Temptation and Self Control: Evidence and Applications

Mark Dean

Behavioral Economics G6943
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- A sketch of the theoretical conclusions
  - People who suffer from temptation and who are
    - Certain about the future
    - Sophisticated

    Should exhibit preferences for commitment
  - Non-exponential discounting should lead to
    - Preference reversals in intertemporal choice
    - Preference for commitment

- In this lecture we will talk about the evidence for
  - Preference for commitment
  - Preference for flexibility
  - Preference reversals in discounting experiments
  - The link between the two
  - Sophistication
  - The role of noise
- And three applications
  - Willpower and Personal Rules
  - Procrastination
  - Poverty Traps

Preference for Commitment

- Do we see much evidence for 'Preference for Commitment' in the field?
- Arguably not much
- Some evidence for ‘informal’ commitment devices
  - New year's resolutions
  - Joining a gym
  - ROSCAs
- Most formal commitment devices have been generated by behavioral economists
  - Stiikk
  - Beeminder
  - SMART
- And are relatively small in scale
  - e.g. Stickk has 424,000 'commitments'
- Can we generate preference for commitment in the lab?

Can We Generate A Preference for Commitment?

- Two examples:
- Lab: "Eliciting temptation and self-control through menu choices: a lab experiment" [Toussaert 2017]
  - See also "Temptation and commitment in the laboratory," [Hauser et al 2018]
- Field: “Self Control at Work” [Kaur et al 2015]
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Temptation and Self Control In the Lab

- Aim: Estimate fraction of people who exhibit "Temptation" and "Self Control" a la Gul and Pesendorfer
  - Obviously going to be more interesting if they do manage to generate some of this type of behavior!
- How to generate temptation and self control in the lab?
- They use 'curiosity'
  - All subjects were given 10 mins to write about an incredible life event
  - RA picked one
  - Temptation was the chance to read one of the stories
- Temptation occurred while subjects asked to perform a boring task
  - Stare at a 4 digit number which updated for 60 seconds
  - At random intervals a prompt appeared telling them to report number
  - Paid $2 per correct answer
  - Lasted up to 60 mins (!?!?)

Temptation and Self Control In the Lab

- Two options:
  - (0) Get paid for each of the 5 prompts
  - (1) Read story and get paid for 4 randomly selected prompts
- Three menus
  - $\{0\}$, $\{1\}$, and $\{0.1\}$
- Temptation: $\{0\} \succ \{0,1\}$
- Self control: $\{0\} \succ \{0,1\} \succ \{1\}$

- Experimental timing:
  1. Practice task
  2. Rank menus (higher ranked menus have higher probability of being implemented)
  3. Extract WTP to replace worse options with better options
  4. Elicit beliefs about reading the story if given the option
  5. Perform task

Temptation and Self Control In the Lab

Table 1: Main preference orderings

Preference ordering	menu type	% subjects	(N)	random benchmark	p-value
$\{0\} \succ_1 \{0,1\} \succ_1 \{1\}$	SSB_{-0}	**35.8%**	**(43)**	7.7%	< 0.001
$\{1\} \succ_1 \{0,1\} \succ_1 \{0\}$	SSB_{-1}	4.2%	(5)	7.7%	0.171
$\{0,1\} \succ_1 \{0\} \succ_1 \{1\}$	$FLEX_{-0}$	**20.8%**	**(25)**	7.7%	< 0.001
$\{0,1\} \succ_1 \{1\} \succ_1 \{0\}$	$FLEX_{-1}$	7.5%	(9)	7.7%	1.000
$\{0,1\} \succ_1 \{0\} \sim_1 \{1\}$	$FLEX_{-0\vee 1}$	5.8%	(7)	7.7%	0.605
$\{0\} \sim_1 \{0,1\} \succ_1 \{1\}$	STD_{-0}	9.2%	(11)	7.7%	0.494
$\{0\} \succ_1 \{1\} \succ_1 \{0,1\}$	$GUILT$	6.7%	(8)	7.7%	0.863
other ordering		10.0%	(12)	46.1%	< 0.001
Total		100%	(120)	100%	

- Results using rankings only

Table 3: Alternative classification accounting for WTP choices

Preference ordering	menu type	% subjects	(N)	random benchmark	p-value
$\{0\} \succ_1 \{0,1\} \succ_1 \{1\}$	SSB_{-0}	**23.3%**	**(28)**	7.7%	< 0.001
$\{1\} \succ_1 \{0,1\} \succ_1 \{0\}$	SSB_{-1}	4.2%	(5)	7.7%	0.171
$\{0,1\} \succ_1 \{0\} \succ_1 \{1\}$	$FLEX_{-0}$	10.8%	(13)	7.7%	0.226
$\{0,1\} \succ_1 \{1\} \succ_1 \{0\}$	$FLEX_{-1}$	5.8%	(7)	7.7%	0.605
$\{0\} \sim_1 \{0,1\} \succ_1 \{1\}$	STD_{-0}	**30.0%**	**(36)**	7.7%	< 0.001
$\{0\} \succ_1 \{1\} \succ_1 \{0,1\}$	$GUILT$	8.3%	(10)	7.7%	0.732
$\{0\} \sim_1 \{1\} \sim_1 \{0,1\}$	IND	9.2%	(11)	7.7%	0.494
other ordering		8.3%	(10)	46.1%	< 0.001
Total		100%	(120)		

- Results using rankings and WTP

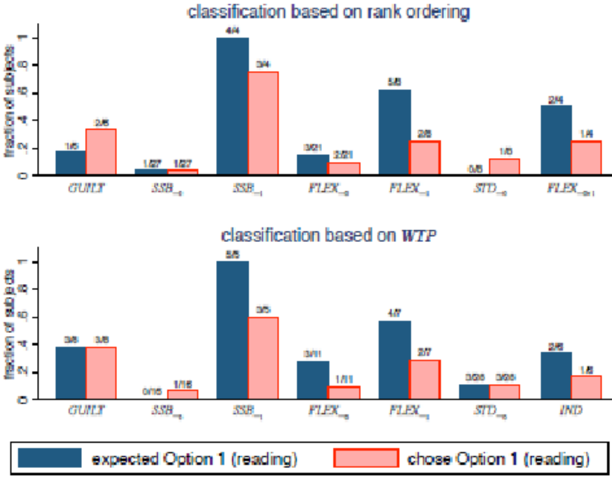
Temptation and Self Control In the Lab

Table 4: Relationship between initial preference ordering and beliefs

Preference ordering $\succeq_1$ on $\mathcal{M}$	menu type	dist. of Period 2 choices under S and NPR	Incentivized $\bar{\lambda}_1$		Unincentivized $\bar{\lambda}_1$	
			$\succeq_1^{rank}$	$\succeq_1^{WTP}$	$\succeq_1^{rank}$	$\succeq_1^{WTP}$
$\{0\} \succ_1 \{0,1\} \succ_1 \{1\}$	SSB_{-0}	$\lambda_0 > \lambda_1 \geq 0$	0.023 *(1/43)*	0 *(0/28)*	0.023 *(1/43)*	0 *(0/28)*
$\{1\} \succ_1 \{0,1\} \succ_1 \{0\}$	SSB_{-1}	$\lambda_1 > \lambda_0 \geq 0$	1 *(5/5)*	1 *(5/5)*	1 *(5/5)*	1 *(5/5)*
$\{0,1\} \succ_1 \{0\} \succ_1 \{1\}$	$FLEX_{-0}$	$\lambda_0 > \lambda_1 > 0$	0.12 *(3/25)*	0.385 *(5/13)*	0.12 *(3/25)*	0.308 *(4/13)*
$\{0,1\} \succ_1 \{1\} \succ_1 \{0\}$	$FLEX_{-1}$	$\lambda_1 > \lambda_0 > 0$	0.667 *(6/9)*	0.571 *(4/7)*	0.778 *(7/9)*	0.714 *(5/7)*
$\{0,1\} \succ_1 \{0\} \sim_1 \{1\}$	$FLEX_{-0\vee 1}$	$\lambda_0, \lambda_1 > 0$	0.714 *(5/7)*	–	0.714 *(5/7)*	–
$\{0\} \sim_1 \{0,1\} \succ_1 \{1\}$	STD_{-0}	$\lambda_1 = 0$	0 *(0/11)*	0.083 *(3/36)*	0 *(0/11)*	0.056 *(2/36)*
$\{0\} \succ_1 \{1\} \succ_1 \{0,1\}$	$GUILT$	$\lambda_0 > \lambda_1 \geq 0$	0.125 *(1/8)*	0.30 *(3/10)*	0.25 *(2/8)*	0.20 *(2/10)*
$\{0\} \sim_1 \{1\} \sim_1 \{0,1\}$	IND	$\lambda_0, \lambda_1 \geq 0$	–	0.364 *(4/11)*	–	0.455 *(5/11)*

Notes: Incentivized $\bar{\lambda}_1$ is the fraction of subjects who guessed that someone with the same rank ordering would read the story if offered {0,1} in Period 2. Unincentivized $\bar{\lambda}_1$ is the fraction of subjects who reported being somewhat or very likely to read the story if offered {0,1} in Period 2; for subjects reporting being "unsure", answers to the *Incentivized* question are used as a tie breaker. The distribution of Period 2 choices inferred from $\succeq_1$ relies on the

Figure 2: Beliefs versus ex post choice by menu type



Can We Generate A Preference for Commitment?

- Two examples:
- Lab: "Eliciting temptation and self-control through menu choices: a lab experiment" [Toussaert 2017]
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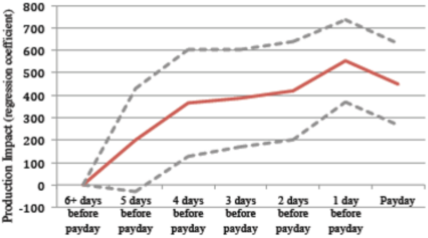
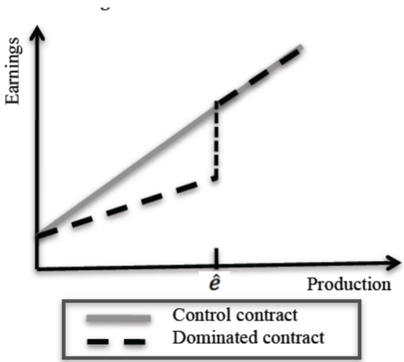
Self Control at Work

- Consider a job in which you get paid piece rate
  - Paid only at the end of the week
- What is the effect of temptation (as modelled by hyperbolic discounting)?
  - Pay day effects: work harder when reward is immediate
  - May work less hard in period t+1 than would like in period t: Creates a demand for commitment
- Test this using an experiment with a data entry firm in Mysore, India

Figure 2: Production over the Pay Cycle



- 102 workers over 8 months
- Number of additional fields (over a base of about 5000)
- Size of effect inconsistent with discounting
- Gradual slope: incommensurate with quasi-hyperbolic discounting?



- Dominated Contracts: Reduce pay if target is not met
- A form of commitment, as it removes the possibility of producing less than the target at the same pay

Table 3
Contract Treatments

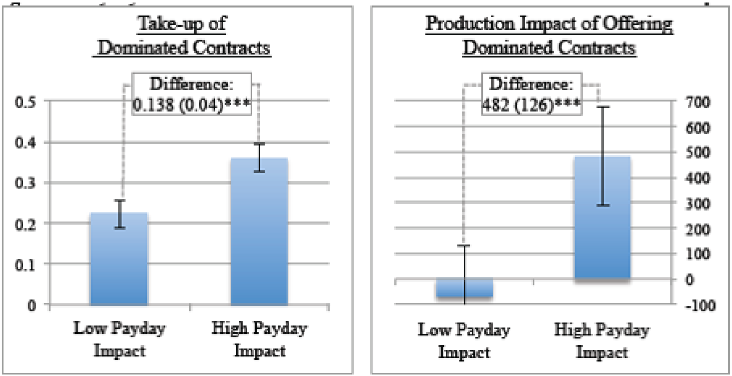
Panel A: Take-up of Dominated Contracts (Summary Statistics)	
Dominated contract chosen: conditional on attendance	0.36
	(0.31)
Dominated contract chosen: target=0 if absent	0.28
	(0.26)

- In some weeks, workers offered the chance to choose a target b
- Receive half pay if fail to hit target
- t=0 the same as the standard contract

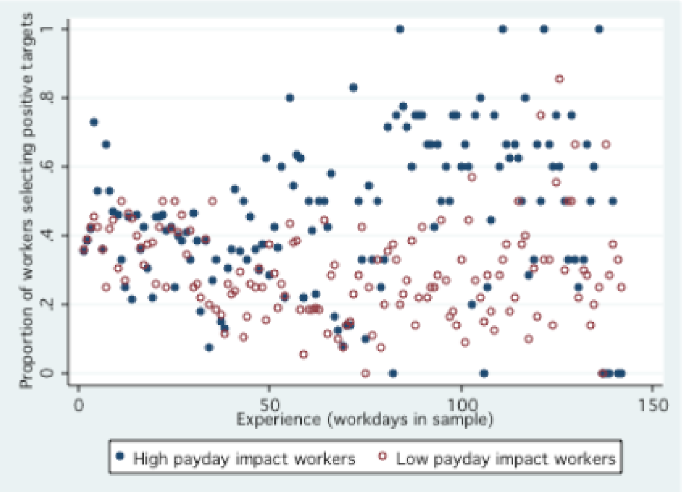
Panel B: Treatment Effects of Contracts

Sample	*Dependent variable: Production* Control & Option Obs (1)	Control & Option Obs (2)	Full Sample (3)	*Dependent var: Attendance* Full Sample (4)
Option to choose dominated contract	120			
	(59)**			
Evening option to choose dominated contract		156	150	0.01
		(69)**	(69)**	(0.01)
Morning option to choose dominated contract		84	73	-0.00
		(69)	(69)	(0.01)
Target imposed: Low target			3	-0.00
			(90)	(0.01)
Target imposed: Medium target			213	-0.01
			(91)**	(0.01)
Target imposed: High target			334	-0.01
			(150)**	(0.02)
Observations: worker-days	6310	6310	8423	8423
R2	0.60	0.60	0.59	0.15
Dependent variable mean	5311	5311	5337	0.88

- Targets increased output
  - If they were self imposed (columns 1 and 2)
  - Exogenously imposed (3)



- Those with high payday impacts more likely to take up dominated contract
- Output also more affected



- Those with high payday impacts also chose the dominated contract more with experience

Other Examples

Type of contract Authors (year)	Take-up rate	At stake
A. Penalty-based:		
Giné *et al.* (2010)	11%	Own money
Royer *et al.* (2015)	12%	Earned money
Bai *et al.* (2021)	14%	Own money
Bhattacharya *et al.* (2015)	23%	Own money
John (2020)	27%	Own money
Kaur *et al.* (2015)	36%	Own money
Schwartz *et al.* (2014)	36%	House money
Bonein and Denant-Boèmont (2015)	42%	Other[1]
Beshears *et al.* (2020)	39–46%[2]	House money
Toussaert (2019)	21–65%	House money
Schilbach (2019)	31–55%	House money
Exley and Naecker (2017)	41–65%	House money
Avery *et al.* (2019)	63%	House money
Ariely and Wertenbroch (2002)	73%	Other[3]
Average take-up rates (Penalty-based contracts)		
Own money at stake	22%	
House money at stake	47%	
Other stakes	42%	
Overall	37%	

Other Examples

B. Removing options:		Restricted access to
Brune *et al.* (2016)	6%	Own money
Afzal *et al.* (2019)	4-9%	Own money
Zhang and Greiner (2021)	16-31%	Other
Sadoff and Samek (2019)	20-50%	Other
Ek and Samahita (2020)	27%[4]	Other
Ashraf *et al.* (2006)	28%	Own money
Sadoff *et al.* (2019)	33%	Other
Acland and Chow (2018)	35%	Other
John (2020)	42%	Own money
Karlan and Linden (2017)	44%	Own money
Toussaert (2018)	45%	Other
Bisin and Hyndman (2020)	31-62%	Other
Houser *et al.* (2018)	48%	Other
Brune *et al.* (2021)	50%	Own money
Beshears *et al.* (2020)	56%[5]	House money
Augenblick *et al.* (2015)	59%	Other
Milkman *et al.* (2014)	61%[4]	Other
Dupas and Robinson (2013)	65%	Own money
Alan and Ertac (2015)	69%	House chocolates
Chow (2011)	79%	Other
Casaburi and Macchiavello (2019)	93%	Own money
Average take-up rates (Option removal contracts)		
Own money at stake	42%	
House money/object at stake	63%	
Other stakes	43%	
Overall	45%	

Preference for Commitment

- So we **can** generate preference for commitment
- But (perhaps) surprisingly little of it
- Why?
- (At least) two possibilities
  - Preference for Flexibility (Discuss this now)
  - Lack of sophistication (Discuss after we have talked about time preference experiments)
- Not an exhaustive list
  - e.g. self signalling?

Preference Uncertainty Model

- Preference uncertainty is the enemy of preference for commitment
  - Creates preference for flexibility
- Can we find evidence for preference uncertainty?
  - Dean and McNeill [2015]

Preference Uncertainty Model

- X : set of alternatives
- S : set of states
- $\mu \in \Delta(S)$: probability distribution over states
- $u : X \times S \rightarrow \mathbb{R}$: utility function
  - $u(x, s)$ utility of alternative x in state s
- Preference uncertainty driven by uncertainty about s
- Use this model to think about
  - Choices **between** menus of alternatives
  - Choices **from** those menus
- i.e. do people use the flexibility they desire?

- Let A be a menu of alternatives
- Choice from A will take place **after** the state is known
- Value of A **before** the state is known given by

$$U(A) = \sum_{s \in S} \mu(s) \max_{x \in A} u(x, s)$$

- U represents **choice between menus**

- The same model also makes predictions about choices **from** menus
- $P(y, A)$: Probability of choosing alternative y from menu A

$$P(y, A) = \sum_{s \in S} \mu(s) \mathbf{1}[\mathbf{x} \in \arg\max_{\mathbf{y} \in \mathbf{A}} \mathbf{u}(\mathbf{y}, \mathbf{s})]$$

- Preference uncertainty implies a link between menu preference and stochastic choice
  - See Ahn and Sarver [2013]

Weak Preference for Flexibility For any two menus $A \succeq B$, $A \cup B \succeq A$

- The union of two menus weakly preferred to each individually
- Rules out 'preference for commitment' i.e. $A \cup B \prec A$
  - Observable implication of temptation
- Note: $A \cup B \succ A$ **only if** there is preference uncertainty (i.e. S is not a singleton)
  - If there is no uncertainty, $A \cup B \sim A$
  - Call this strict preference 'Preference for Flexibility'

Implications [Ahn and Sarver 2013]

Consequentialism $A \cup \{x\} \succ A \Rightarrow P(x, A \cup \{x\}) > 0$

- If you would pay for x to be added to the menu A, must sometimes choose x
- If it is never chosen it cannot be increasing the value of the menu

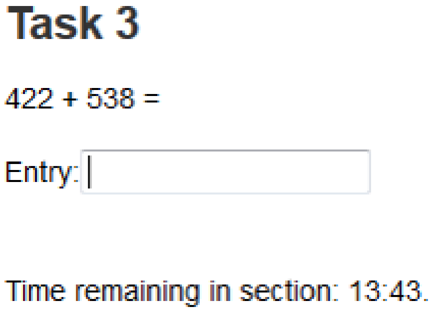
Responsive Menu Preferences $P(x, A \cup \{x\}) > 0 \Rightarrow A \cup \{x\} \succ A$

- If x is sometimes chosen when added to A ,the larger menu must be preferred
- Except in the case of indifference (which we will discuss later)

Experimental Design

- Simulated workplace environment
- Subject perform real effort tasks for payment according to payment contracts
    - Choice from menus
- Subjects choose between different payment contracts
    - Choice between menus

- Simple addition tasks



Contract 11

Tasks completed	Payment
0-4	0.00
5-9	0.00
10-14	0.00
15-19	0.00
20-49	0.20
50+	0.20

Contract 25

Tasks completed	Payment
0-4	0.00
5-9	0.00
10-14	0.00
15-19	0.00
20-49	0.00
50+	0.40

Contract 24

Tasks completed	Payment
0-4	0.00
5-9	0.00
10-14	0.00
15-19	0.00
20-49	0.20
50+	0.40

- Low (L), High (H) and Flex (F)

Contracts

- Each contact offers two or three undominated options

Tasks	0	20	50
Payment	0	20	40
L	Yes	Yes	No
H	Yes	No	Yes
F	Yes	Yes	Yes

- Note that $F = L \cup H$

Choice of Contracts

Contract 25

Tasks completed	Payment
0-4	0.00
5-9	0.00
10-14	0.00
15-19	0.00
20-49	0.00
50+	0.40

Contract 24

Tasks completed	Payment
0-4	0.00
5-9	0.00
10-14	0.00
15-19	0.00
20-49	0.20
50+	0.40

Contract 25 + \$0.50	Contract 24
Contract 25 + \$0.15	Contract 24
Contract 25 + \$0.10	Contract 24
Contract 25 + \$0.05	Contract 24
Contract 25 + \$0.01	Contract 24
Contract 25	Contract 24
Contract 25	Contract 24 + \$0.01
Contract 25	Contract 24 + \$0.05
Contract 25	Contract 24 + \$0.10
Contract 25	Contract 24 + \$0.15
Contract 25	Contract 24 + \$0.50

- Three questions: H vs L, H vs F, L vs F

Evidence for Preference for Flexibility

Type	N	Percent	Benchmark I	p-value	Benchmark II	p-value
Flexibility	43	35%	17%	0.00	6%	0.00
Standard	40	32%	17%	0.00	6%	0.00
Indifferent	23	19%	25%	0.12	13%	0.06
Commitment	7	6%	42%	0.00	16%	0.00
Intransitive	11	9%	-	-	59%	0.00

- Benchmark 1: Uniform random choice over transitive preference profiles
- Benchmark 2: Randomizing between preferences at each choice

Evidence for Preference for Flexibility

- 85% of subjects can be explained by the model
- 35% can only be explained by the model if there is preference uncertainty
- 15% not explained by the model
- Of which 9% are intransitive
- Very little (6%) evidence of preference for commitment

Subjects who:	Do Low number in Flex	N	p-value
Flex $\not\succ$ *High*	0.09	57	p=0.00
Flex $\succ$ *High*	0.37	67	

Subjects who:	Do High number in Flex	N	p-value
Flex $\not\succ$ *Low*	0.42	53	p=0.00
Flex $\succ$ *Low*	0.77	71	

- Subjects who strictly prefer F to H (L) make use of the additional available option
- Do so at a higher rate than those that do not have such a preference

Evidence for Responsive Menu Preferences

	Menu Preference:	All Subj.	Non-Indiff.
Do Low number in Flex	$Flex \succ High$	0.83	0.96
Do High number in Flex	$Flex \succ Low$	0.71	0.83

- Most subjects who do low (high) number of acts prefer F to H (L)
- This is near universal in the case of non-indifferent subjects

Time Preference Experiments

- Measuring time preferences is an important thing for economists to do
  - Even if we are not interested in temptation and self control
- Going to go into it in some detail
- For a recent review see
  - Cohen, J., Ericson, K. M., Laibson, D., & White, J. M. (2020). Measuring time preferences. Journal of Economic Literature, 58(2), 299-347.

Time Preference Experiments

- Typical time preference experiment [e.g Benhabib Bisin Schotter 2007]:
  - Identify \$$x$ that is indifferent to \$$y$ in 1 month's time
  - Identify \$$z$ in 1 month's time that is indifferent to \$$w$ in 2 month's time
- Approximate the discount rates as

$$\begin{aligned}\delta(0,1) &= \frac{x}{y} \\ \delta(1,2) &= \frac{z}{w}\end{aligned}$$

- Evidence of present bias if

$$\frac{x}{y} < \frac{z}{w}$$

- What are some of the problems with this approach?
  - Curvature of the utility function
  - Transaction costs/trust
  - Income smoothing and shocks

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  - Curvature of the utility function
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Curvature of the Utility Function

- Assume that money is consumed in the period it is received.
- Background consumption $\bar{c}$ in each period
- Indifference point occurs when

$$\begin{aligned} & u(\bar{c}+x)+\delta(0,1)u(\bar{c})+\sum_{t=2}^{\infty}\delta(0,t)u(\bar{c}) \\ = \; & u(\bar{c})+\delta(0,1)u(\bar{c}+y)+\sum_{t=2}^{\infty}\delta(0,t)u(\bar{c}) \end{aligned}$$

- Which implies

$$\delta(0,1)=\frac{u(\bar{c}+x)-u(\bar{c})}{u(\bar{c}+y)-u(\bar{c})}$$

- Which equals $\frac{x}{y}$ only if u is locally linear
- Note, will not affect identification of present bias, but will affect identification of discount factor

Curvature of the Utility Function

- Solution #1: "Eliciting Risk and Time Preferences " [Andersen et al 2008]
- (As the name suggests) measure risk and time preferences for each subject
  - MPL to measure indifference point between present and future consumption
  - MPL to measure indifference point between safe and risky prospects
- Use the latter to estimate curvature of the utility function
- Replace $\frac{x}{y}$ with $\frac{u(x)}{u(y)}$
- Reduces estimated annual discount rates from around 25% to around 10%
- Note: assumes same curvature in 'risk' and 'time' preferences

- Solution #2: "Estimating Time Preferences from Convex Budgets " [Andreoni and Sprenger]

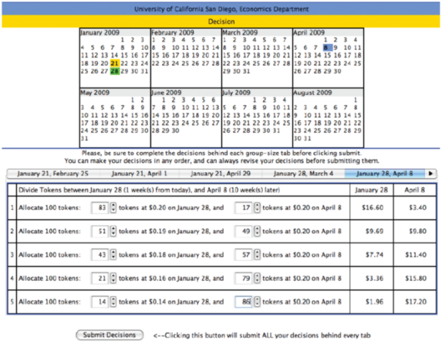


FIGURE 1. SAMPLE DECISION SCREEN

- Assuming subjects do not pick at the endpoints, can estimate curvature and discount rate

Curvature of the Utility Function

- Are convex time budgets a good idea?
  - Yes: Andreoni, James, Michael A. Kuhn, and Charles Sprenger. "Measuring time preferences: A comparison of experimental methods." Journal of Economic Behavior & Organization 116 (2015): 451-464.
  - Perhaps not: Cheung, Stephen L. "Risk preferences are not time preferences: on the elicitation of time preference under conditions of risk: comment." American Economic Review 105.7 (2015): 2242-60.

- What are some of the problems with this approach?
  - Curvature of the utility function
  - Transaction costs/trust
  - Income smoothing and shocks

Transaction Costs/Trust

- Imagine that you think that the experimenter is forgetful
- If they give you the money today, they will remember for sure
- If they are supposed to give you the money in the future, there is a γ probability they will forget
- Then indifference point between today and one month (assuming linear utility) if

$$\frac{x}{y} = \gamma\delta(0,1)$$

- And between one month and two months

$$\frac{z}{w} = \delta(1,2)$$

- Even an exponential discounted will look like they have present bias
- Same effect if there are transaction costs to collecting money on any day other than today

Transaction Costs/Trust

- Various authors have made different attempts to solve this problem:
- Andreoni and Sprenger [2013]
  - All payments (current and future) paid to campus mailbox
  - Always payments in all periods
  - Self addressed envelopes
  - Provided with the address of the experimenter
- Halevy [2015]
  - Repeated visits to classroom
- Dean and Sautmann [2021]
  - Repeated survey visits to household
- Generally studies that take these measures find little present bias for money

Transaction Costs/Trust

	week 1		week 2		week 3	
	A	B	A	B	A	B
avg. switch at or below (CFA)	157.0	155.6	153.5	152.4	158.4	154.6
correlation A	weeks 1 and 2: 0.61			weeks 2 and 3: 0.67		
correlation B	weeks 1 and 2: 0.62			weeks 2 and 3: 0.64		
A=B	64.40%		65.39%		69.82%	
more patient in A	18.47%		16.17%		13.32%	
more patient in B	17.13%		18.45%		16.86%	
pay neg. interest	9.66 %	8.15%	7.38%	5.52%	7.37%	6.86%
inconsistent	14.76%	13.93%	10.16%	11.71%	11.13%	10.51%
N	969		965		961	

- Experiment in urban Mali
- Surveyors came to the house every week
- No problem with transaction costs or trust
- No present bias!

- What are some of the problems with this approach?
  - Curvature of the utility function
  - Transaction costs/trust
  - Income smoothing and shocks

Income Smoothing and Shocks

- So far, we have assumed that experimental payments take place in isolation
  - Often described as 'narrow bracketing'
- But this may be inappropriate
  - Subjects may suffer shocks to income/value of consumption
    - Get paid today
    - Have a big bill due today
  - May smooth consumption by borrowing and saving

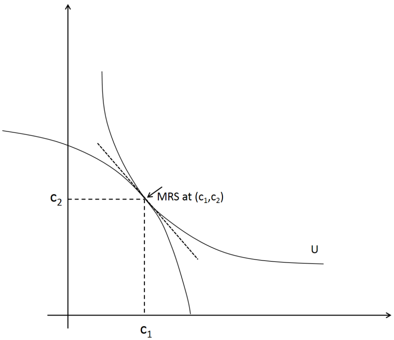
- Recall the Strong Hyperbolic Euler Equation

$$\begin{aligned}\frac{\partial u(c_t)}{\partial c_t} &= R_t E_t \left[\left(\beta\delta c'_{t+1} + (1 - c'_{ct+1})\delta \right) \frac{\partial u(c_{t+1})}{\partial c_{t+1}} \right] \\ &= R_t E_t d_t \frac{\partial u(c_{t+1})}{\partial c_{t+1}}\end{aligned}$$

- It can be shown that, if experimental payments are small

$$\frac{y}{x} = R_t = MRS_t = \frac{\frac{\partial u(c_t)}{\partial c_t}}{E_t \left(d_t \frac{\partial u(c_{t+1})}{\partial c_{t+1}} \right)}$$

- Experimental payments measure MRS not time preferences



- This does **NOT** rely on direct arbitrage of experimental payments
  - Only that experimental subjects obey Euler Equation
  - Take their actual MRS into account when making experimental decisions

$$\frac{y}{x} = R_t = MRS_t = \frac{\frac{\partial u(c_t)}{\partial c_t}}{E_t\left(d_t \frac{\partial u(c_{t+1})}{\partial c_{t+1}}\right)}$$

- What will we see in time preference experiments?
- Depends on the interest rate regime
  - Perfect credit markets with market interest rate $\bar{R}$

$$\frac{y}{x} = R_t = \bar{R}$$

- No access to credit

$$\frac{y}{x} = \frac{\frac{\partial u(y_t)}{\partial y_t}}{E_t\left(d_t \frac{\partial u(y_{t+1})}{\partial y_{t+1}}\right)}$$

$$\frac{\frac{\partial u(y_t)}{\partial y_t}}{\beta\delta E_t\left(\frac{\partial u(y_{t+1})}{\partial y_{t+1}}\right)}$$

  - No smoothing, but measured MRS affected by shocks
  - 'Present bias' individual could just be having a bad day
  - Will give $\beta\delta$ 'on average'

Income Smoothing and Shocks

- Partial access to credit: $R_t = R(s_t)$
  - Interest rates increase with borrowing (decrease with savings)
- Implies that measured MRS should
  - Fall with exogenous increase in income
  - Rise with an exogenous increase to $\frac{\partial u(c_{t+1})}{\partial c_{t+1}}$ (i.e. expenditure shock such as family illness)
  - Fall with an increase in savings
- Test this using the experiment in Mali

Income Smoothing and Shocks

	OLS	OLS	OLS	OLS	IV	IV	CL
Labor income			-0.185	-0.189	-0.153	-0.159	-0.262 +
			(0.142)	(0.143)	(0.163)	(0.142)	(0.136)
Nonlabor income "endogenous"			-0.330	-0.321	-0.268	-0.265	-0.316
			(0.251)	(0.258)	(0.261)	(0.270)	(0.282)
Nonlabor income "exogenous"	**-0.409** **	**-0.409** **	**-0.382** **	**-0.384** **	**-0.378** *	**-0.380** *	**-0.379** *
	(0.142)	**(0.149)**	**(0.125)**	**(0.133)**	**(0.171)**	**(0.149)**	**(0.171)**
Other spending			0.268 *	0.245 +	0.192	0.177	0.215 +
			(0.128)	(0.131)	(0.141)	(0.132)	(0.119)
Adv. event expense	**0.252** +	**0.233** +	**0.251**	**0.222**	**1.683** +	**1.562** *	**0.390** *
	(0.145)	**(0.139)**	**(0.182)**	**(0.183)**	**(0.761)**	**(0.769)**	**(0.199)**
1/(error SD)	-	-	-	-	-	-	0.916 **
							(0.044)
Constant	4.69 **	4.782 **	4.56 **	4.67 **	4.527 **	4.622 **	-
	(0.011)	(0.059)	(0.093)	(0.125)	(0.144)	(0.145)	
Ind FE	yes	yes	yes	yes	yes	yes	yes
Time FE		yes		yes		yes	yes
Observations	2540	2540	2390	2390	2390	2390	12608

*Standard errors clustered at the individual level (in parentheses). Significance levels + $p<0.10$, * $p<0.05$, ** $p<0.01$*

Table 8: Savings and MRS_t.

	OLS	OLS	CL
Savings (I-E)	-0.291 **	-0.279 **	-0.291 **
	(0.076)	(0.079)	(0.080)
1/(error SD)	-	-	0.916 **
			0.044
Constant	4.584 **	4.673 **	-
	(0.029)	(0.070)	
Ind FE	yes	yes	yes
Time FE		yes	yes
Observations	2390	2390	12608

Standard errors clustered at the individual level (in parentheses).
*Significance levels + p<0.10, * p<0.05, ** p<0.01*

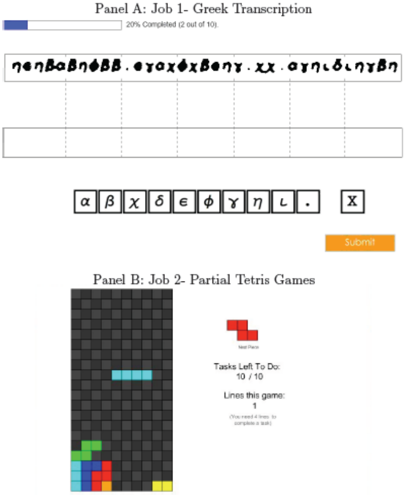
- So what can we learn from time preference experiments?
- If people are not 'narrow bracketers' then not a lot about time preferences
  - Measured MRS reports effective market interest rate
  - Income and expenditure shocks can look like present bias
  - In complete credit constraints case, average of repeated measures can be used to estimate parameters
- However, we can potentially learn about the shocks and constrains on a household finances
  - Less credit constrained $\Rightarrow$ less volatile MRS
  - Positive correlation between spending and MRS $\Rightarrow$ importance of expenditure shocks

Measuring Time Preferences

- Given these problems, how can we measure time preferences?
- We could use something other than money
  - Primary Rewards: e.g. "Time Discounting for Primary Rewards" [McClure et al 2007]
  - Effort: e.g "Working Over Time: Dynamic Inconsistency in Real Effort Tasks" [Augenblick et al 2015]
- Does this solve the problem?
- Depends on
  - Whether or not people suffer shocks to the cost of effort
  - Can 'smooth' effort

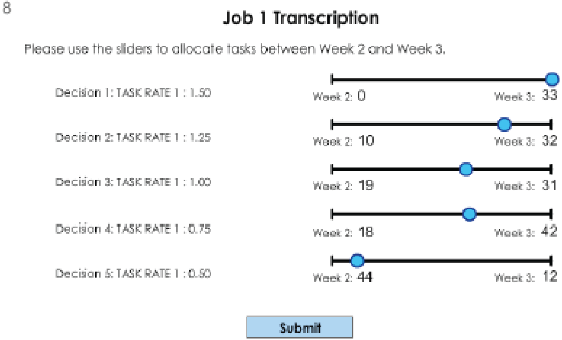
Working Over Time

Augenblick et al. [2015]



Working Over Time

Augenblick et al. [2015]



Working Over Time

Augenblick et al. [2015]

	Monetary Discounting		Effort Discounting		
	(1) All Delay Lengths	(2) Three Week Delay Lengths	(3) Job 1 Greek	(4) Job 2 Tetris	(5) Combined
Present Bias Parameter: $\hat{\beta}$	0.974 (0.009)	0.988 (0.009)	0.900 (0.037)	0.877 (0.036)	0.888 (0.033)
Daily Discount Factor: $\hat{\delta}$	0.998 (0.000)	0.997 (0.000)	0.999 (0.004)	1.001 (0.004)	1.000 (0.004)
Monetary Curvature Parameter: $\hat{\alpha}$	0.975 (0.006)	0.976 (0.005)			
Cost of Effort Parameter: $\hat{\gamma}$			1.624 (0.114)	1.557 (0.099)	1.589 (0.104)
# Observations	1500	1125	800	800	1600
# Clusters	75	75	80	80	80
Job Effects					Yes
$H_0 : \beta = 1$	$\chi^2(1) = 8.77$ ($p < 0.01$)	$\chi^2(1) = 1.96$ ($p = 0.16$)	$\chi^2(1) = 7.36$ ($p < 0.01$)	$\chi^2(1) = 11.43$ ($p < 0.01$)	$\chi^2(1) = 11.42$ ($p < 0.01$)
$H_0 : \beta(Col.\ 1) = \beta(Col.\ 5)$	$\chi^2(1) = 6.37$ ($p = 0.01$)				
$H_0 : \beta(Col.\ 2) = \beta(Col.\ 5)$		$\chi^2(1) = 8.26$ ($p < 0.01$)			

A Caveat

- Andreoni, J., Gravert, C., Kuhn, M. A., Saccardo, S., & Yang, Y. (2018). Arbitrage Or Narrow Bracketing? On Using Money to Measure Intertemporal Preferences (No. w25232). National Bureau of Economic Research.
  - Run an experiment with electronic payments making arbitrage easy
  - Find very little evidence that people in fact do
  - Also find very little present bias for experimental receipts ('gains', similar to money in Augenblick et al)
  - But do find it for payments ('losses', similar to working in Augenblick et al)

Link Between Preference Reversals and Preference for Commitment

- Augenblick et al. [2015] find preference reversals in the real effort task
- Does this lead to a preference for commitment?
- Recall:

$$\begin{aligned} & \text{Non-exponential discounting} \\ \Leftrightarrow \quad & \text{Preference reversals} \\ \Leftrightarrow \quad & \text{Demand for commitment} \end{aligned}$$

- Subjects offered a commitment device
  - Choice for effort at $t+1$ vs $t+2$ made at time t and $t+1$
  - Commitment: Higher probability that time t choice would be operationalized

Link Between Preference Reversals and Preference for Commitment

-

Table 4: Monetary and Real Effort Discounting by Commitment

	Monetary Discounting		Effort Discounting	
	Commit (=0)	Commit (=1)	Commit (=0)	Commit (=1)
	(1) Tobit	(2) Tobit	(3) Tobit	(4) Tobit
Present Bias Parameter: $\hat{\beta}$	0.999 (0.010)	0.981 (0.013)	0.965 (0.022)	0.835 (0.055)
Daily Discount Factor: $\hat{\delta}$	0.997 (0.000)	0.997 (0.001)	0.988 (0.005)	1.009 (0.005)
Monetary Curvature Parameter: $\hat{\alpha}$	0.981 (0.009)	0.973 (0.007)		
Cost of Effort Parameter: $\hat{\gamma}$			1.553 (0.165)	1.616 (0.134)
# Observations	420	705	660	940
# Clusters	28	47	33	47
Job Effects	-	-	Yes	Yes
$H_0 : \beta = 1$	$\chi_2(1) = 0.01$ ($p = 0.94$)	$\chi_2(1) = 2.15$ ($p = 0.14$)	$\chi_2(1) = 2.64$ ($p = 0.10$)	$\chi_2(1) = 9.00$ ($p < 0.01$)
$H_0 : \beta(Col.\ 1) = \beta(Col.\ 2)$	$\chi_2(1) = 1.29$ ($p = 0.26$)			
$H_0 : \beta(Col.\ 3) = \beta(Col.\ 4)$			$\chi_2(1) = 4.85$ ($p = 0.03$)	

Sophistication

- Subjects who commit have higher measured present bias
- However, as usual, hard to get people to pay for commitment
- Also note that many people chose commitment in money treatment, when no present bias

Sophistication

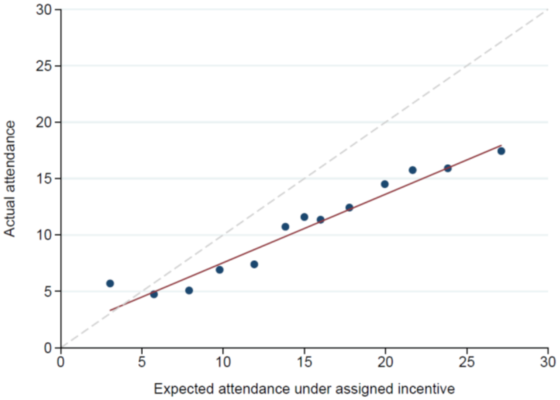
- Is the fact that present bias agents won't pay for commitment a sign of a lack of sophistication?
- Not really
  - Technically: violation of sophistication is paying to add an option which you then do not use
  - Intuitively: Maybe present bias is not due to other factors - e.g. non-exponential discounting
- Do we have other evidence for lack of sophistication?

- "Paying Not to Go to the Gym" [DellaVigna and Malmendier, 2006]
- Test whether people have sophisticated beliefs about their future behavior
- Examine the contract choices of 7978 healthcare members
- Also examine their behavior (i.e. how often they go to the gym)
- Do people overestimate how much they will go the gym, and so choose the wrong contract?

- Three contracts
  - Monthly Contract – automatically renews from month to month
  - Annual Contract – does not automatically renew
  - Pay per usage

Sophistication

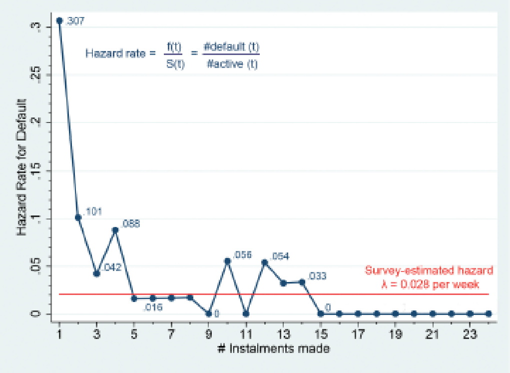
- Consumers appear to be overconfident
  - Overestimate future self control in doing costly tasks
    - Going to the gym
    - Cancelling contract
- 80% of customers who buy monthly contracts would be better off had they paid per visit (assuming same number of visits)
  - Average cost of $17 vs $10
- Customers predict 9.5 visits per month relative to 4.5 actual visits
- Customers who choose monthly contracts are 18% more likely to stay beyond a year than those who choose annual contract, and wait 2.29 months after last visit before cancelling



30
25
20
15
10
5
0
Actual attendance
0
5
10
15
20
25
30
Expected attendance under assigned incentive

Sophistication

- Partial naivete can also lead people to take up commitment contracts which are bad for them
  - "When Commitment Fails - Evidence from a Regular Saver Product in the Philippines" [John 2019]
- Subjects offered the chance to take up an "Achiever's Savings Account'"
  - Had to make regular payments
  - If they failed, paid a 'default cost'
  - Interest rate equal to the standard market rate



- 55% default on contract
- Largely do so ‘immediately’: unlikely to be due to shocks

The Role of Noise

- We have, so far, stated that preference for commitment and preference reversals are signs of time inconsistency
- However, two recent paper have called this into doubt
  - Strack and Taubinsky [2022] - preference reversals
  - Carrera et al [2021] - Commitment
- In both cases the problem comes when you introduce some random component in the decision process

- Consider the follwoing set up:
  - Choose at time zero what snack to have in time 1
  - Two possible snacks: apple (a) or chocolate (c)
  - Two possible states of the word: sugar deprived (s) or not (n)
  - State dependant utility function

$$\begin{aligned} u(a,n) &= 1,\ a(a,s)=0 \\ u(c,n) &= -1,\ a(c,s)=1 \end{aligned}$$

- Both states equally likely

- What should the DM choose at time zero (before state is realized)?
  - $E(u(a)) = \frac{1}{2}$, $E(u(c)) = 0$
  - Should chose the apple 100% of the time
- What if they were given the chance to revise their choice in period 1 (after state is realized)?
  - 50% of the time they would change their choice to chocolate

Noise and Preference Reversals

- Taubinsky and Strack show that this really matters
- Consider a two period model in which DM chooses $x \in [0, 1]$

$$\text{Time 0 utility } E_o\left[\beta\theta_1 c(x) + \beta\theta_2 c(1-x)\right]$$
$$\text{Time 1 utility } E_1\left[\theta_1 c(x) + \beta\theta_2 c(1-x)\right]$$

- Assume utility is $c(x) = x^{\gamma}$ for known γ
- In period 0 DM chooses $x = \frac{1}{2}$
- In period 1 DM the distribution of x choices has

$$\text{mean } 0$$
$$\text{SD } 0.12$$
$$\frac{x}{(1-x)} \text{ log normally distributed}$$

- What can we learn about β?

Table 1: Implied time inconsistency under different information revelation assumptions

	Distribution of shocks	*Information* *time 0*	*Information* *time 1*	γ	Estimated β
1	iid		θ_1, θ_2	2	0.82
2	iid		θ_1, θ_2	3	0.67
3	independent	θ_1	θ_1, θ_2	2	0.93
4	independent	θ_1	θ_1, θ_2	3	1.11
5	independent	θ_2	θ_1, θ_2	2	0.72
6	independent	θ_2	θ_1, θ_2	3	0.41
7	independent		θ_1	2	0.72
8	independent		θ_1	3	0.41
9	mult. random walk		θ_1, θ_2	2	0.93
10	mult. random walk		θ_1, θ_2	3	1.11
11	mult. AR(1), α=1.5		θ_1	2	1.53
12	mult. AR(1), α=1.5		θ_1	3	8.17
13	mult. AR(1), α=0.5		θ_1	2	0.56
14	mult. AR(1), α=0.5		θ_1	3	0.15

Noise and Preference Reversals

- In fact, the paper shows that there is not much which cannot be explained by exponential disconting if you have freedom to choose the shock process
- Their theorem shows that, if preferences are single peaked, then data is only inconsistent with exponential discounting if there exists an y, x such that
  - x is preferred to y in period 0
  - y is preferred to x always in period 1

Noise and Preference Reversals

- Solution?
- Measure WTP for goods in some currency the value of which is state independent
  - e.g. cash in the distant future
- Assume also that preferences for money are quasi linear
- In this cases, expected WTP for a snack in period 1 should be equal to the WTP in period 2
- In our example
  - WTP for apple in period 1 is

$$\frac{1}{2} = \frac{1}{2}u(a,n) + \frac{1}{2}u(a,s) = \frac{1}{2}WTP(a,n) + \frac{1}{2}WTA(a,s)$$

- Papers that use this approach (e.g. Augenblick and Rabin 2019) do seem to find present bias

Noise and Preference for Commitment

- What about preference for commitment?
- Here the problem might come about from noise in the decision process
- Imagine a random utility type model
  - 'True' utility of the commitment contract is $v(c) = 0$
  - 'True' utility of no commitment is $v(n) = 1$
  - But choice is governed by

$$u(x) = v(x) + \varepsilon$$

- Commitment contract will be chosen some of the time, even if it gives lower true utility

Noise and Preference for Commitment

- Is there evidence that this might be driving demand for commitment contracts?
- Yes!
- Carrera et al [2021] study commitment contract for going to the gym
- Subjects asked if they would like $80 unconditionally, or $80 for going to the gym more than 8, 12 or 16 times in the next month
- Also asked if they would like $80 unconditionally, or $80 for going to the gym **less** than 8, 12 or 16 times in the next month
    - 64% to 32% of subjects chose commitment in the first case
    - 34% to 27% of subjects chose commitment in the second case
- Those who choce commitment in the first case more likely to do so in the second case
- Suggest some choice of commitment contract due to noise

Noise and Preference for Commitment

- Solution?
- Offer people piece rate incentives to go to the gym
- Elicit WTP for this piece rate
- Consider someone who expects to go to the gym 8 times
- What is the WTP for a $1 payment every time they go to the gym?
- If they are time consistent then it should be $8, by envelope theorem
- If they value it more than this, it indicates a 'preference for commitment'

Noise and Preference for Commitment

- Carrera et al. apply this measure
- Find evidence for a WTP for piece rate above that of time consistent people
  - And so evidenence for a preference for commitment
- Also show that, in the presence of random shocks piece rate incentives have better welfare properties than commitment contracts

Application: Procrastination

- O'Donoghue and Rabin [1999]
- T time periods
- Have to decide in which period to perform a task
- $\{c_1, ...c_T\}$: Cost of performing the task in each period
- $\{v_1, ...v_T\}$: Value of performing the task in each period
- Two cases:
    - Immediate costs, delayed rewards
    - Immediate rewards, delayed cost

- For simplicity, assume that $\delta = 1$
- Period t utility from the task being done in period τ is:
  - Immediate costs case

$$\begin{aligned} \beta v_\tau - \beta c_\tau \text{ if } \tau &> t \\ \beta v_\tau - c_\tau \text{ if } \tau &= t \end{aligned}$$

  - Immediate rewards case

$$\begin{aligned} \beta v_\tau - \beta c_\tau \text{ if } \tau &> t \\ v_\tau - \beta c_\tau \text{ if } \tau &= t \end{aligned}$$

Application: Procrastination

- Example 1: Writing a referee report in the next 4 weeks
- Costs are immediate, rewards delayed
  - Rewards: $v = \{0, 0, 0, 0\}$
  - Costs: $c = \{3, 5, 8, 15\}$
- Report has to be done in week 4 if not done before
- Time consistent agent ($\beta = 1$) will do the report in week 1
- Sophisticated agent with $\beta = \frac{1}{2}$?
  - In week 3 would delay (8 vs 15/2)
  - In week 2 would do report (5 vs 15/2)
  - In week 1 will delay (3 vs 5/2)
  - Report is done in week 2
- Naive agent with $\beta = \frac{1}{2}$?
  - will end up doing the report in week 4
  - Always thinks they will do the report next week

- Example 2: Choosing when to see a movie
- Costs are delayed, rewards immediate
  - Rewards: $v = \{3, 5, 8, 13\}$
  - Costs: $c = \{0, 0, 0, 0\}$
- Movie has to be seen in week 4 if not done before
- Time consistent agent ($\beta = 1$) will see the movie in week 4
- Sophisticated agent with $\beta = \frac{1}{2}$?
  - In week 3 would choose to see it (8 vs 13/2)
  - In week 2 would choose to see it (5 vs 4)
  - In week 1 would choose to see it (3 vs 5/2)
  - Will see the movie in week 1
- Naive agent with $\beta = \frac{1}{2}$?
  - In week 3 would see movie (8 vs 13/2)
  - In week 2 will delay (5 vs 13/2)
  - In week 1 will delay (3 vs 13/2)
  - Will see movie in week 3

- Proposition: Naive decision makers will always take action later than sophisticates
    - Immediate costs: Sophisticates recognize future procrastination and act to avoid it
    - Immediate rewards: Sophisticates recognize future 'greed', and act to preempt it

A Different Approach to Commitment

- So far we have considered how external commitment devices can help people with temptation problems
- The next two papers we will look at will use the tools of game theory suggest that people may be able to 'self commit'
  - Bernheim, B. Douglas, Debraj Ray, and Șevin Yeltekin. "Poverty and self-control." Econometrica 83.5 (2015): 1877-1911.
  - Bénabou, Roland, and Jean Tirole. "Willpower and personal rules." Journal of Political Economy 112.4 (2004): 848-886.
- Will allow us to think about 'personal rules'
  - Only smoke when out of the country
  - Only drink on weekends
  - Go to the gym on Mondays, Wednesdays and Fridays

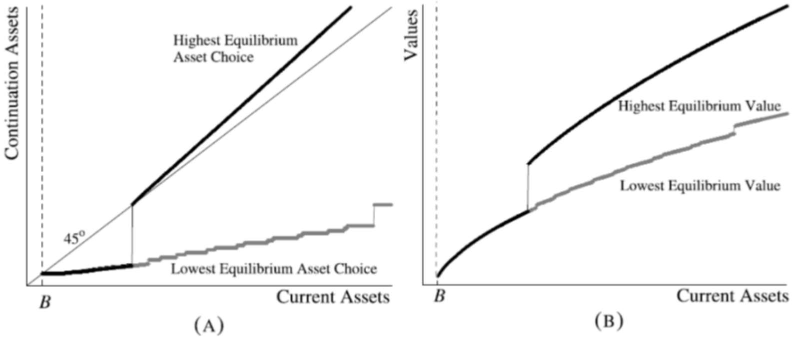
Subgame Perfection

- As discussed, we can model the actions of a quasi-hyperbolic player as a dynamic game
  - Each player 'in charge' for one period only
  - Takes the strategies of other players as given
- Dynamic games have been heavily studied
- A general 'rule'
  - Good outcomes can be supported in equilibrium through the threat of bad actions in the future
  - e.g. in repeated prisoner dilemma games co-operation can be supported by trigger strategies
  - If players deviate in period t then stop co-operating in future periods
- In order for threats to be credible, they need to be subgame perfect

Subgame Perfection

- BRY [2015] apply the same idea to quasi-hyperbolic agent
- Allow strategies of the player to be history dependent
- There are equilibria in which good behavior at time t can be supported by the threat of (equilibrium) bad behavior in the future
- Has the feeling of a 'personal rule'
    - If I have a burger for lunch today I will have a burger for lunch again tomorrow

- Apply this logic to a consumption/savings example
- What is 'good' and ‘bad' behavior'?
    - Good behavior: Savings
    - Bad behavior: (over) consuming
- Savings today can be supported by the threat of high consumption tomorrow
- Key finding: if accumulation depends on the initial asset level then
    - There is always a level below which assets decline to zero
    - Another level above which assets grow unboundedly



Continuation Assets
Highest Equilibrium
Asset Choice
45°
Lowest Equilibrium Asset Choice
B
Current Assets
(A)
Values
Highest Equilibrium Value
Lowest Equilibrium Value
B
Current Assets
(B)

Comments

- ‘Poverty trap’: If assets are too low, then the threat of high consumption is not very threatening
  - Turns out it is a bit more complex than that
- Best equilibrium strategy has a nice simple structure
  - Set a savings rule
  - If violated, binge for at most two periods
- Issues:
  - Furiously complex to work through
  - How is this equilibrium being selected?

Willpower and Personal Rules

- BYR provide one reason why personal rules may be effective
  - To avoid equilibrium punishment in the future
- Benabou and Tirole [2004] have another answer:
  - Signal about the strength of willpower

- Two periods, two subperiods

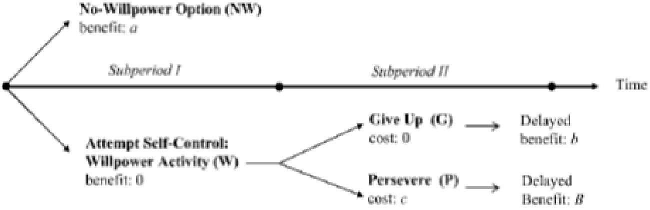
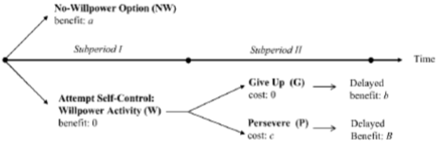


FIG. 1.—Decisions and payoffs in any given period $t = 1, 2$

Set up



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- Discounting δ between periods 1 and 2
- Time inconsistency:
    - At the time of decision between NW and N, a is valued at a/γ for $\gamma \leq 1$
    - At the time of decision between G and P, c is valued at c/β for $\beta \leq 1$

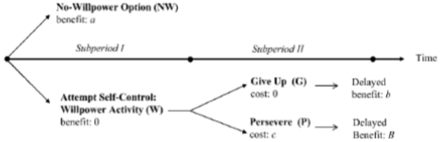

FIG. 1.—Decisions and payoffs in any given period $t = 1, 2$

- Note latter assumption means that subperiod I agent would prefer P as long as
$$c \leq B - b$$
- But P will only be chosen if
$$\frac{c}{\beta} \leq B - b$$
- Similarly former assumption means that period 1 agent would prefer W if its expected value is greater than a, but will only be chosen if it is greater than a/γ

Set up

- Key Assumption: β is not know perfectly. Can either be β_H or β_L with
$$\beta_L < \beta_H \leq 1$$
- Prior ρ_1 on β_H
- Imperfect recall: will discover β in period 1:2 if is chosen, but then forgets it
- If the DM 'lapses' (i.e. chooses G) in state 1 they will remember it with probability λ

Set up

- Model this as a game between multiple agents
- Solution concepts: Perfect Bayesian Equilibrium
    - Previous ‘players’ can try to hide information
    - But beliefs will be correct given the information each player has

- First assume

$$\frac{c}{\beta_H} < B - b < \frac{c}{\beta_L}$$

so in the second period DM will choose p only if they are of type β_H

- This means that in second period, DM will only choose W if $\rho > \rho_2^*$ defined by

$$\rho_2^*(B - c) + (1 - \rho_2^*)b = a/\gamma$$

- To make things stark, assume $b > a$ so period 1 DM would prefer period 2 to choose W even if they give up

- Let $V_2^I(\rho)$ be the value of W being selected in period 2 from the perspective of type I in period 1, as a function of beliefs ρ

$$
\begin{aligned}
V_2^H(\rho) &= p_2(\rho)(B-c)+(1-p_2(\rho))a \\
V_2^L(\rho) &= p_2(\rho)(b-c)+(1-p_2(\rho))a
\end{aligned}
$$

- Where $p_2(\rho)$ is the probability of choosing W given beliefs ρ
  - So in this case $p_2(\rho)=1$ if $\rho>\rho_2^*$

- Assume lapses weakly lower ρ
- This means that for type β_H P is a dominant strategy
- For type β_L they will choose P if

$$\frac{c}{\beta_L} - B - b \leq \delta\lambda \left[V_2^L(\rho_2^+) - V_2^L(\rho_2^-) \right]$$

  where ρ_2^+ and ρ_2^- are the values of ρ if there is not and is a recalled lapse
- The RHS is the benefit of self-reputation

Equilibrium

- Let $\hat{\rho}_1(\lambda) = \frac{(1-\lambda)\rho_2^*}{1-\lambda\rho_2^*}$
- This game has a unique equilibrium
  1. if ρ_1 is below a threshold $\rho_1^* < \rho_2^*$ then NW is chosen in the first period
  2. If $\rho_1 > \rho_1^*$ then W is chosen, and β_H always chooses P, while β_L
     1. Always chooses P if $\rho_1 > \rho_2^*$
     2. Never chooses P if $\rho_1 < \hat{\rho}_1(\lambda)$
     3. For intermediate values choose P with a probability q_1^* defined as the solution to

$$\rho_2^+ = \frac{\rho_1}{\rho_1 + (1-\rho_1)q_1 + (1-\lambda)(1-q_1)} = \rho_2^*$$

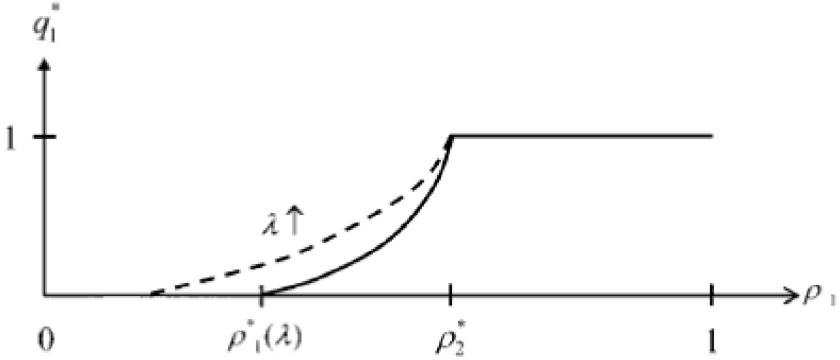

FIG. 2.—Self-control by the weak-willed

Summary

- There are not a lot of naturally occurring commitment devices out there
- But people can be induced to take up commitment
  - Often will not pay for it
- Two possible reasons for this
  - Preference for flexibility
  - Lack of sophistication

  There is evidence for both of these
- Time preference experiments run with money are problematic
- Other tasks may be better
  - Show more present bias
- There is a link between present bias and preference for commitment