ECN 119: Economics and Psychology
Time

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Time

How is sooner different from later? Some of our decisions have repercussions, and sometimes we have to decide things now but live with the consequences afterwards.

In this section we will learn how economists try to figure out how patient or impatient a person is. We will see how things like procrastination and temptation can be modeled, what happens when a person is time inconsistent, and how institutions and policy might be able to help protect people from their future selves.

Time

In this section:

1. The discounted utility model
2. Time inconsistency
3. The beta-delta model
4. Naivety, sophistication, and commitment
5. Choice from menus
6. Temptation and self-control
7. Scarcity, agency, and time preference
8. Habit formation and rational addiction

<Insert Title Later>

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- Today we shall see that you are not alone. We can rationalize your procrastination. We can learn from it.
- Procrastination comes under what economists call **time inconsistent preferences**: I'll do it tomorrow. But... tomorrow never comes.
- Time inconsistency was a big breakthrough in to the mainstream for behavioral economics. Why was this the big breakthrough? Because *everyone procrastinates*.

Plans; temptation; self-control

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- We had a five-year plan and we were keeping our prospects. But at the trade deadline we were so close...
- I'm supposed to check down when I feel the pass rush coming. But he really looked like he was open...

Preferences and choice

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- The concept of **net present value** in finance captures the idea that the same amount of money is worth less when it's received later than sooner.
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- But when it comes to intertemporal choice, economists typically used to assume something quite restrictive about preferences.
- The concept of **net present value** in finance captures the idea that the same amount of money is worth less when it's received later than sooner.
- For a long time economists modeled people's internal feelings—their preferences—about rewards through time this way too
- But these days economic rationality has moved away from 'not leaving money on the table' to a more flexible, personal interpretation.
- One way in which people routinely deviate from the money on the table idea is with what we now call time inconsistency.

The standard view of discounting

Consider a consumer who

- has instantaneous utility function $u(\cdot)$ (this is how she feels 'in the moment' about getting something),
- has a discount factor of $\delta \in (0, 1)$ (this is her preference for sooner versus later), and
- will receive outcomes $x_0, ..., x_T$ at times $t = 0, ..., T$.

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According to the 'standard', NPV-style concept of discounting, her total utility over this time period is:

$$U(\{x_t\}_{t=0}^{T}) = \sum_{t=0}^{T} \delta^t u(x_t) \tag{1}$$

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- The difference in weight between two adjacent time periods is always the same.
- This is typically called **stationarity** or constant impatience (see Bleichrodt et al. 2009)

Exponential discounting

Figure: The weight on period $t+1$ is always δ times the weight on period t

The standard view of discounting

The standard view follows Samuelson (1937) and the axiomatization in Koopmans (1960)

- The single parameter of the discount rate make the standard model extremely simple and usable
- Neither author was advocating for this as a 'realistic' model...
- As with so much else in our course the mid-20th century approach begins to appear an outlier between two eras with a more holistic view
- See Frederick et al. (2002) for much more on the history here

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- Where was time preference in the Fisher two-period model?

Stationarity: an example

To see how stationarity (a.k.a. time invariance) works, let's use an example with marshmallows and three time periods (now, 10 min. from now, 20 min. from now)

- If you prefer one marshmallow now over two in 10 minutes:

$$\delta^0 u(1) + \delta^1 u(0) + \delta^2 u(0) \geq \delta^0(0) + \delta^1 u(2) + \delta^2 u(0) \tag{2}$$

$$u(1) + \delta u(0) \geq u(0) + \delta u(2) \tag{3}$$

$$\delta(u(2) - u(0)) \leq u(1) - u(0) \tag{4}$$

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Stationarity: an example

- If you prefer one marshmallow in 10 minutes over two in 20 minutes:

$$\delta^0 u(0) + \delta^1 u(1) + \delta^2 u(0) \geq \delta^0(0) + \delta^1 u(0) + \delta^2 u(2) \tag{6}$$

$$\delta u(1) + \delta^2 u(0) \geq \delta u(0) + \delta^2 u(2) \tag{7}$$

$$u(1) + \delta u(0) \geq u(0) + \delta u(2) \tag{8}$$

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$$\delta \leq \frac{u(1) - u(0)}{u(2) - u(0)} \tag{10}$$

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- Exactly the same condition as before—either you always prefer to get one marshmallow earlier or you always prefer to get two marshmallows later

Some implications of the discounted utility model

- Notice the affinity between discounted utility and net present value in finance
- Frederick, Loewenstein, and O'Donoghue (2002) gives a few examples of things that the DU model seemingly requires
  1. Only the discounted sum of utility matters, not the distribution
  2. Utility of something is independent of what happened in previous periods or will happen in the future
  3. The utility function is not changing over time
  4. Time preference is the same for any good

Anomalies in intertemporal choice

Loewenstein and Prelec (1992) give a taxonomy of ways in which the discounted utility model doesn't make good predictions

1. The common difference effect
   - Failures of stationarity, a.k.a. preference reversals
2. The absolute magnitude effect
   - Large dollar amounts are discounted proportionally less than small dollar amounts
3. Gain-loss asymmetry
   - Losses are time discounted at lower rates than gains
4. Delay-speedup asymmetry
   - Amount required to compensate for delaying a reward is 2-4x greater than willingness to pay to speed up the reward in the opposite direction

Paying not to go to the gym

DellaVigna & Malmendier (2006): data from 3 US gyms, 7,752 members over three years. Customers could choose:

- Pay \$10 per visit using a 10-visit pass, or
- Pay \$70 per month for unlimited visits

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Monthly customers made, on average, 4.3 visits per month.

Exponential discounting

	Standard model	Trans. costs of payment per usage	Membership benefits per usage	Limited memory	Time inconsist. with sophistication	Time inconsist. with naiveté	Overestimation of future efficiency	Persuasion
Finding 1								
Price per average attendance = $17.27		Distaste of pay per usage	Membership benefits		Commitment	Commitment, overestimation of attendance	Overestimation of attendance	Pressure of salesman
Finding 2								
Average attendance in months 2–4 higher in annual than monthly contract	Sorting at enrollment	Sorting at enrollment	Sorting at enrollment	Sorting at enrollment	Sorting at enrollment	Sorting at enrollment	Sorting at enrollment	Sorting at enrollment
Finding 3								
Users predict 9.50 monthly visits; actual monthly visits are 4.17						Overestimation of attendance	Overestimation of attendance	
Finding 4								
Interval between last attendance and termination 2.31 full months		Distaste of pay per usage	Membership benefits	Forget to cancel		Overestimation of cancellation	Overestimation of cancellation	Pressure of salesman
Finding 5								
Survival probability after 14 months 17 percent higher for monthly than for annual contract				Forget to cancel		Overestimation of cancellation	Overestimation of cancellation	Pressure of salesman
Finding 6								
Average attendance 27 percent higher in second year for annual contract	Learning, sorting out	Learning, sorting out	Learning, sorting out	Learning, sorting out	Learning, sorting out	Learning, sorting out	Learning, sorting out	Learning, sorting out
Finding 7								
Decreasing average attendance over time in monthly contract				Forget to cancel		Overestimation of cancellation	Overestimation of cancellation	Pressure of salesman
Finding 8								
Positive correlation of price per average attendance and interval between last attendance and termination						Heterogeneity in naiveté	Heterogeneity in overconf.	

A puzzle

Choose one of the following:

A. Receive \$100 now.

B. Receive \$120 in a month.

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Choose one of the following:

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Choose one of the following:

C. Receive \$100 in six months.

D. Receive \$120 in seven months.

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Standard discounting can't reconcile A over B with D over C.

- Typically somewhere around one third of experimental subjects will display preferences like these (Ainslie 1992).

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- Typically somewhere around one third of experimental subjects will display preferences like these (Ainslie 1992).
- We call these preferences **time inconsistent**: I state a preference to wait a month for extra dollars, but when that month is this month I renege.

Experiments to measure time preference

A standard approach to measuring time preference is to elicit thresholds for reversals

- Identify an amount a such that the DM is indifferent between a now and b in one month
- Identify an amount c such that the DM is indifferent between c in one month and d in two months

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- Identify an amount a such that the DM is indifferent between a now and b in one month
- Identify an amount c such that the DM is indifferent between c in one month and d in two months
- Interpret $\frac{a}{b} < \frac{c}{d}$ as present bias
- Issues:
  1. Will the experimenter really give me this money later?
  2. Isn't it a pain to have to deal with getting the money later?
  3. How much I need or value the money isn't always the same
  4. I could just take the money now and put it in an interest-bearing account

Preference reversals

- Ainslie and Herrnstein (1981): pigeons display preference reversals
  - Two keys to peck; they allowed either 2 or 4 seconds of access to grain
  - 4 second reward always arrived with a 4 second delay relative to the smaller one
  - As delay between the choice and the availability of the 2 second reward was varied from 0.01 to 12 seconds, all 6 pigeons reversed their preference from the small-early to large-late reward

Gender and time inconsistency

Prince and Shawhan (2011) report differences by gender in a time preference experiment

- 239 subjects from an intro business management class at Cornell
- Two groups:
  - 'immediate payment group': initial payment now, final payment 3 weeks later
  - 'delayed payment group': initial payment in 3 weeks, final payment in 6 weeks
- Each got \$7 and had two options:
  - A: pay \$1 from the initial payment to get \$5 at final time
  - B: pay \$5 from the initial payment to get \$8.50 at final time

Gender and time inconsistency

Number of subjects choosing each option

Group	Chose Option A	Chose Option B	Total
Delayed Payment Group	20	95	115
Immediate Payment Group	48	71	119

Number of subjects, by gender, choosing each option

Gender	Group	Chose Option A	Chose Option B	Total
Male	Delayed Payment Group	5	51	56
	Immediate Payment Group	31	28	59
Female	Delayed Payment Group	15	44	59
	Immediate Payment Group	17	43	60

Figure: Male subjects in this experiment displayed more time inconsistency

The beta-delta discounting model

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Using the beta-delta model to capture potential time inconsistency gives her total utility as:

$$U(\{x_t\}_{t=0}^{T}) = u(x_0) + \beta \sum_{t=1}^{T} \delta^t u(x_t), \beta \in (0, 1) \tag{11}$$

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- This still has sooner versus later just as before.
- But there's a new distinction between 'now' and 'later'.
- The relative weight on two adjacent periods depends on whether one of them is 'now'.
- When tomorrow becomes today, later becomes now...

Beta-delta discounting

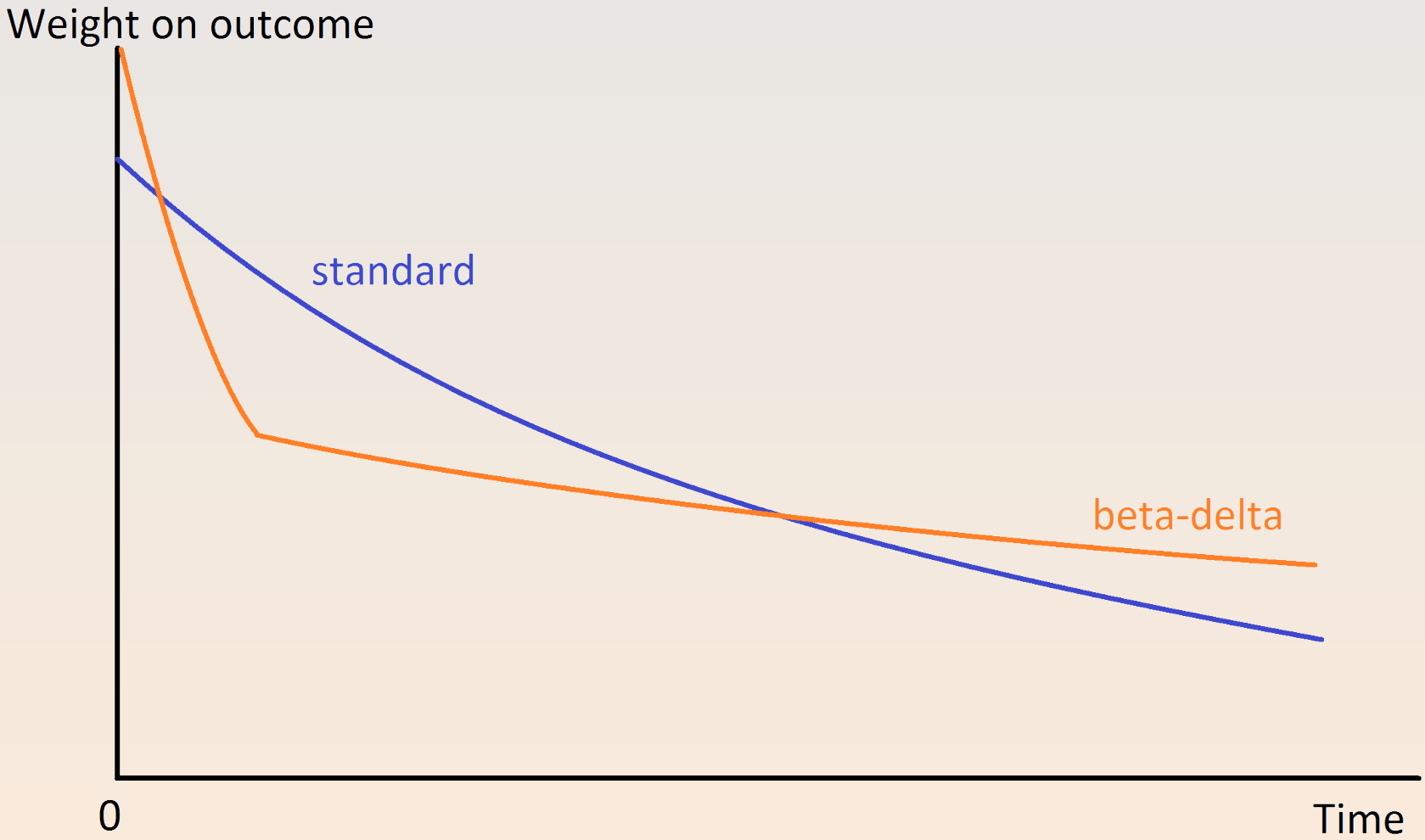

Figure: There's an extra 'spike' in the value of the reward when the reward arrives now

Beta-delta discounting

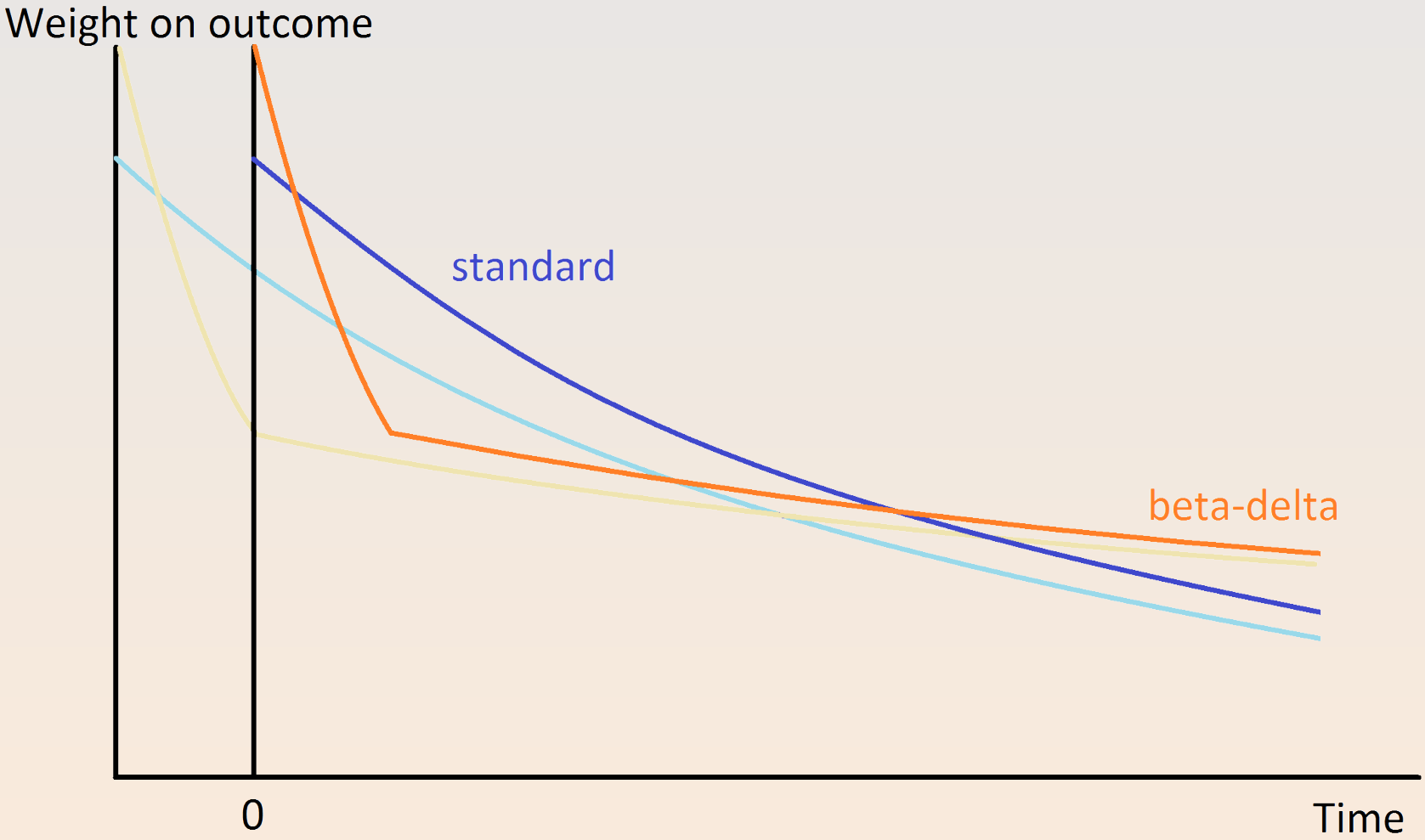

Figure: The 'spike' moves as 'now' moves: how I feel about tomorrow changes when it becomes today

Failure of stationarity: an example

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$$\delta^0 u(1) + \beta\delta^1 u(0) + \beta\delta^2 u(0) \geq \delta^0(0) + \beta\delta^1 u(2) + \beta\delta^2 u(0) \quad (12)$$

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- This is different than before; present bias is possible if $\beta < 1$ such that

$$\beta\delta < \frac{u(1) - u(0)}{u(2) - u(0)} < \delta \tag{21}$$

Procrastination: an example

It's the last Friday of the baseball season and the AL East is coming down to the wire. Jim would love to see all of the final three Red Sox games, but he has a lot of work so he has to choose one to skip. The games are getting more important each day: Jim's instantaneous utility from watching each game would be:

$$u(\text{Friday}) = 4 \tag{22}$$

$$u(\text{Saturday}) = 6 \tag{23}$$

$$u(\text{Sunday}) = 10 \tag{24}$$

He gets instantaneous utility of 0 on the day he skips watching the game.

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Assume $\delta = 1$ and $\beta = \frac{1}{2}$. If Jim has time consistent preferences, which game will he plan to skip? What if he is time inconsistent? Will he stick to his plan?

Time consistent preferences

- Let's call the time consistent utility function U. With $\delta = 1$, it just adds up the instantaneous utilities on each day:

$$U(\text{Weekend}) = u(\text{Friday}) + u(\text{Saturday}) + u(\text{Sunday}) \tag{25}$$

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- So what will he do?

$$U(\text{skip Friday}) = 0 + 6 + 10 = 16 \tag{26}$$
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- The best plan is to skip tonight's game. Easy!

Time inconsistent preferences

- Let's call the time inconsistent utility function V. With $\delta = 1$ and $\beta = \frac{1}{2}$, on Friday it looks like this:

$$V(\text{Weekend}) = u(\text{Friday}) + \frac{1}{2}[u(\text{Saturday}) + u(\text{Sunday})] \tag{29}$$

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- He can't resist watching today. Friday Jim will plan to skip tomorrow's game.

Time inconsistent preferences

- Will he stick to the plan?
- On Saturday Jim wakes up with this utility function:

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- What will he do?

$$V(\text{skip Saturday}) = 0 + \frac{1}{2}(10) = 5 \tag{34}$$

$$V(\text{skip Sunday}) = 6 + \frac{1}{2}(0) = 6 \tag{35}$$

Time inconsistent preferences

- Will he stick to the plan?
- On Saturday Jim wakes up with this utility function:

$$V(\text{Remaining Weekend}) = u(\text{Saturday}) + \frac{1}{2}[u(\text{Sunday})] \tag{33}$$

- What will he do?

$$V(\text{skip Saturday}) = 0 + \frac{1}{2}(10) = 5 \tag{34}$$

$$V(\text{skip Sunday}) = 6 + \frac{1}{2}(0) = 6 \tag{35}$$

- He fails to stick to his plan and ends up stuck at work on Sunday while his friends watch the Red Sox clinch.

Know thyself

If I'm time inconsistent—am I self-aware enough to know it?

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- A sophisticated Jim in our example might have bitten the bullet and worked on Friday—if he was strong enough!

Commitment devices

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- Another way to see this kind of device is that giving the reins to your smart, deliberative self and tying the hands of the impulsive one (Kahneman 2011).
- A person may *rationally* choose to restrict her own future options so as to avoid temptation.
- Or trick your impulsive self! (Pomodoro, website blockers)
- Is procrastination *innate*? Does that make me feel better or worse?

Commitment devices in the field

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- Randomized control trial of a commitment savings product for a Philippine bank, Green Bank of Caraga in Mindanao; 4,001 individuals in sample
- First: survey of 1,777 current or former clients of the bank; asked hypothetical questions to gauge their time discounting preferences
  - "Would you prefer to receive P200 guaranteed today, or P300 guaranteed in 1 month?"
  - "Would you prefer to receive P200 guaranteed in 6 months, or P300 guaranteed in 7 months?"
  - Classification: earlier preference 'impatient'; early-then-late 'hyperbolic'

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  - "Would you prefer to receive P200 guaranteed in 6 months, or P300 guaranteed in 7 months?"
  - Classification: earlier preference 'impatient'; early-then-late 'hyperbolic'
- Next: randomly selected half of the clients
  - That half offered a 'SEED' account—pure commitment savings that restricted access to deposits but with no compensation for the restriction
  - Other half either control group or marketing group who got a visit to encourage use of existing savings products

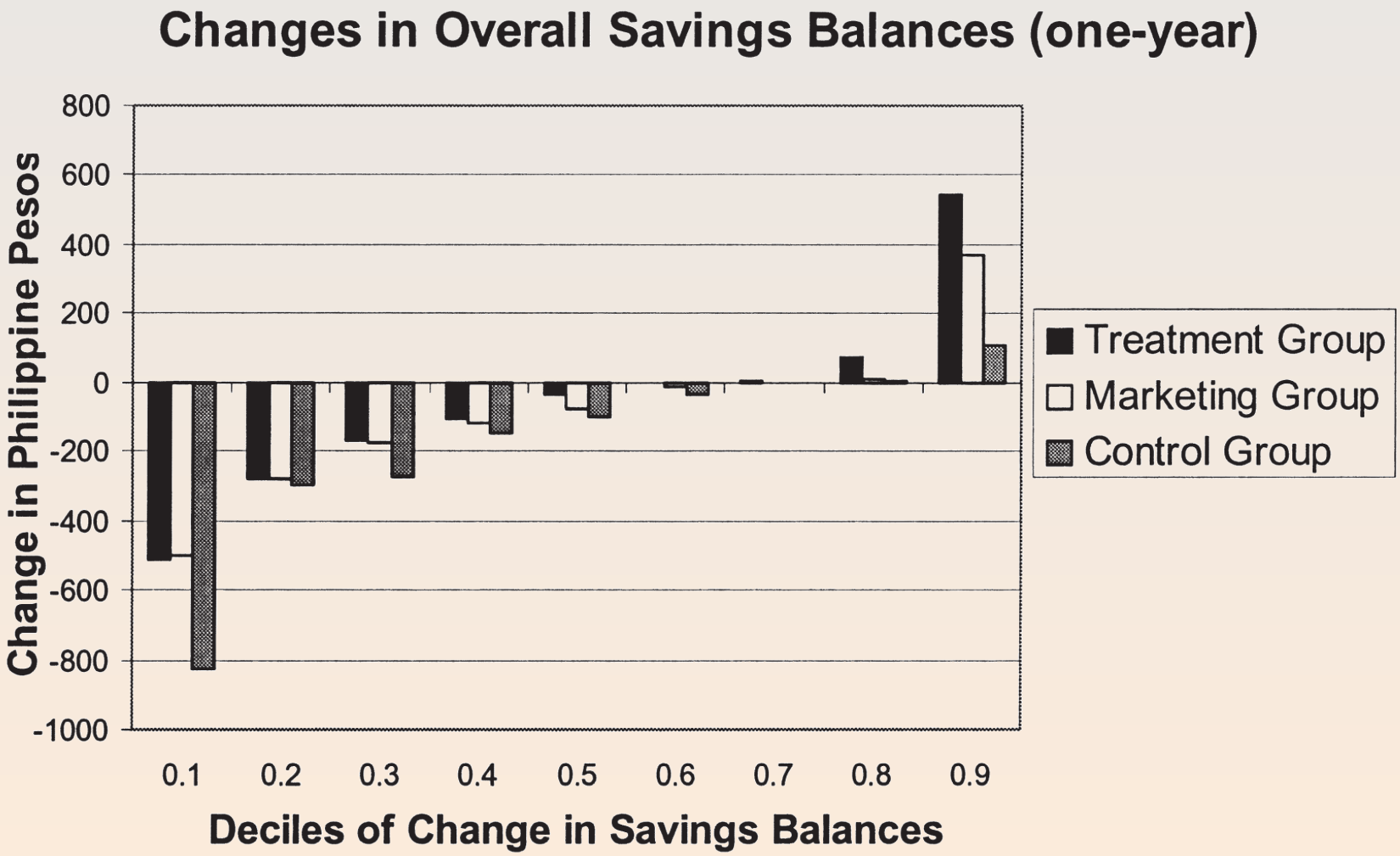
Ashraf, Karlan & Yin (2006)

TABULATIONS OF RESPONSES TO HYPOTHETICAL TIME PREFERENCE QUESTIONS

			Indifferent between 200 pesos in 6 months and X in 7 months			
			Patient X < 250	Somewhat impatient 250 < X < 300	Most impatient 300 < X	Total
Indifferent between 200 pesos now and X in one month	Patient	X < 250	606 34.4%	126 7.2%	73 4.1%	805 45.7%
	Somewhat impatient	250 < X < 300	206 11.7%	146 8.3%	59 3.3%	411 23.3%
	Most impatient	300 < X	154 8.7%	93 5.3%	299 17%	546 31%
	Total		966 54.8%	365 20.7%	431 24.5%	1,762 100%

"Hyperbolic": More patient over future trade-offs than current trade-offs.
"Patient now, Impatient later": Less patient over future trade-offs than current trade-offs.
Time inconsistent (direction of inconsistency depends on answer to open-ended question).

Ashraf, Karlan & Yin (2006)



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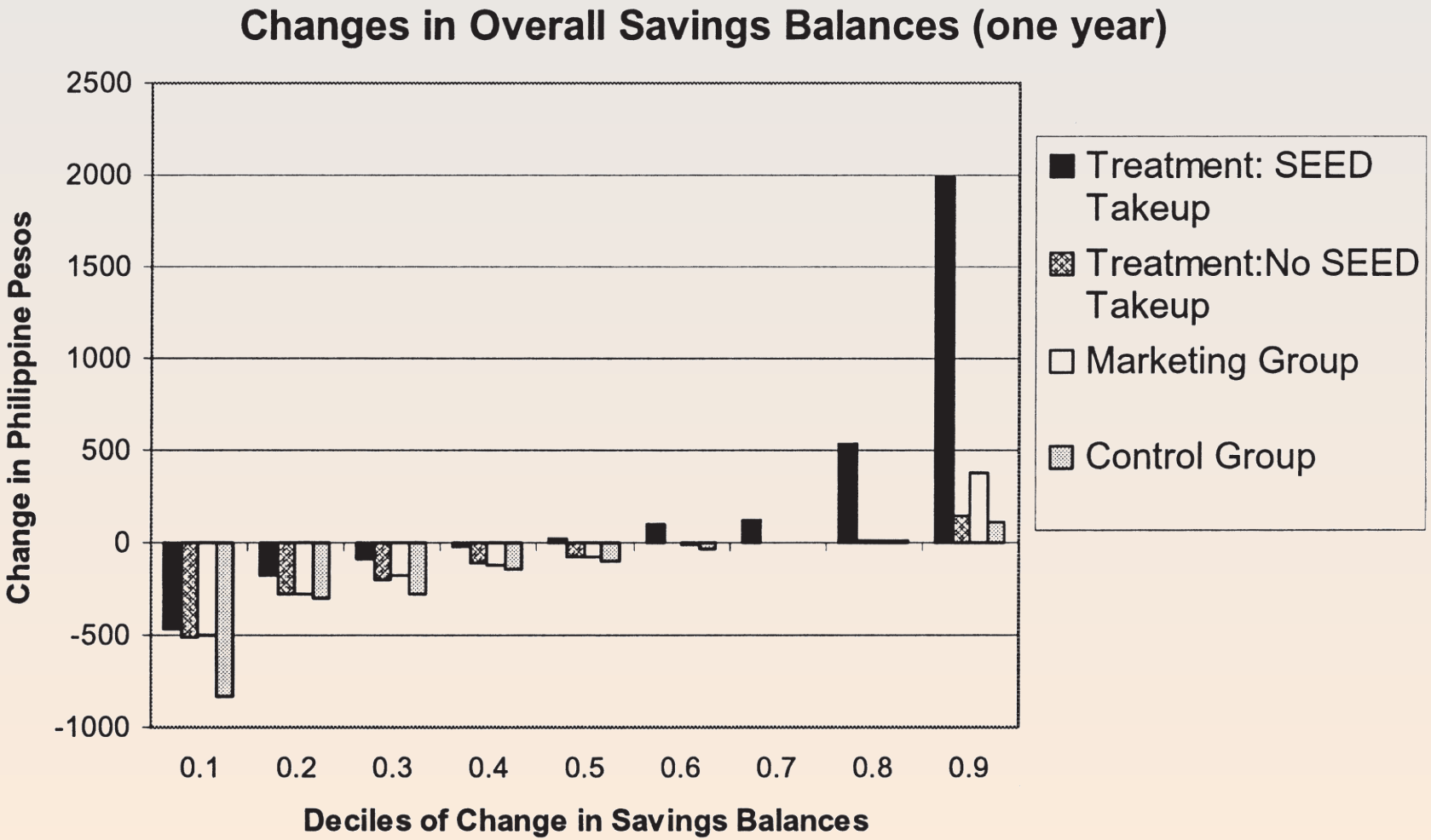

Commitment devices in the field

- Time inconsistent subjects were significantly more likely to open the commitment account (sophistication?)
- Women with hyperbolic preferences more likely to open the commitment account
- After 12 months average savings for treatment group increased by 411 pesos relative to treatment (81 percentage point increase relative to preintervention savings levels)
- 10.1pp higher probability of increasing their savings relative to control group; 6.4pp higher relative to marketing visit group

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- Median daily income is 350 pesos (around 7 USD) and mean savings balances around 500 pesos

Dean Karlan went on to found `http://www.stickk.com`.

Time preference and commitment in effort

Augenblick, Niederle, and Sprenger (2015) study a real-effort task

- 102 UC Berkeley students, 7 week longitudinal experiment
- Subjects allocated effort over two work dates
- Tasks were (i) transcribing meaningless Greek texts and (ii) completing Tetris games

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  2. Subsequent allocation made on work date 1
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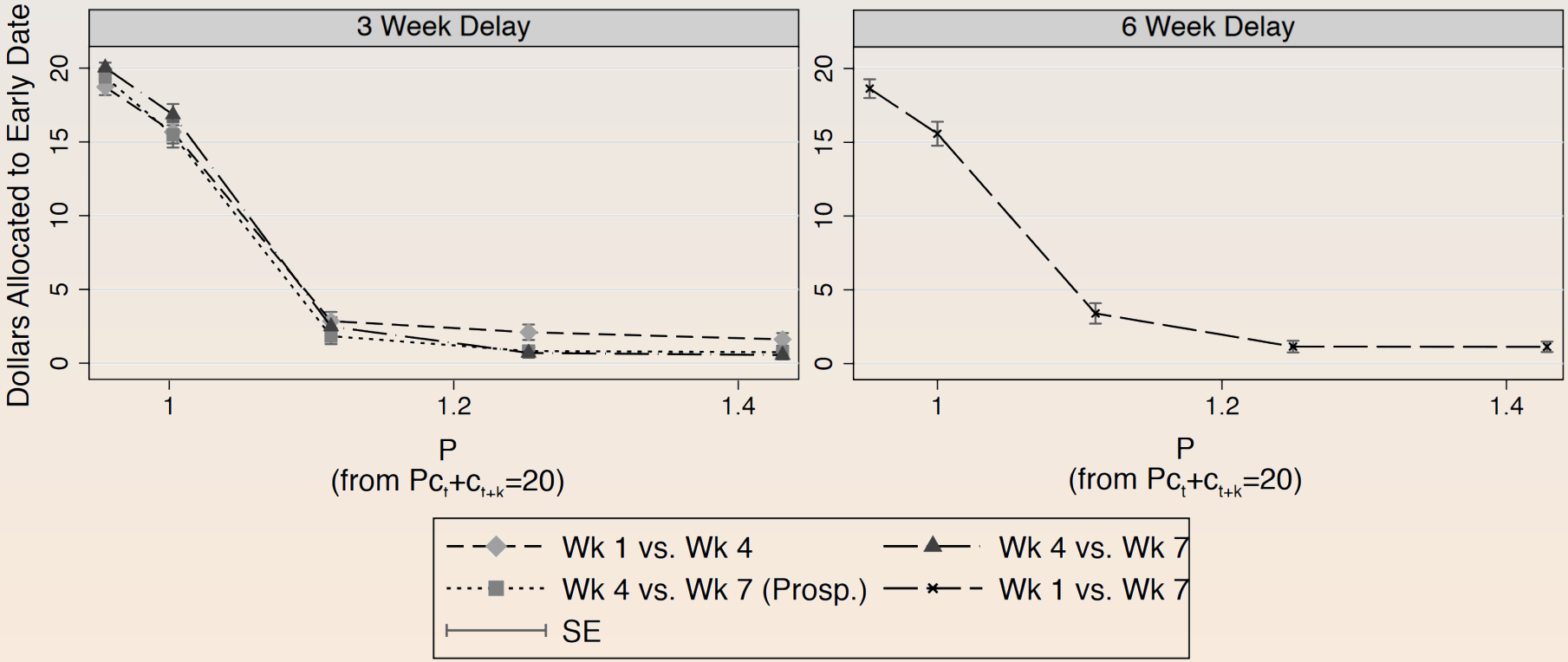
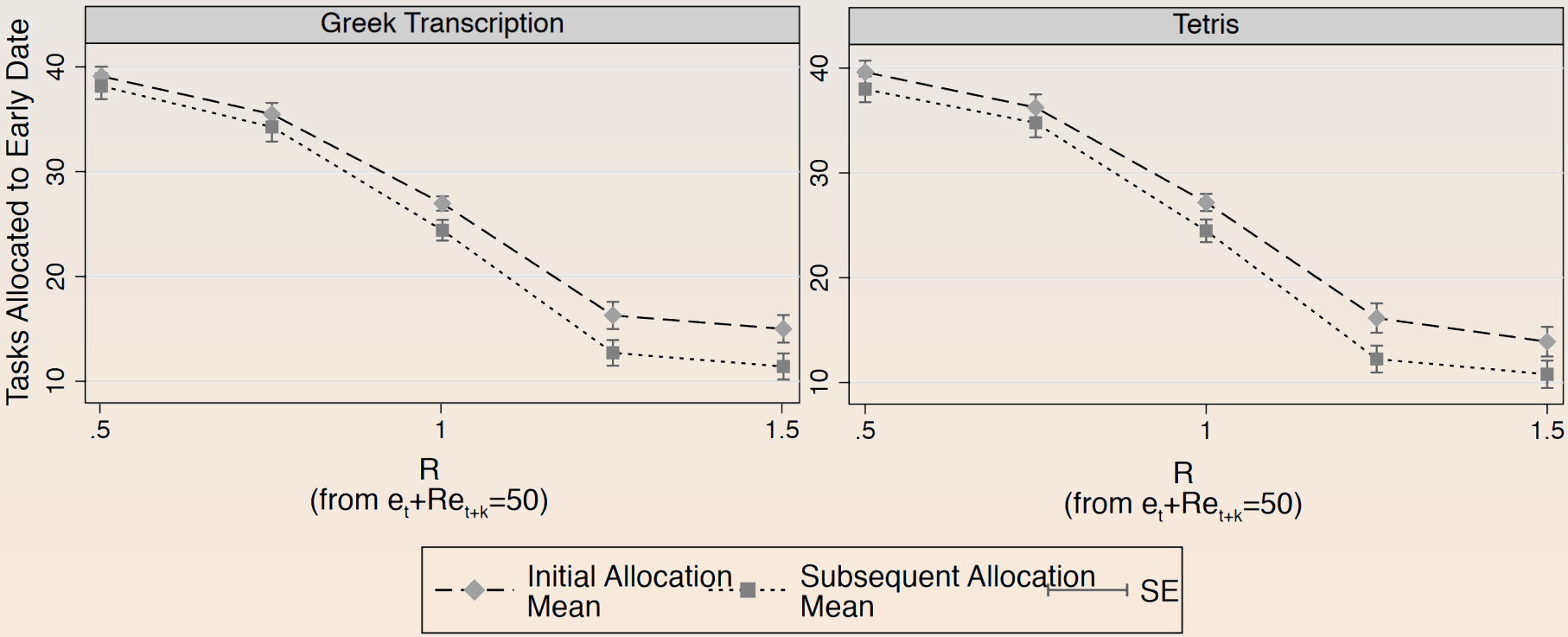
  1. Initial allocation made in advance of work date 1
  2. Subsequent allocation made on work date 1
- Difference between initial and subsequent allocation picks up time inconsistency
- Two three-week blocks:
  - First as above
  - Second included commitment device: subject could (at no cost) probabilistically favor their initial allocations over subsequent allocations in the random selection process

Augenblick et al. (2015)



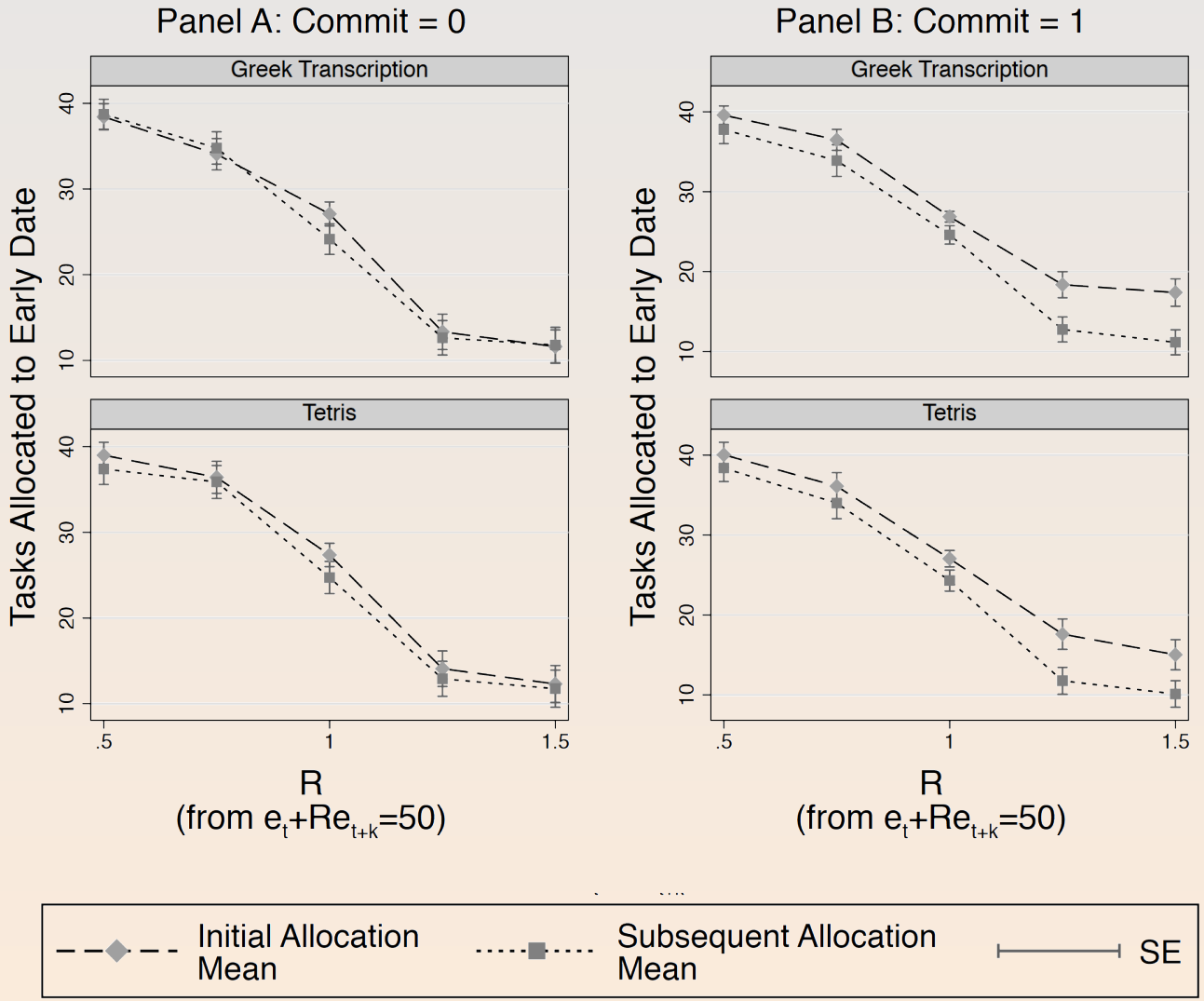
Not much time inconsistency for money

Augenblick et al. (2015)



Subjects initially allocate 9.3% more tasks to the sooner work date than they subsequently allocate

Augenblick et al. (2015)



Subjects who choose costless commitment in week 4 were more present-biased in their week 2 choices

Self-control and commitment for consumption goods

- Wertenbroch (1998): 'vice' goods consumed in small package sizes even if there's a big quantity discount
  - Implications for optimal second-degree price discrimination

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- Wertenbroch (1998): 'vice' goods consumed in small package sizes even if there's a big quantity discount
  - Implications for optimal second-degree price discrimination
- Oster and Scott-Morton (2004): magazine subscriptions vs. store prices
  - For People magazine store price is high relative to subscription
  - For Foreign Affairs magazine store price is low relative to subscription
  - But People is sold disproportionately in stores and FA disproportionately by subscription

Commitment to sobriety

Schilbach (2019): field experiment on demand for commitment to sobriety by cycle rickshaw drivers in India

- 229 subjects in Chennai, 3 week field experiment in 2014
- Asked to visit an office every day for a breathalyzer, survey on work, earnings, spending, and alcohol consumption
- Opportunity to save money at the study office too

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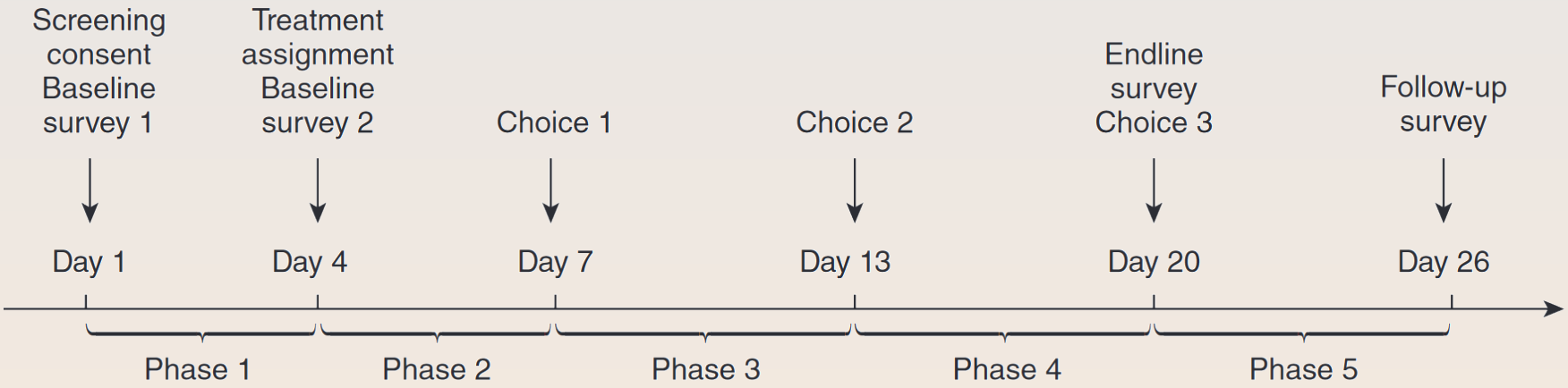
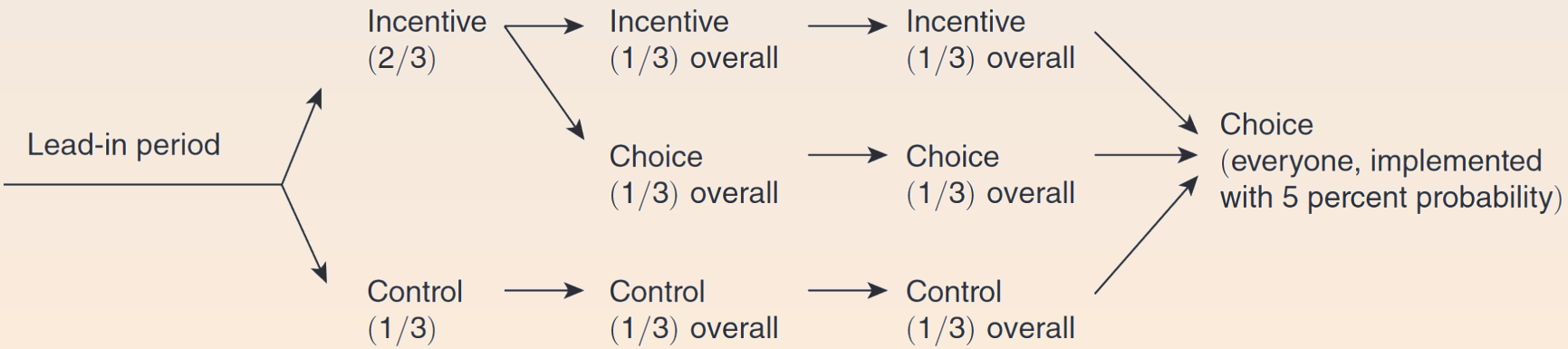
- Asked to visit an office every day for a breathalyzer, survey on work, earnings, spending, and alcohol consumption
- Opportunity to save money at the study office too
- Treatments were randomly assigned:
  1. Subsample got cash to visit the office sober, the rest paid regardless
  2. Subsample got to choose between incentives for sobriety and unconditional payments
  3. Subsample provided with a commitment savings account

	Option A		Option B
Choice	BAC $>$ 0	BAC $=$ 0	Regardless of BAC
1.	Rs 60	Rs 120	Rs 90
2.	Rs 60	Rs 120	Rs 120
3.	Rs 60	Rs 120	Rs 150

Schilbach (2019)





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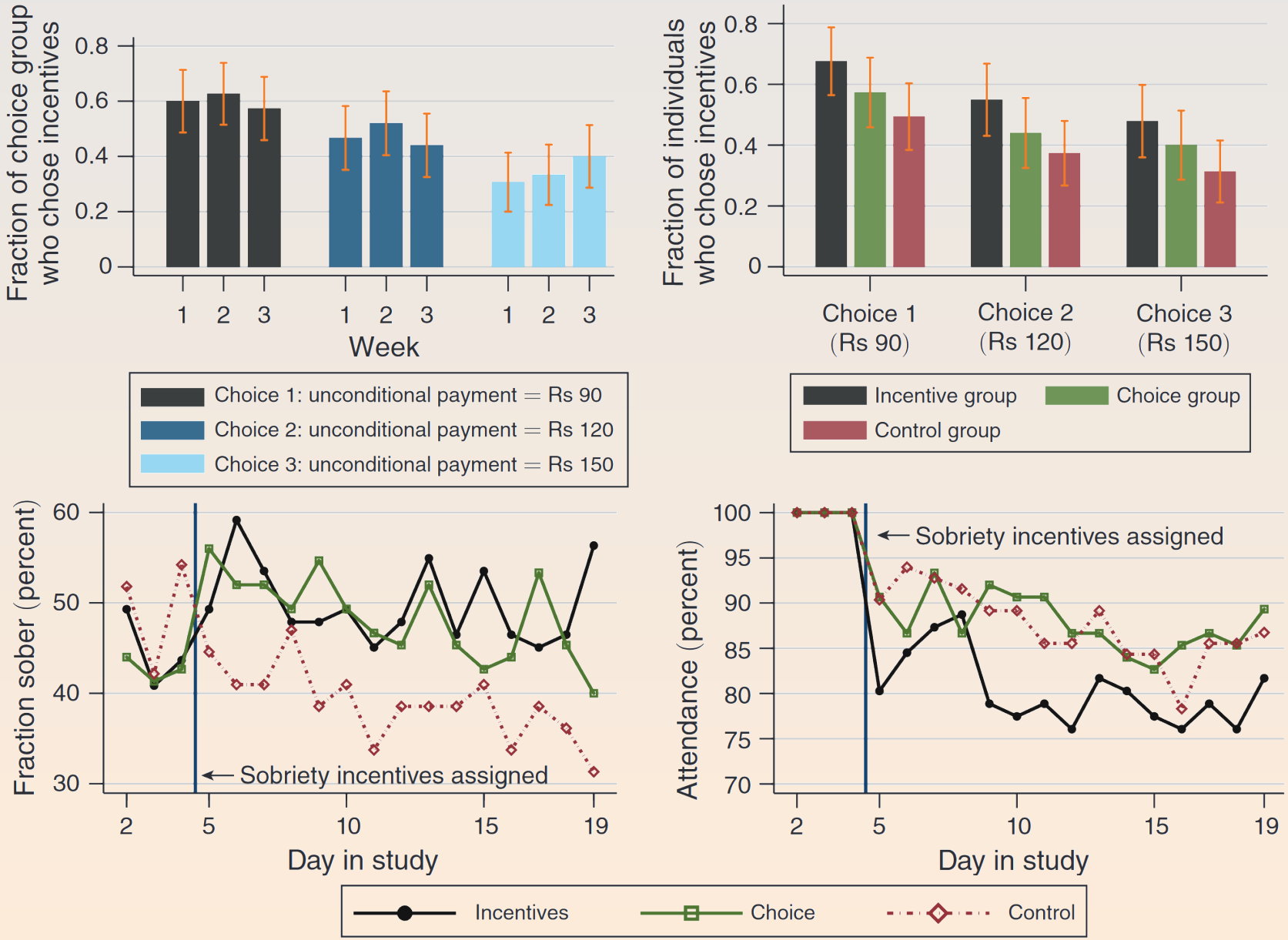

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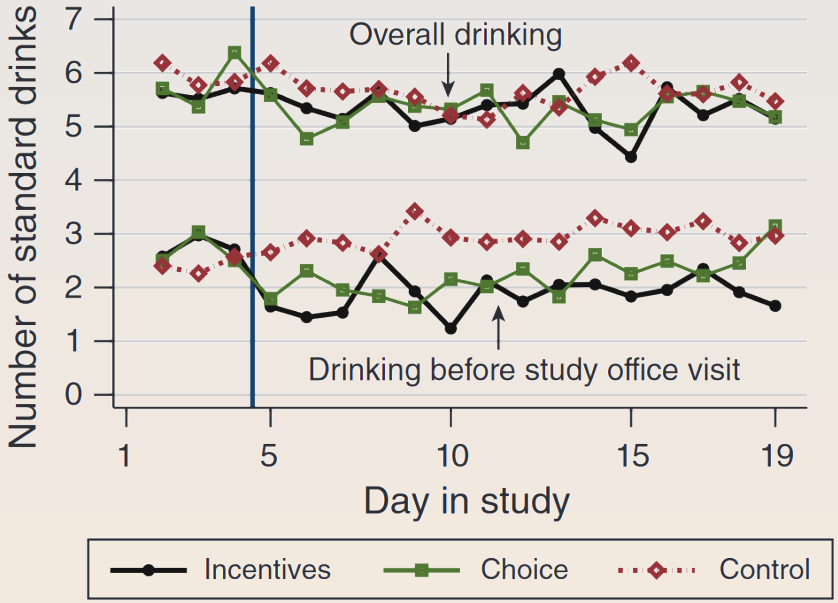

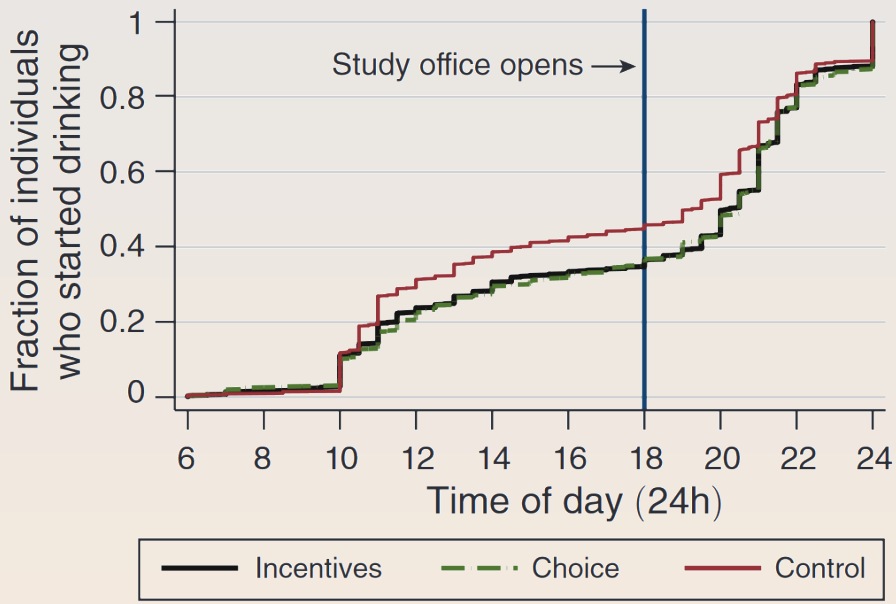

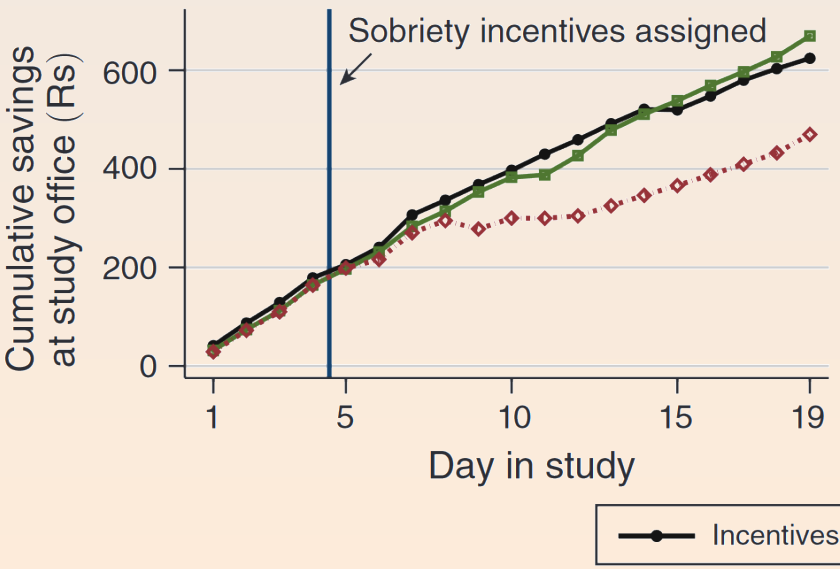

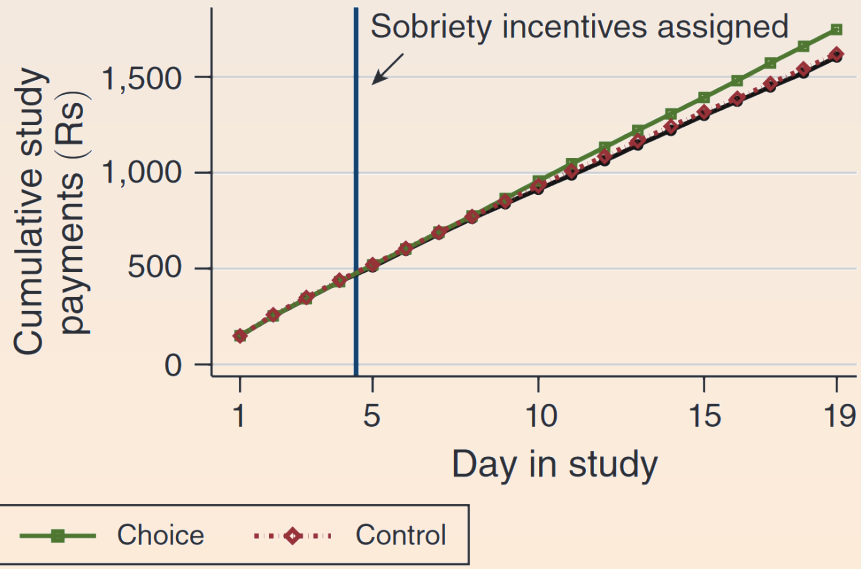

Schilbach (2019) results

- Willingness to sacrifice about 10% of daily income for commitment to sobriety
- Daytime drinking down 33%, but shifted later; total drinking not really different
- Not much evidence of changes in labor supply
- Increasing sobriety reduced self-control problems in savings decisions; savings up 50%, more than just the amount not spent on alcohol
  - Or just that alcohol is a temptation good... but intervention didn't reduce alcohol consumption that much
- Alcohol causing present bias?contract

Policy

Can we design policy to protect time inconsistent consumers from themselves?

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- To the macro level: Laibson (1997) argued that financial innovation caused a decline in economywide saving rates by increasing liquidity and decreasing ability of consumers to commit to a spending path.
- 'Libertarian paternalism', 'nudges' (Thaler & Sunstein 2008).
- The way choices are presented affects the choice, even when the options are the same.
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- The way choices are presented affects the choice, even when the options are the same.
  - Since people procrastinate, whatever the default option is, it's chosen disproportionately often.
- Are time inconsistent consumers naive or sophisticated?
- Whose happiness are we thinking about: present self, future self, past self?
- Are there ethical problems with 'nudging'?
- Will market forces result in more exploitation of naive consumers, more tools to help them, or both?

Bill shock

An example of a regulation designed to protect naive consumers is the FCC's 'bill shock' agreement.

- Cell phone charges or bank overdraft charges can sneak up on you: if you're not quite sure how much you're already used, you might be surprised to have been hit with a charge when you went over your limit.
- If I'm naive and don't anticipate my own future inattention, then I may think a contract with low rates and high overage charges is a great deal... but am I being fooled?

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- Regulation could force firms to disclose when I'm about to be stuck with a hefty bill.
- But whether this is good or bad depends on what proportions of consumers are (i) attentive, (ii) sophisticatedly inattentive, or (iii) naively inattentive (Grubb 2014).

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- This is just one example of how we could design better economic institutions with a better understanding of behavior.

Subadditive discounting

Read (2001) suggests a slightly different regularity in how people discount

- **Subadditive discounting**: the total amount of discounting over some time period increases when the time period is more finely partitioned
- In experiments, 24 month interval was decomposed into either one or three subintervals
- Subjects saw a sequence of choices between a smaller amount of money sooner or a larger amount later; the sequence was designed to 'home in' on their point of indifference
  1. Exp 1: paid vouchers and a candy bar for showing up; hypothetical choices framed in terms of dates
  2. Exp 2: same payments; hypothetical choices framed in terms of months from now; feedback given on indifference points
  3. Exp 3: one randomly drawn subject was really paid out (post-dated check for the later reward they 'preferred')
- Discount rate for the three interval case was higher than for the three interval case

Read (2001)

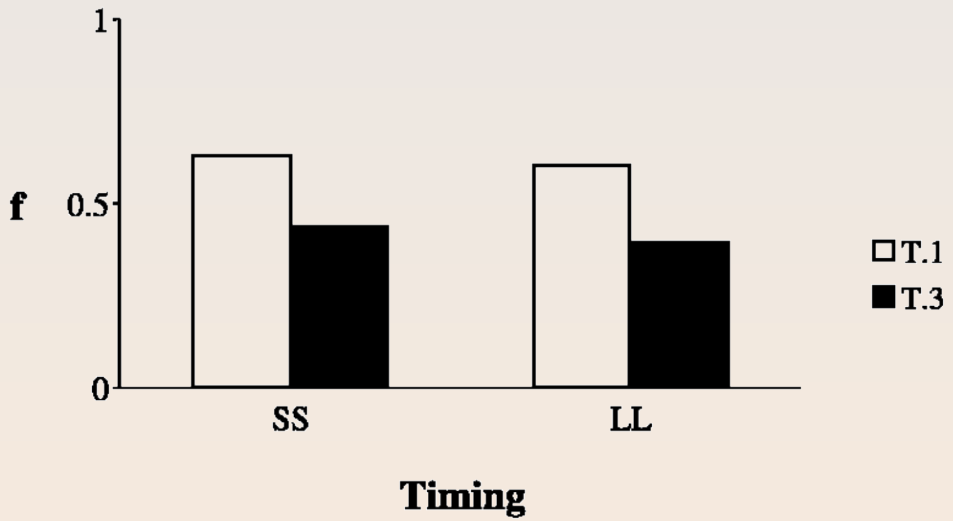

Figure 7. Test of H1 (Subadditivity) in Experiment 3. $T \cdot 1$ is the discount fraction when the interval is undivided (1 interval), and $T \cdot 3$ is when it is divided into 3 subintervals.

The more subintervals, the smaller the overall discount fraction

Read (2001)

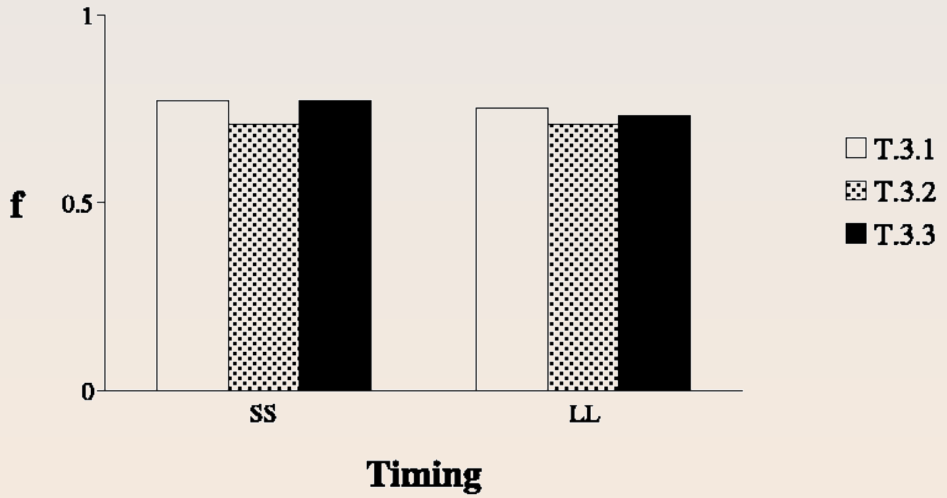

Figure 8. Test of H2 (True declining impatience) in Experiment 3. $T \cdot 1$ is the discount fraction when the interval is undivided (1 interval), and $T \cdot 3$ is when it is divided into 3 subintervals.

But discount fractions for subintervals do not decrease with delay added

Choice from menus and temptation

Temptation is an analog of procrastination. One way we could model temptation and the consumer's response to it is by modeling a choice over *menus*.

Choice from menus and temptation

Temptation is an analog of procrastination. One way we could model temptation and the consumer's response to it is by modeling a choice over *menus*. Let A be a menu of options, and $U(A, x)$ the utility of picking x from menu A. Capturing self-control:

$$U(A, x) = u(x) - s(A, x) \tag{36}$$

The utility from x if it were the only available item less the cost of self-control needed to select x from A. An example:

$$s(A, x) = \max_{y \in A} v(y) - v(x) \tag{37}$$

Cost of self-control depends on most tempting thing foregone.

Temptation model: an example

You're deciding on dinner. First you have to pick a restaurant, and once you get there you pick your food. You're on a diet and so you'd prefer to eat broccoli than ice cream, but if you end up at a restaurant with both on the menu, you are tempted to have ice cream.

Temptation model: an example

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Let there be three menus: $A_1 = \{b, i\}$, $A_2 = \{b\}$, and $A_3 = \{i\}$. The consumer's preferences are:

$$u(b) = 4 \tag{38}$$
$$u(i) = 3 \tag{39}$$
$$v(b) = 0 \tag{40}$$
$$v(i) = 2 \tag{41}$$

Here u is 'long run' utility and v is 'temptation' utility

Temptation model: an example

There are three possibilities: go to the place with menu 1 and order broccoli, go to the place with menu 1 and order ice cream, or go to the place with menu 2 and order broccoli

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$$U(A_1, b) = u(b) - s(A_1, b) = 4 - 2 = 2 \tag{42}$$
$$U(A_1, i) = u(i) - s(A_1, i) = 3 - 0 = 3 \tag{43}$$
$$U(A_2, b) = u(b) - s(A_2, b) = 4 - 0 = 4 \tag{44}$$
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If the consumer forsees the temptation problem, they choose the restaurant with fewer options

Menu choice as commitment

This model of preference over menus is due to Gul and Pesendorfer (2001)

- Rewriting the function from earlier, the utility of a menu itself is the utility you get from facing that menu and choosing the 'optimal' thing (including the temptation part) from it

$$U(A) = \max_{x \in A}[u(x) + v(x)] - \max_{y \in A} v(y) \tag{46}$$

- Notice that $u(l) \geq u(k) \Leftrightarrow \{l\} \succsim \{k\}$

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- Notice that $u(l) \geq u(k) \Leftrightarrow \{l\} \succsim \{k\}$
- In our example, we had that $\{b\} \succ \{b, i\} \sim \{i\}$
- Sophisticated DM would prefer the smaller menu as a commitment device: eat broccoli, avoid the temptation of ice cream

Menu choice as avoiding willpower cost

Take a slight change to the example:
$u(b) = 6, u(i) = 3, v(b) = 0, v(i) = 2$. Then:

$$U(A_1, b) = u(b) - s(A_1, b) = 6 - 2 = 2 \tag{47}$$
$$U(A_1, i) = u(i) - s(A_1, i) = 3 - 0 = 3 \tag{48}$$
$$U(A_2, b) = u(b) - s(A_2, b) = 6 - 0 = 6 \tag{49}$$
$$U(A_3, i) = u(i) - s(A_3, i) = 3 - 0 = 3 \tag{50}$$

- Again we have that $\{b\} \succ \{i\} \succ \{b, i\}$
- Rationale is slightly different: DM can avoid the temptation of ice cream if both are on the menu, but prefers the smaller menu to save on willpower cost

Naivety

What about a DM who doesn't anticipate temptation?

- In the original example, DM who makes choices governed only by u has preference over menus $\{b, i\} \succ \{i\}$
- But they will choose ice cream from that menu when they sit down in front of it
- They will never choose commitment devices because they don't anticipate the problem

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- But they will choose ice cream from that menu when they sit down in front of it
- They will never choose commitment devices because they don't anticipate the problem
- A slightly more subtle issue here is that someone who underestimates their temptation can be ripped off

Lab experiment on temptation and self-control

Séverine Toussaert (2018): lab experiment to identify self-control types and study their behavior

- Seek to identify those who would pay to restrict their choice sets even though they expect to be able to resist temptation
- i.e. those who want to avoid willpower costs

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- Seek to identify those who would pay to restrict their choice sets even though they expect to be able to resist temptation
- i.e. those who want to avoid willpower costs
- Task: subjects perform a boring task to focus on a four digit number updated every second and enter the last one when randomly prompted
- Temptation: gossip
  - Subjects given 10 minutes at the beginning of the experiment to write about an 'incredible or strange life event that they personally experienced'
  - Experimenter read the stories and picked the one they found most entertaining (these are in the appendix of the paper!)
  - (Why not just use watching TV or something?)
  - Had to leave lab one at a time to minimize off-channel gossip

Toussaert (2018)

- Section B: choose to do the task w/o story and get paid for all 5 prompts, or read the story during the task and get paid for 4 randomly selected prompts
- Section C: elicit menu preferences among 3 options: no access to story, pay for 5 prompts; access to story, pay for 4 prompts; decide during the task whether and when to read the story
  - Assigned a menu based on their ranking, but probabilistically: get the 3rd menu with pr. 0.5 and with pr. 0.5 get a menu drawn with probs that depend on menu ordering
- Section D: elicit WTP (either money or time, randomly assigned) to replace a ranked choice with the one above it
- Section E: elicit beliefs about whether they'd read the story if offered
- Then the task, then the exit survey

Toussaert (2018) findings

- 25-33% of subjects are self-control types who would like to restrict their choice even when they expect to resist temptation
- Almost all of them did in fact resist temptation
- Subjects assigned to not have the story available were about 20 percentage points more likely to get a perfect score on the task than those who had the choice (51.7% vs. 32.3%)
- Conflicted subjects (reading the story conflicted with their initial beliefs or preferences) were more likely to report that the story was in their mind when it was available to choose
- Compare to Toussaert (2016) working paper on menu choice in weight loss challenge and commitment demand in a related domain, exercise

Temptation bundling

Milkman, Minson, and Volpp (2014): field experiment on bundling instant gratification goods with delayed gratification goods

- 'Want' good: listening to page-turner audiobooks
- 'Should' good: going to the gym

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- 'Want' good: listening to page-turner audiobooks
- 'Should' good: going to the gym
- 226 faculty, staff, and students at a 'large NE U.S. university'
- Treatments:
  1. Full: given an iPod with four audiobooks of their choice, only usable at the gym
  2. Intermediate: four audiobooks of their choice loaded on their personal iPods; could access any time but encouraged to try self-imposing only listening at the gym
  3. Control: given a $25 Barnes and Noble gift card (around the same as renting four audiobooks)

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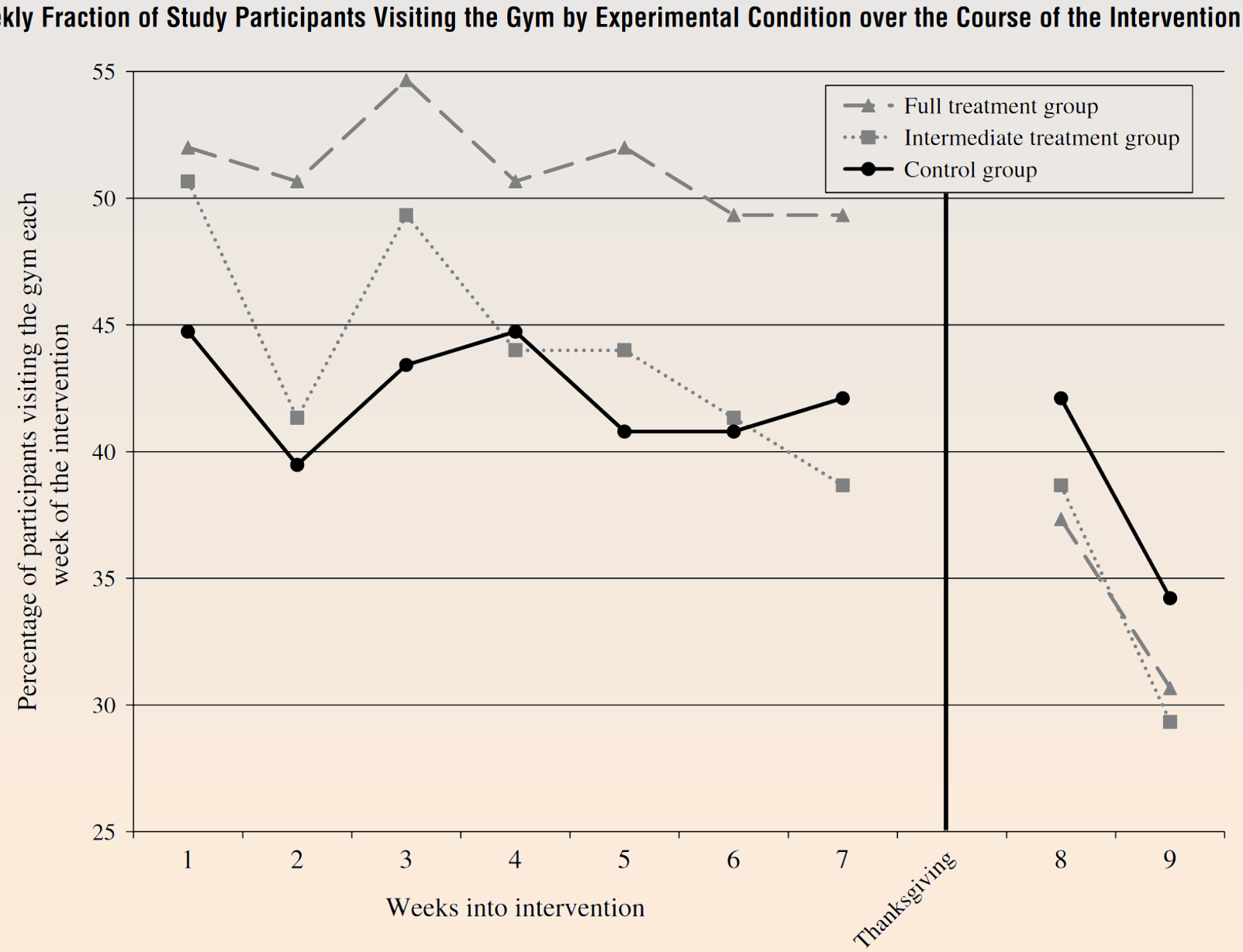
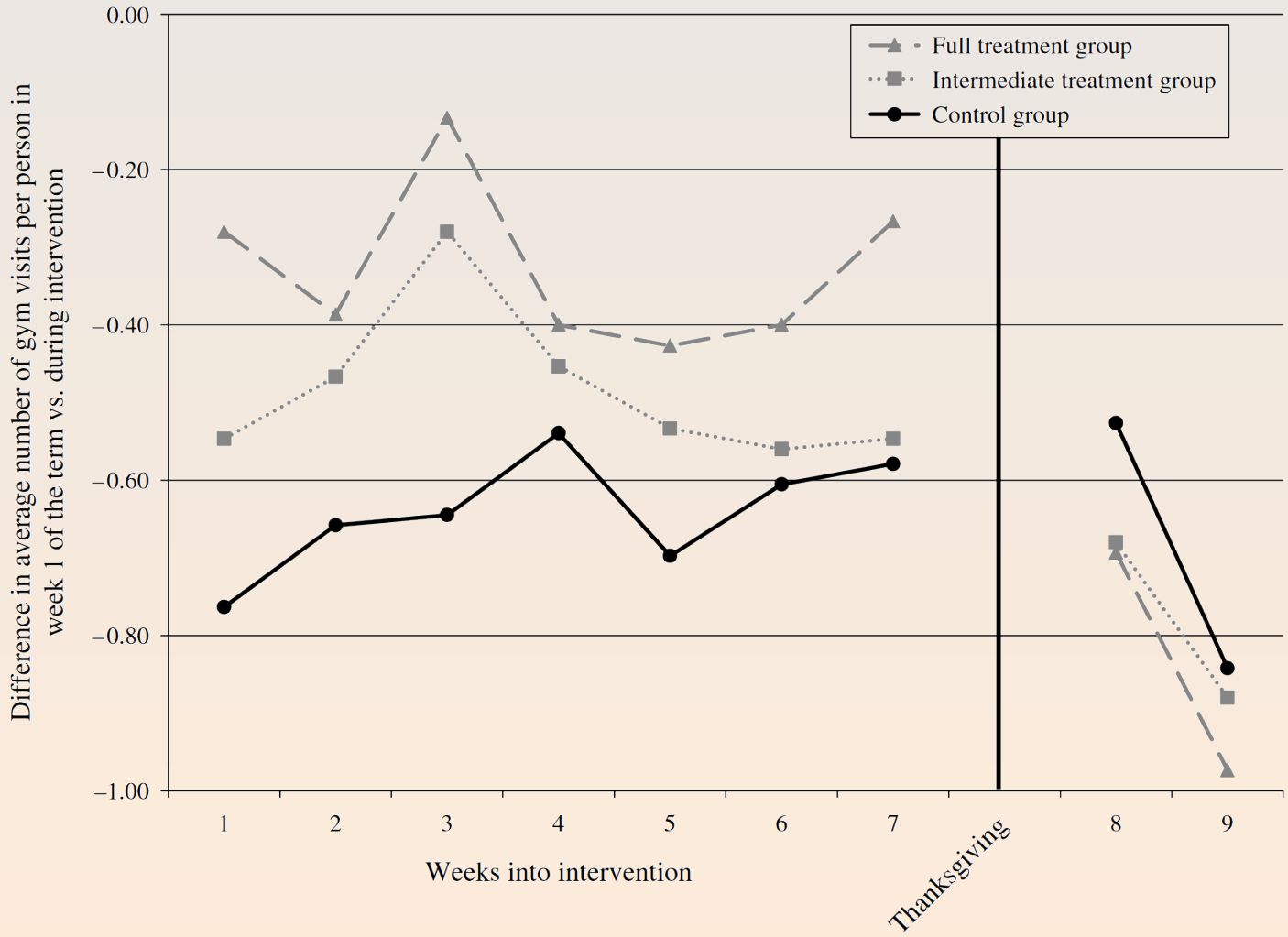
  3. Control: given a $25 Barnes and Noble gift card (around the same as renting four audiobooks)
- After nine weeks, audiobooks and/or iPods returned
- WTP for one month of restricted, gym-only access to an iPod with a single tempting audiobook elicited, compared to if they could take it home any time to listen to for free

Milkman, Minson, and Volpp (2014)

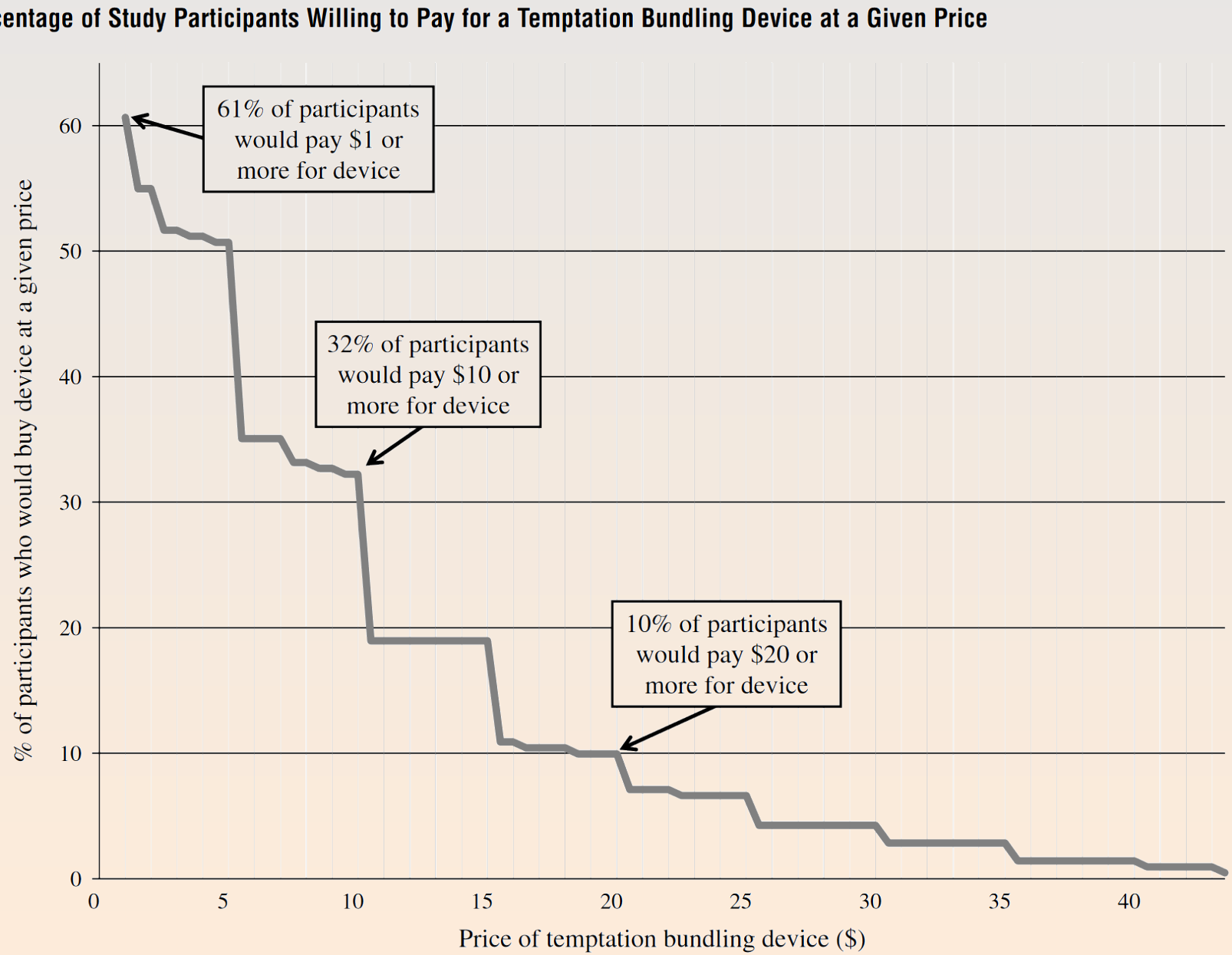


Milkman, Minson, and Volpp (2014)

Gym Attendance for All Groups Declined Precipitously from Baseline Levels Measured in the First Week of the University Semester, Prior to the Start of Our Intervention; Participants in the Treatment Conditions Experienced a Smaller Decline in Gym Attendance Than Those in the Control Condition



Milkman, Minson, and Volpp (2014)



Keeping your options open

Another sense in which you might have a preference over menus is the idea of flexibility

- Example: packing for a vacation
  - Choose your 'menu of clothes' now, choose from them later
  - Need to pack for a chance of rain

Keeping your options open

Another sense in which you might have a preference over menus is the idea of flexibility

- Example: packing for a vacation
  - Choose your 'menu of clothes' now, choose from them later
  - Need to pack for a chance of rain
- Example: ice cream or hot chocolate
  - Don't know what the weather's going to be like next week, so you prefer to have a menu with both available
  - Some affinity here with things from the 'Risk' section of our course

Preference for flexibility: example

Take two equally likely states, dry (d) and rainy (r) and two shoes, sneakers (s) and boots (b)

- Say that $u(s|d) = 5$ and $u(s|r) = 1$: you don't want to wear your sneakers in the rain
- Say that $u(b|d) = 1$ and $u(b|r) = 4$: boots are better in the rain but worse if it's dry

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Take two equally likely states, dry (d) and rainy (r) and two shoes, sneakers (s) and boots (b)

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- Say that $u(b|d) = 1$ and $u(b|r) = 4$: boots are better in the rain but worse if it's dry

$$U(\{s\}) = \frac{1}{2}5 + \frac{1}{2}1 = 3 \tag{51}$$

$$U(\{b\}) = \frac{1}{2}1 + \frac{1}{2}4 = 2.5 \tag{52}$$

$$U(\{s, b\}) = \frac{1}{2}5 + \frac{1}{2}4 = 4.5 \tag{53}$$

So preference ordering is $\{s, b\} \succ \{s\} \succ \{b\}$

Willpower as a constraint

A different approach to willpower is found in Masatlioglu, Nakajima, and Ozdenoren (2013)

$$U(A) = \max_{x \in A} u(x) \tag{54}$$

$$\text{subject to } \max_{y \in A} v(y) - v(x) \leq w \tag{55}$$

- What does this capture that the other model does not?

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- What does this capture that the other model does not?
- Differences in willpower: two DMs that face identical problems but have different stocks of willpower may choose differently here
- There is some evidence that willpower is a depletable resource in ways that change subsequent economic behavior (Vohs and Faber 2004, Dewitte et al. 2005)
- Ozdenoren, Salant, and Silverman (2012) models depletable willpower

Scarcity and patience

A robust literature in psychology and economics suggests that people who are subject to more scarcity behave differently than people who have abundant resources

- Shah, Mullainathan, & Shafir (2012): scarcity changes how people allocate attention
  - Experiments in which subjects played modified Wheel of Fortune, Angry Birds, and Family Feud style games
  - Some subjects had a lot of guesses / attempts / time and some had less
  - Could borrow guesses or time from future puzzles at 100% interest rate (i.e. get 2 fewer guesses later)

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  - Some subjects had a lot of guesses / attempts / time and some had less
  - Could borrow guesses or time from future puzzles at 100% interest rate (i.e. get 2 fewer guesses later)
  - 'Poor' are more attentive and successful in the no-borrowing case
  - For example, spend more time aiming their first Angry Birds shot and did better per shot
  - But when borrowing was available, 'poor' borrowed more attempts from the future and this was counterproductive—'rich' did similarly with or without borrowing but 'poor' did worse with borrowing

Agency and time preference

Gneezy, Imas, & Jaroszewicz (2018): how does having agency over one's own resource scarcity matter?

- Study 1 used 220 Amazon Mechanical Turk recruits, three conditions: Scarcity-Agency, Scarcity-No Agency, No Scarcity (Control)
- Part 1: all subjects responded to 15 true or false Wonderlic style questions
  - Both Scarcity groups had 10 seconds per question; Control had unlimited time; paid base rate and per correct answer
- Part 2: second set of 15 true or false questions; told that afterwards a threshold would be drawn randomly between 1 and 15
  - Scarcity conditions had 6 seconds per question; Control had no time limit
  - No Agency could not increase their time limit; Agency could increase it back to 10 seconds but at an 80% cost to the base payment
  - Designed to test effect of agency but not to have it actually matter by dissuading anyone from taking it (4 did and were excluded from analysis)

Gneezy, Imas, & Jaroszewicz (2018)

- Part 3: subjects' time preferences were elicited
  - Asked to allocate 100 tokens across two dates
  - Tokens allocated to later dates had 50% higher values such that patience was rewarded
  - Two decisions: 100 to allocate between today and in 1 week from today; 100 to allocate between 1 week and 2 weeks from today
  - One of these two decisions would be randomly chosen to be paid out
- Part 4: four hypothetical risk questions (we haven't studied risk preference yet so we'll not think about this right now)
- Part 5: asked to indicate on 1-7 scale whether they felt time constrained in the true or false questions

Gneezy, Imas, & Jaroszewicz (2018)

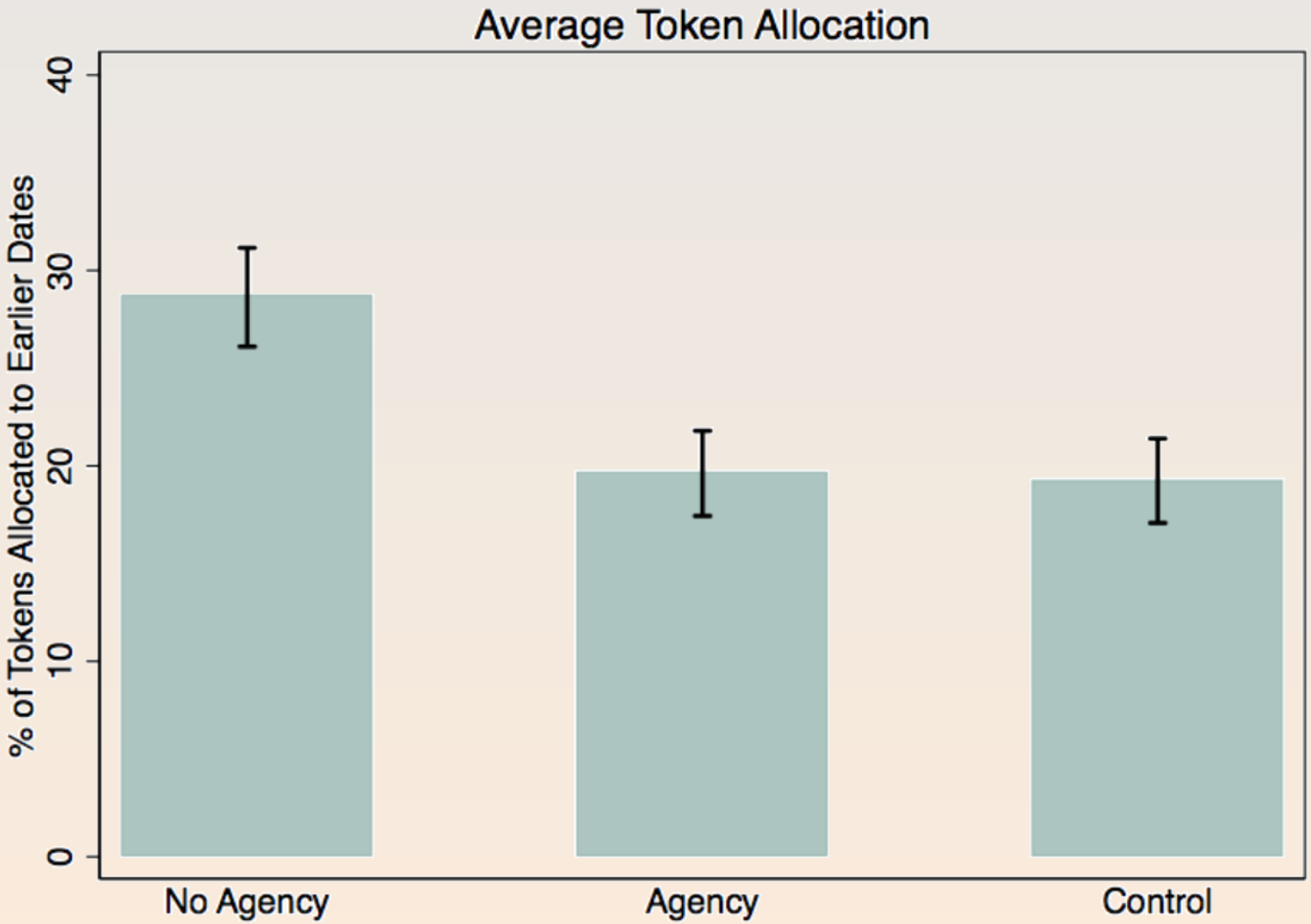


Figure 1. Study 1 results: percent of tokens allocated to earlier dates, collapsing across allocation decisions. *N*=216. Error bars denote ±1 SE.

Gneezy, Imas, & Jaroszewicz (2018)

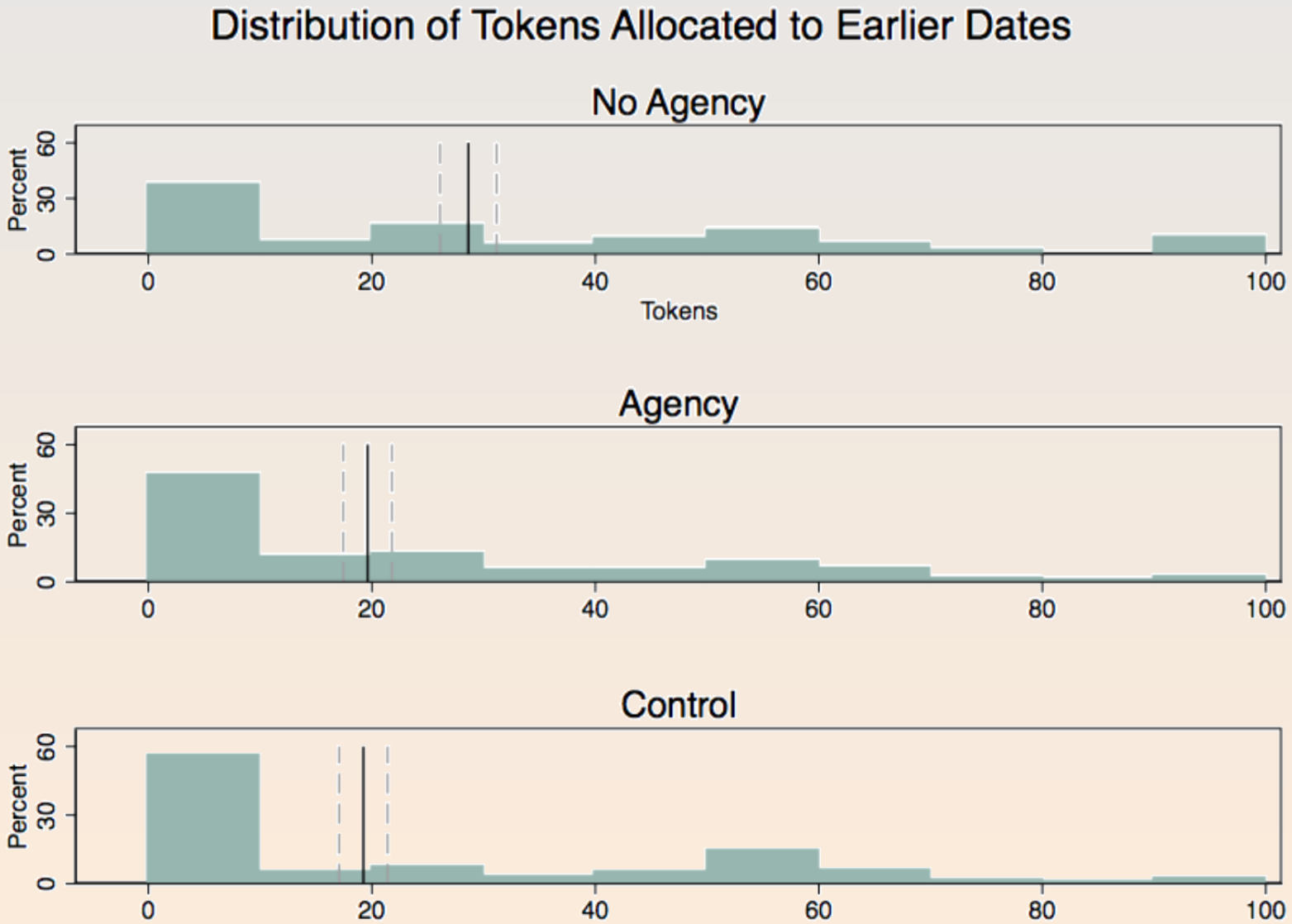


Figure 2. Study 1 results: percent of tokens allocated to earlier dates, collapsing across allocation decisions. *N*=216. Black solid line denotes mean; grey dashed lines denote ±1 SE.

Gneezy, Imas, & Jaroszewicz (2018)

Study 2: can increased agency moderate the effect of environmental stressors on behavior?

- 115 subjects; lab experiment for class credit
- Participants asked to solve 30 anagrams in 5 minutes while listening to a "loud, jarring noise" over headphones
- 1 in 10 participants got a $20 bonus
- No Agency condition: removing headphones disqualified them from the study
- Agency: removing the headphones would cost 50% of the potential bonus (again trying to discourage exercising agency)
- Afterwards patience elicited: 27 hypothetical choices between a smaller sooner or larger later reward (amounts and delay varied to allow for detailed estimation)

Gneezy, Imas, & Jaroszewicz (2018)

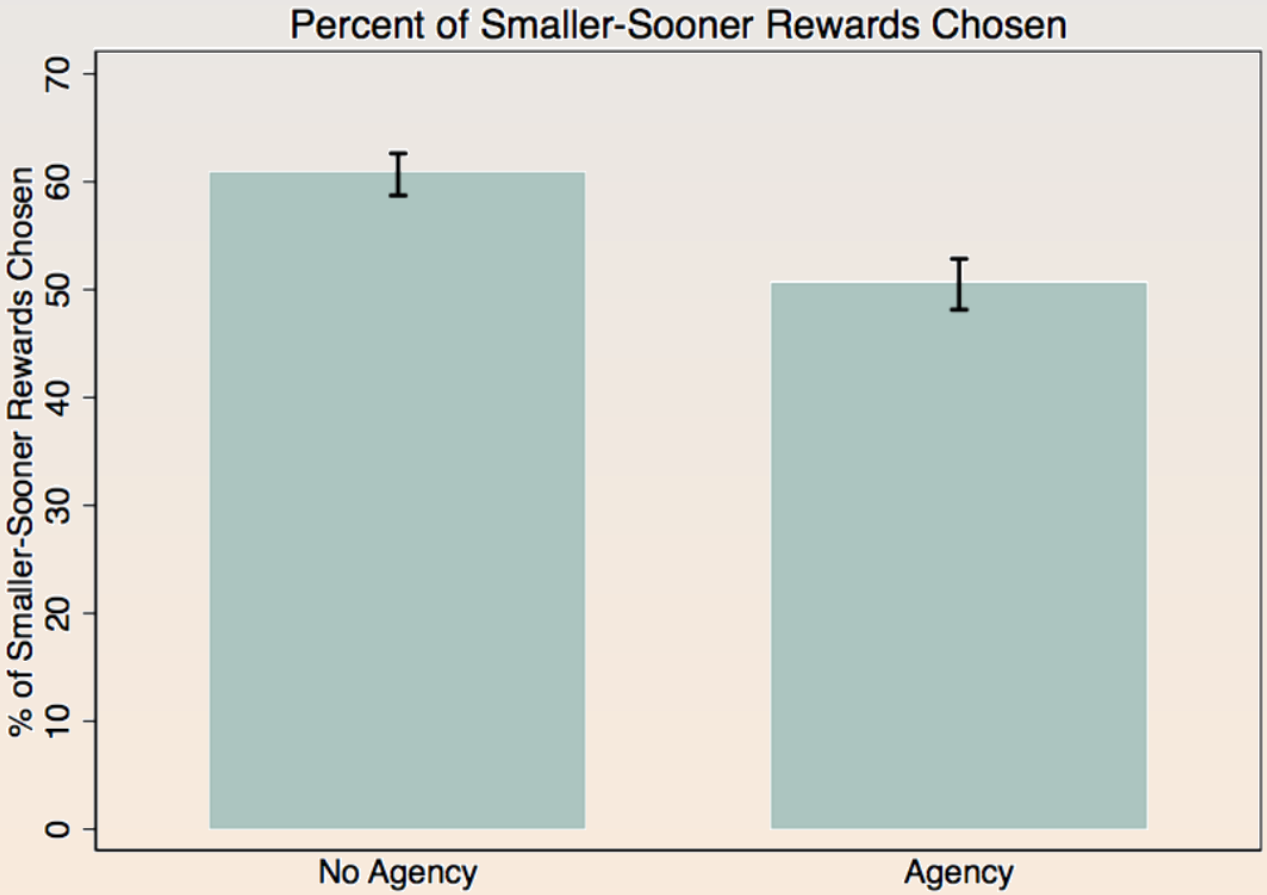
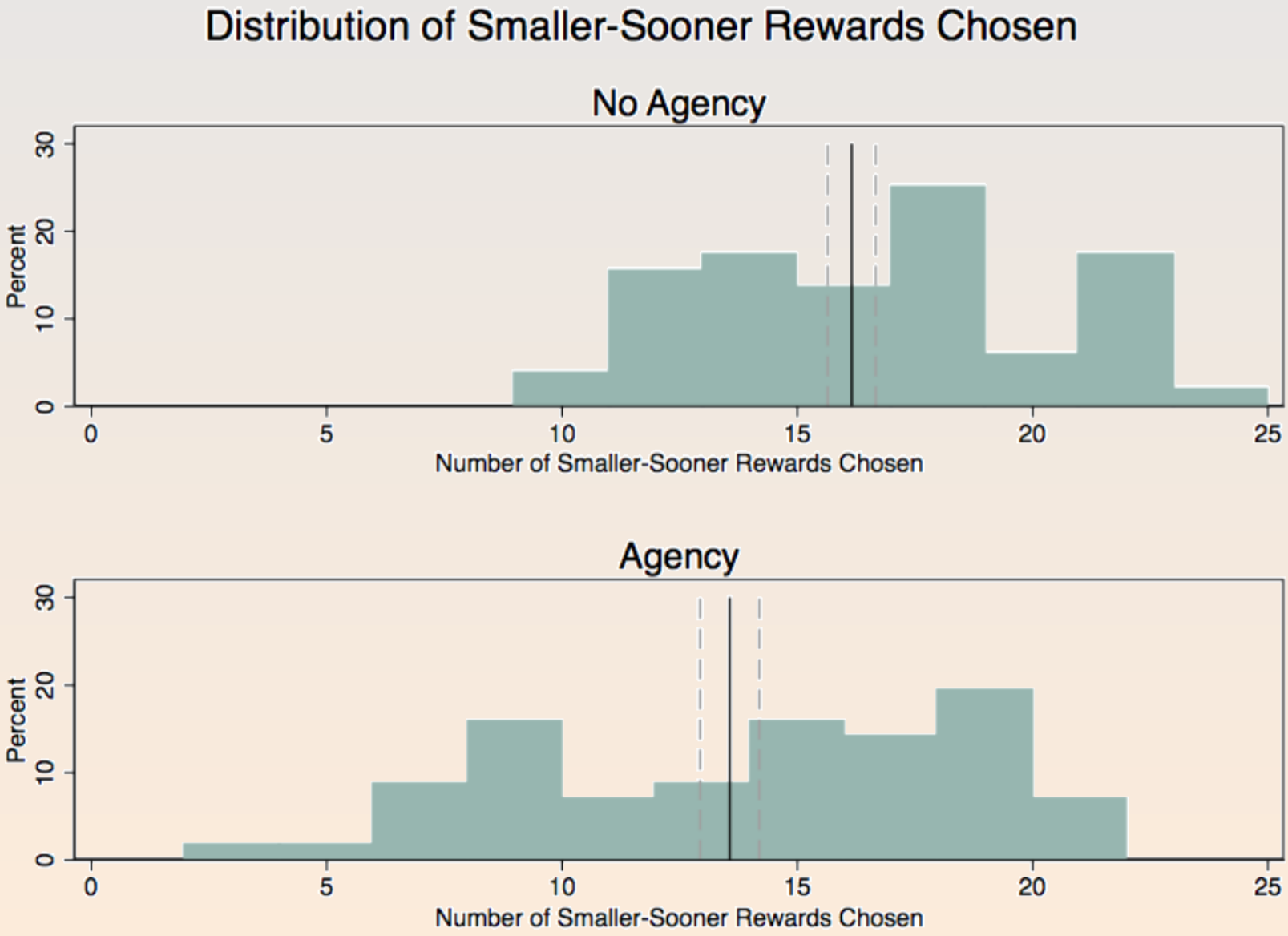


Figure 3. Study 2 results: percent of smaller-sooner rewards chosen, by treatment group. N=109. Error bars denote ±1 SE.

Gneezy, Imas, & Jaroszewicz (2018)



Other behaviors contradicting the standard model

Time inconsistency is not the only type of behavior that is hard to reconcile with the standard exponential discounting model

- Preference for spread
- Habit formation
- 'Rational' addiction
- Consumption commitments

Preference for spread

Imagine that over the next five weekends you must decide how to spend your Saturday nights. From each pair of sequences of dinners below, circle the one you would prefer. "Fancy French" refers to a dinner at a fancy French Restaurant. "Fancy Lobster " refers to an exquisite lobster dinner at a 4 star restaurant. Ignore scheduling considerations (e.g., your current plans).

Options	first weekend	second weekend	third weekend	fourth weekend	fifth weekend	
A	Fancy French	Eat at home	Eat at home	Eat at home	Eat at home	[11%]
B	Eat at home	Eat at home	Fancy French	Eat at home	Eat at home	[89%]

Options	first weekend	second weekend	third weekend	fourth weekend	fifth weekend	
C	Fancy French	Eat at home	Eat at home	Eat at home	Fancy Lobster	[49%]
D	Eat at home	Eat at home	Fancy French	Eat at home	Fancy Lobster	[51%]

Figure: Lowenstein & Prelec (1993)

Habit formation

Habit formation and its 'dark side' cousin addiction can be captured by having current consumption enter future utility

- The idea here is that consumption of a habit-forming good acts as an investment in a habit stock
- In future periods the habit stock affects the marginal utility of consuming the good
- The technical issue that arises here is that utility is now path-dependent and not separable across time
- This makes the optimization problem dynamic, which requires a different toolbox than static optimization
  - If you have studied dynamic optimization tools in other classes you can read the technical details of these models
  - But we are not going to go through that toolbox in detail here

Rational addiction

Becker and Murphy (1988) propose a model by which addiction can be rationalized by stable preferences

- Individuals recognize that the product is additive
- But if the gains outweigh possible future costs associated with addiction, choosing to consume the good is rational
- Both the actual current sales price and the costs of addiction are fully understood by the consumer

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Becker, Grossman, and Murphy (1994) an early example of a paper testing this model

- Higher prices next year lead to lower consumption today
- Consistent with rational, forward-looking consumers choosing how to consume an addictive good in the model

Evidence on rational addiction

Gruber and Köszegi (2001) look at the purchasing behavior of cigarette smokers to see how the rational addiction model performs

- Motivation 1: price increases are not typically well known in advance so hard to see how forward-looking consumers can be expected to plan
- Motivation 2: time inconsistency would undermine consumers' ability to plan consumption even if future prices were known
- Particularly relevant here since addictive goods are typical examples of goods for which self-control problems are rife

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- Particularly relevant here since addictive goods are typical examples of goods for which self-control problems are rife
- Uses data on state excise tax changes that have been passed into law but haven't yet taken effect
- Evidence of forward-looking behavior in cigarette purchases
- If consumers are time inconsistent, the negative effect cigarette smokers impose on their future selves are much higher than the already well-known externalities imposed on others

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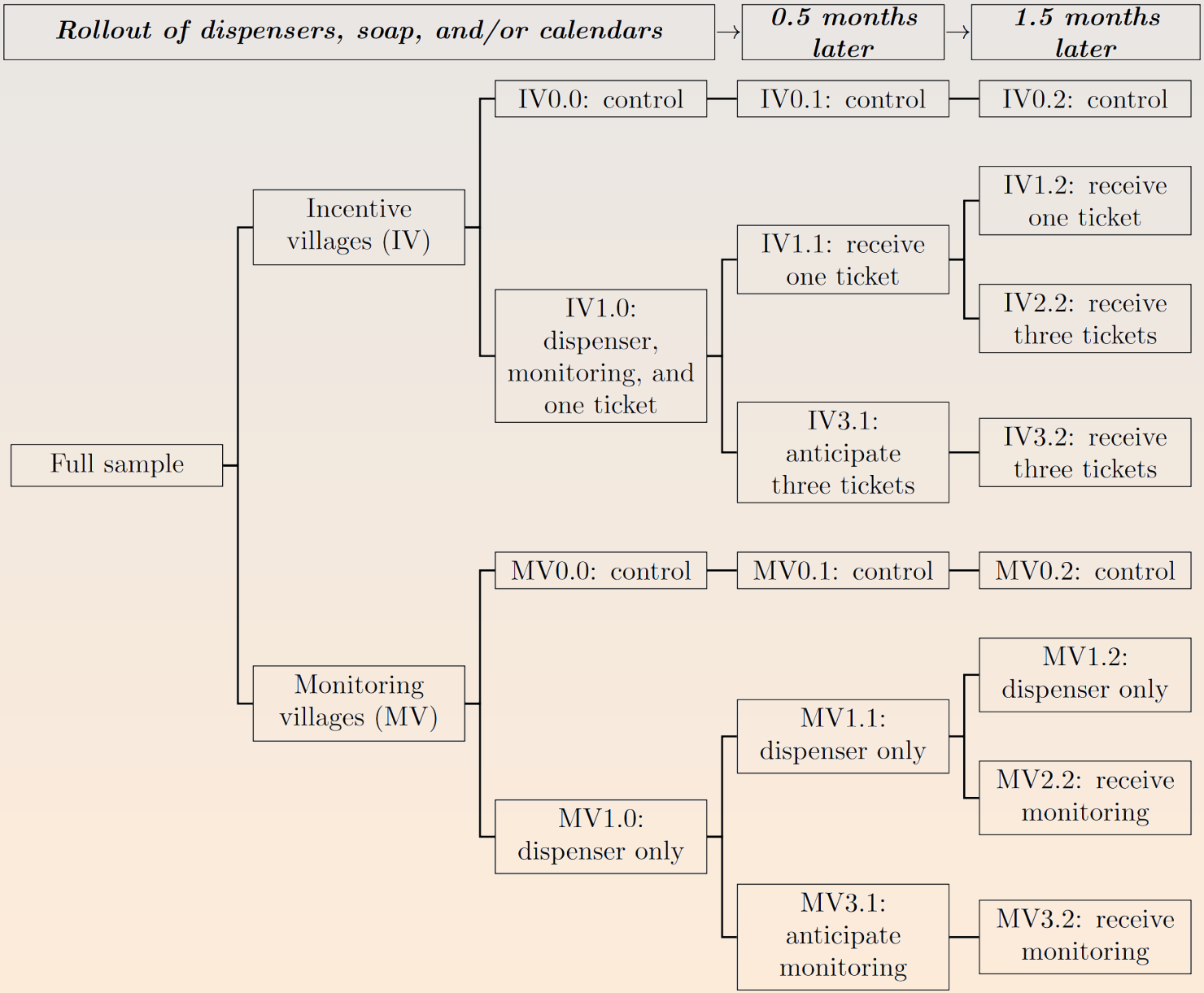
- If consumers are time inconsistent, the negative effect cigarette smokers impose on their future selves are much higher than the already well-known externalities imposed on others
- Auld and Grootendorst (2004) demonstrate 'rational addiction' for things like... milk (i.e. there are empirical issues here)

Policies to exploit habit formation

Hussam, Rabbani, Reggiani, and Rigol (2017): field experiment to test rational addiction model in the context of handwashing

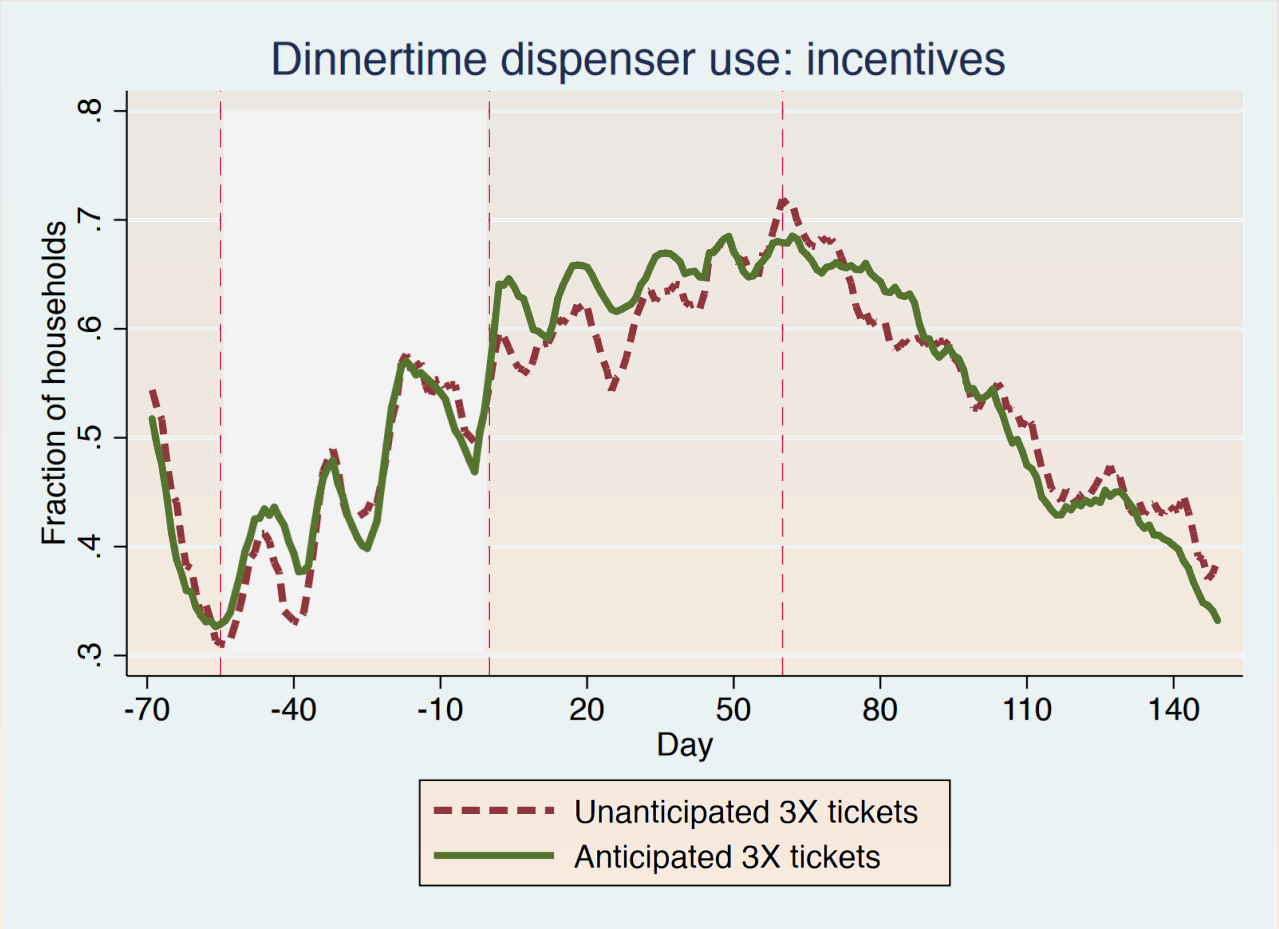
- Soap dispenser with time-stamped sensor
- 2,943 households in 105 villages in Birbhum District, West Bengal
- Various treatments as illustrated on next slide
- Monitoring and incentives both increased handwashing relative to just receiving a dispenser
- Effects persist after incentives removed
- Anticipation of monitoring (but not stronger incentives) increased handwashing rates significantly
- Households in incentive treatment actually had a *lower* WTP for soap when elicited at 8 month mark

Hussam et al. (2017)



Hussam et al. (2017)

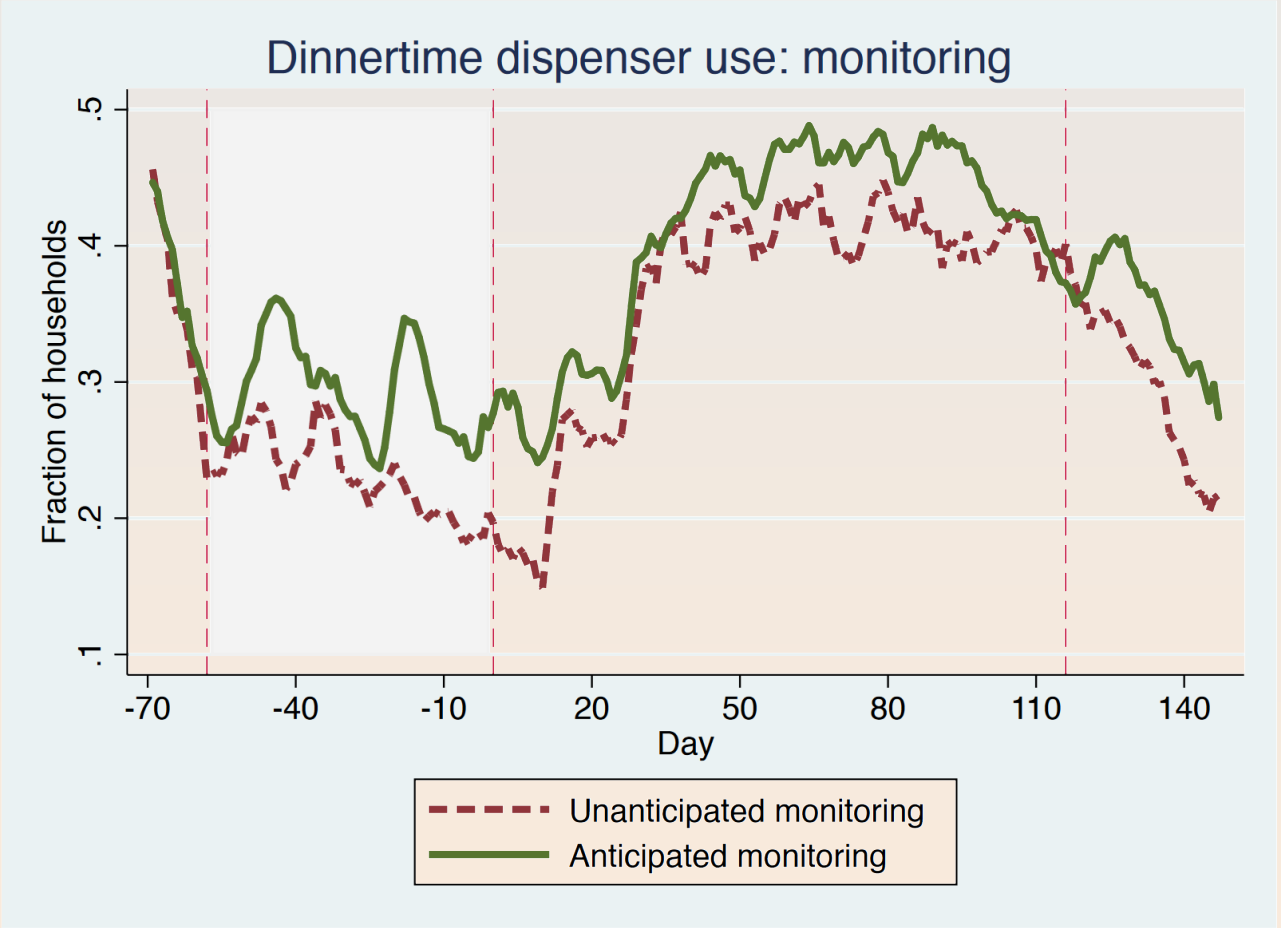
Figure 8a: Rational addiction in incentives



Notes: Figure shows the average likelihood of the dispenser being active (at least one press) 1.5 hours before or after the household's self-reported evening mealtime. Both red and green lines represent households who received the dispenser, feedback, and one ticket until Day 0, after which they received three tickets per day the dispenser was active during the evening mealtime; however, green households were anticipating the tripling of the tickets while red households were not. The gray box represents the time during which green households were anticipating. Triple tickets then commenced on Day 0 and lasted until Day 60 (third vertical red line).

Hussam et al. (2017)

Figure 8b: Rational addiction in monitoring



Notes: Figure shows the average likelihood of the dispenser being active (at least one press) 1.5 hours before or after the household's self-reported evening mealtime. Both red and green lines represent households who received the dispenser only until Day 0, after which they additionally received feedback/monitoring; however, green households were anticipating the start of monitoring/feedback while red households were not. The gray box represents the time during which green households were anticipating. Feedback then commenced on Day 0 and lasted until Day 117 (third vertical red line).

Consumption commitments

Consumption commitments are expenditures that are hard to quickly adjust to changes in income

- For example, if you suddenly lost your job you are still on the hook for rent or mortgage payments
- Olney (1999) shows that household finance commitments were critical in the dynamics of the Great Depression
- Chetty and Szeidl (2016) argues that consumption commitments can explain patterns in the data better than habit formation models
  - If you experience a big shock then you change the commitments
  - But if the shock is less dramatic than that you keep the commitments and adjust what you can
  - If that is true then we would see more excess sensitivity for small shocks than for large shocks

Consumption commitments and jobs

Postlewaite, Samuelson, and Silverman (2008): consumption commitments might influence employment contracts

- Their motivating example: two firms with different characteristics
  - Firm 1: never fires people, but in bad times reduces everyone's pay
  - Firm 2: maintains wages, but in bad times fires the most recently hired workers

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  - Firm 1: never fires people, but in bad times reduces everyone's pay
  - Firm 2: maintains wages, but in bad times fires the most recently hired workers
- A worker may prefer firm 2: she can coordinate her decisions on big consumption commitments with vulnerability to income shocks
  - Hold off on big ticket stuff like buying a house until getting enough seniority
- Whereas at firm 1 a negative shock would leave her facing painful decisions on discretionary spending
- 'Optimal' employment contracts might therefore have the chance of being fired