Table 7 presents the regression results for models that include these demographic characteristics as covariates.

Willingness to commit is significantly higher for women, who are on average 10.0 percentage points more likely to take up commitment than men. This represents an effect size similar in magnitude to the main treatment effect. Willingness to commit also increases slightly with age. Both of these results reflect similar findings 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, Knabe and Leipold, 2014). There is no relationship between income and willingness 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 people doing online tasks for additional income, making them more likely to be cash-strapped than the general population. Finally, there is no level effect by education, but it appears to be the case that the main treatment effect is more pronounced for those with less education, with a larger difference between the before-payday and after-payday periods. 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, 2013).

Figure 9: 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 U.S. workers on MTurk who receive monthly paychecks as their main source of income. d refers to the day they receive their paycheck.

Table 7: Heterogeneity of Treatment Effect by Demographic Characteristics

	(1)	(2)	(3)	(4)	(5)
it:dchar 15011	0.060	0.059	0.061	0.062	0.060
	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)
it:dchar 1508	0.118	0.109	0.114	0.118	0.118
	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)
it:dchar 1505	0.038	0.040	0.033	0.038	0.038
	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)
it:dchar 1502	0.001	-0.002	-0.004	0.001	0.001
	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)
Female		0.100			
		(0.028)			
Age (1-6)			0.028		
			(0.009)		
Income (1-7)				0.007	
				(0.010)	
Education (1-8)					0.002
					(0.010)
Constant	0.345	0.279	0.343	0.348	0.345
	(0.073)	(0.075)	(0.073)	(0.074)	(0.074)
Observations	1229	1229	1229	1229	1229

Standard errors in parentheses

Note: Standard errors are heteroskedasticity robust. Results are from OLS models with the binary decision to adopt a commitment device as the dependent variable. All columns include time controls for day of the week, week, and month. *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.

7.4 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.