Empirical evidence on quasi-hyperbolic discounting

or

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Laibson Lecture 1

1. Motivating thought experiment

Would you like to have
A) 15 minute massage now
or
B) 20 minute massage in an hour

Would you like to have
C) 15 minute massage in a week
or
D) 20 minute massage in a week and an hour

Outline

1. Motivating thought experiment
2. Preference reversals
3. Commitment
4. Indirect evidence

A useful fact:

2. Preference reversals

Quasi-hyperbolic discounters will tend to choose patiently when choosing for the future and impatiently when choosing for the present.

$$\text{Future discount rate} = \frac{D(\tau) - D(\tau+1)}{D(\tau)} = \frac{\beta\delta^{\tau} - \beta\delta^{\tau+1}}{\beta\delta^{\tau}} = 1-\delta \approx 0.05$$

$$\text{Present discount rate} = \frac{D(0) - D(1)}{D(0)} = \frac{1-\beta\delta}{1} = 1-\beta\delta \approx 0.5$$

Read, Loewenstein & Kalyanaraman (1999)

Choose among 24 movie videos

- Some are “low brow”: *Four Weddings and a Funeral*
- Some are “high brow”: *Schindler’s List*

- Picking for tonight: 66% of subjects choose low brow.
- Picking for next Wednesday: 37% choose low brow.
- Picking for second Wednesday: 29% choose low brow.

Tonight I want to have fun…
next week I want things that are good for me.

Quasi-hyperbolic interpretation

Suppose that “Weddings” has immediate benefit of 7.

Suppose that “Schindler” has immediate benefit of 4 and delayed benefit of 4.

Read and van Leeuwen (1998)

Choosing Today → Eating Next Week → *Time*

If you were deciding today, would you choose fruit or chocolate for next week?

Patient choices for the future:

Choosing Today → Eating Next Week → *Time*

Today, subjects typically choose fruit for next week.

74% choose fruit

Impatient choices for today:

Choosing and Eating Simultaneously

Time

If you were deciding today, would you choose fruit or chocolate for today?

Time Inconsistent Preferences:

Choosing and Eating Simultaneously

Time

70% choose chocolate

Quasi-hyperbolic interpretation

$$\text{Again assume } \beta = 1/2 \text{ and } \delta = 1.$$

Suppose that fruit has immediate benefit of 1/2.

Suppose that chocolate has immediate benefit of 1 and delayed cost of 2/3.

Extremely thirsty subjects

McClure, Ericson, Laibson, Loewenstein and Cohen (2007)

- Choosing between,

  juice now or **2x juice in 5 minutes**

  60% of subjects choose first option.
- Choosing between

  juice in 20 minutes or **2x juice in 25 minutes**

  30% of subjects choose first option.

- We estimate that the 5-minute discount rate is 50% and the “long-run” discount rate is 0%.
- Ramsey (1930s), Strotz (1950s), & Herrnstein (1960s) were the first to understand that discount rates are higher in the short run than in the long run.

A bit of math

If you want to relate a discount factor, δ, to a discount rate, remember that if

$$e^{-\rho} = \delta$$

then,

$$\ln e^{-\rho} = -\rho = \ln \delta$$

$$\rho = -\ln \delta$$

Money now vs. money later
Thaler (1981)

- Hypothetical rewards (but some exp use real rewards)
- Baseline exponential discounting model: $Y = \delta^t X$
- So $-\ln\delta = (1/t) \ln [X/Y]$, remember that t is in units of yrs
- What amount makes you indifferent between \$15 today and \$X in 1 month?

  X = 20

  $-\ln\delta = (1/t) \ln[X/15] = 12 \ln[X/15] = 345\%$ per year
- What amount makes you indifferent between \$15 today and \$X in ten years?

  X = 100

  $-\ln\delta = (1/t) \ln[X/15] = 10 \ln[X/15] = 19\%$ per year

But “money now vs. money later” has so many confounds

(Chabris, Laibson, and Schuldt 2009)

- Hypothetical rewards
- Unreliability of future rewards (trust; bird in the hand)
- Transaction costs
- Investment vs. consumption (framing and intertemporal sub)
- Timing of consumption
- Curvature
- Framing (e.g., response scale)
- Demand characteristics

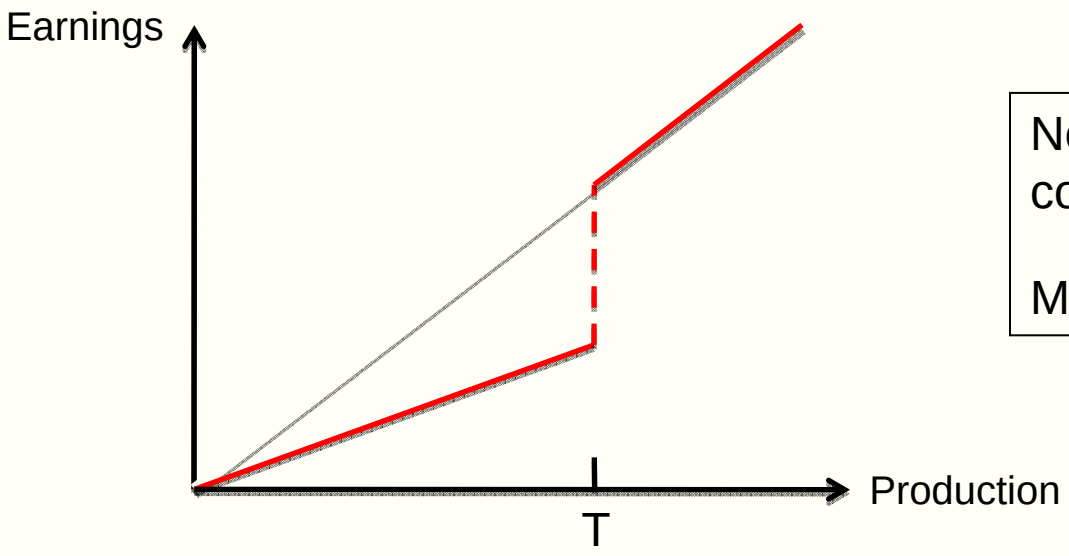
3. Commitment

Ariely and Wertenbroch (2002)

- Proofreading tasks: "Sexual identity is intrinsically impossible," says Foucault; however, according to de Selby[1], it is not so much sexual identity that is intrinsically impossible, but rather the dialectic, and some would say the satsis, of sexual identity. Thus, D'Erlette[2] holds that we have to choose between premodern dialectic theory and subcultural feminism imputing the role of the observor as poet.“
- Evenly spaced deadlines ($20)
- Self-imposed deadlines ($13)
  - subjects in this condition could self-impose costly deadlines ($1 penalty for each day of delay) and 37/51 do so.
- End deadline ($5)

Kaur, Kremer, and Mullainathan (2009):

- Compare two piece-rate contracts:
  1. Linear piece-rate contract ("Control contract")
     - Earn w per unit produced
  2. Linear piece-rate contract with penalty if worker does not achieve production target T ("Commitment contract")
     - Earn w for each unit produced if production>=T, earn w/2 for each unit produced if production<T



Never earn more under commitment contract

May earn much less

Kaur, Kremer, and Mullainathan (2009):

- Demand for Commitment (non-paydays)
  - Commitment contract (Target>0) chosen 39% of the time
  - Workers are 11 percentage points more likely to choose commitment contract the evening before

- Effect on Production (non-paydays)
  - Being offered contract choice increases average production by 5 percentage points relative to control
  - Implies 13 percentage point productivity increase for those that actually take up commitment contract
  - No effects on quality of output (accuracy)

- Payday Effects (behavior on paydays)
  - Workers 21 percentage points more likely to choose commitment (Target>0) morning of payday
  - Production is 5 percentage points higher on paydays

Ashraf, Karlan, and Yin (2006)

- Offered a commitment savings product to randomly chosen clients of a Philippine bank
- 28.4% take-up rate of commitment product
- More hyperbolic subjects were more likely to take up the product
- After twelve months, average savings balances increased by 81% for those clients assigned to the treatment group relative to those assigned to the control group.

TABLE I

CLIENTS' SPECIFIC SAVINGS GOALS

	Frequency	Percent
Christmas/birthday/celebration/graduation	95	47.0%
Education	41	20.3%
House/lot construction and purchase	20	9.9%
Capital for business	20	9.9%
Purchase or maintenance of machine/automobile/appliance	8	4.0%
Did not report reason for saving	6	3.0%
Agricultural financing/investing/maintenance	4	2.0%
Vacation/travel	4	2.0%
Personal needs/future expenses	3	1.5%
Medical	1	0.5%
Total	202	100.0%
Date-based goals	140	69.3%
Amount-based goals	62	30.7%
Total	202	100.0%
Bought ganansiya box	167	82.7%
Did not buy ganansiya box	35	17.3%
Total	202	100.0%

Gine, Karlan, Zinman (2009)

- Tested a voluntary commitment product (CARES) for smoking cessation.
- Smokers offered a savings account in which they deposit funds for six months, after which take urine tests for nicotine and cotinine.
- If they pass, money is returned; otherwise, forfeited
- 11% of smokers offered CARES take it up, and smokers randomly offered CARES were 3 percentage points more likely to pass the 6-month test than the control group
- Effect persisted in surprise tests at 12 months.

4. Other evidence

Dellavigna and Malmendier (2004, 2006)

- Average cost of gym membership: $75 per month
- Average number of visits: 4
- Average cost per vist: $19
- Cost of “pay per visit”: $10

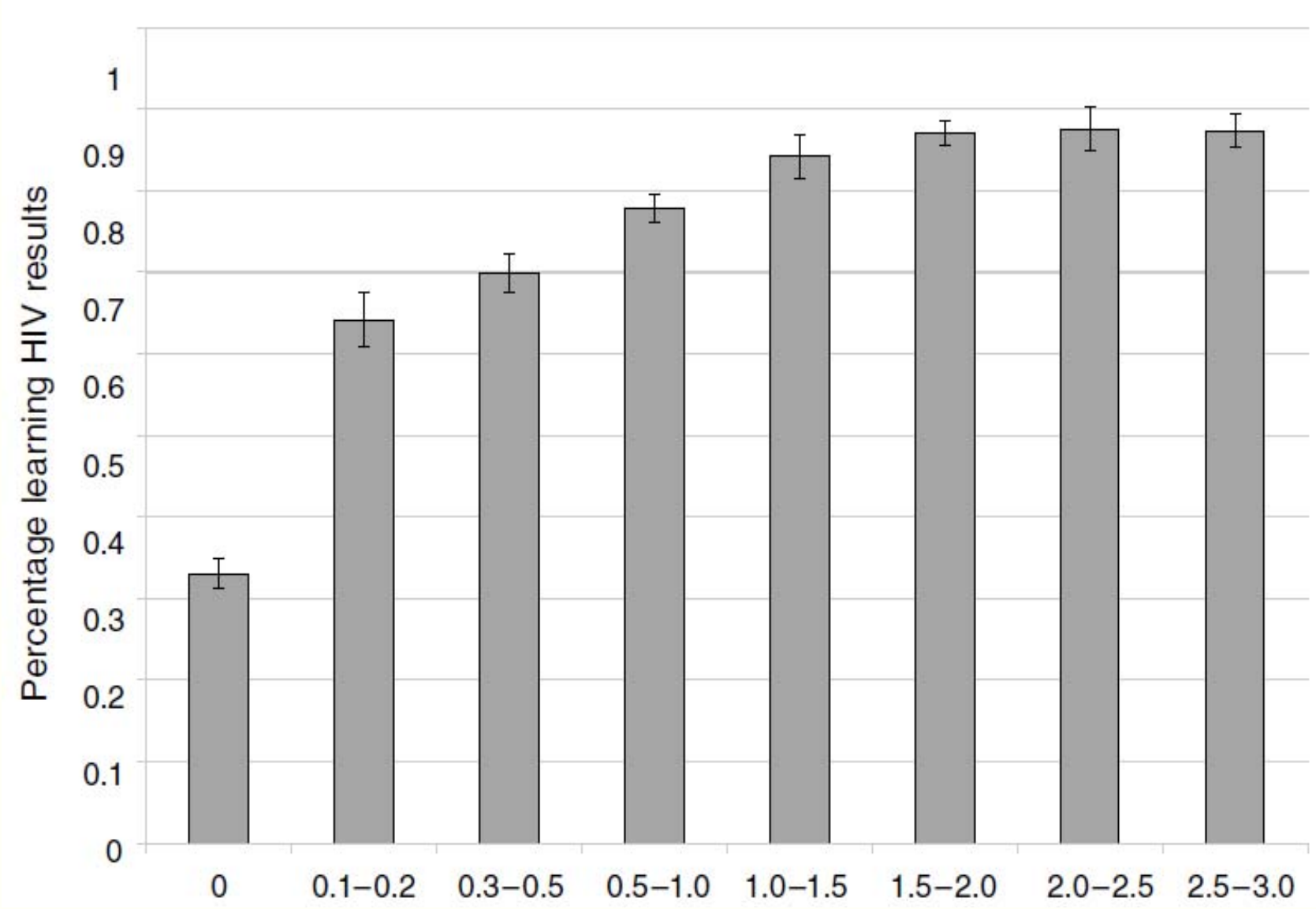
Shapiro (2005)

- For food stamp recipients, caloric intake declines by 10-15% over the food stamp month.
- To be resolved with exponential discounting, requires an annual discount factor of 0.23
- Survey evidence reveals rising desperation over the course of the food stamp month, suggesting that a high elasticity of intertemporal substitution is not a likely explanation.
- Households with more short-run impatience (estimated from hypothetical intertemporal choices) are more likely to run out of food sometime during the month.

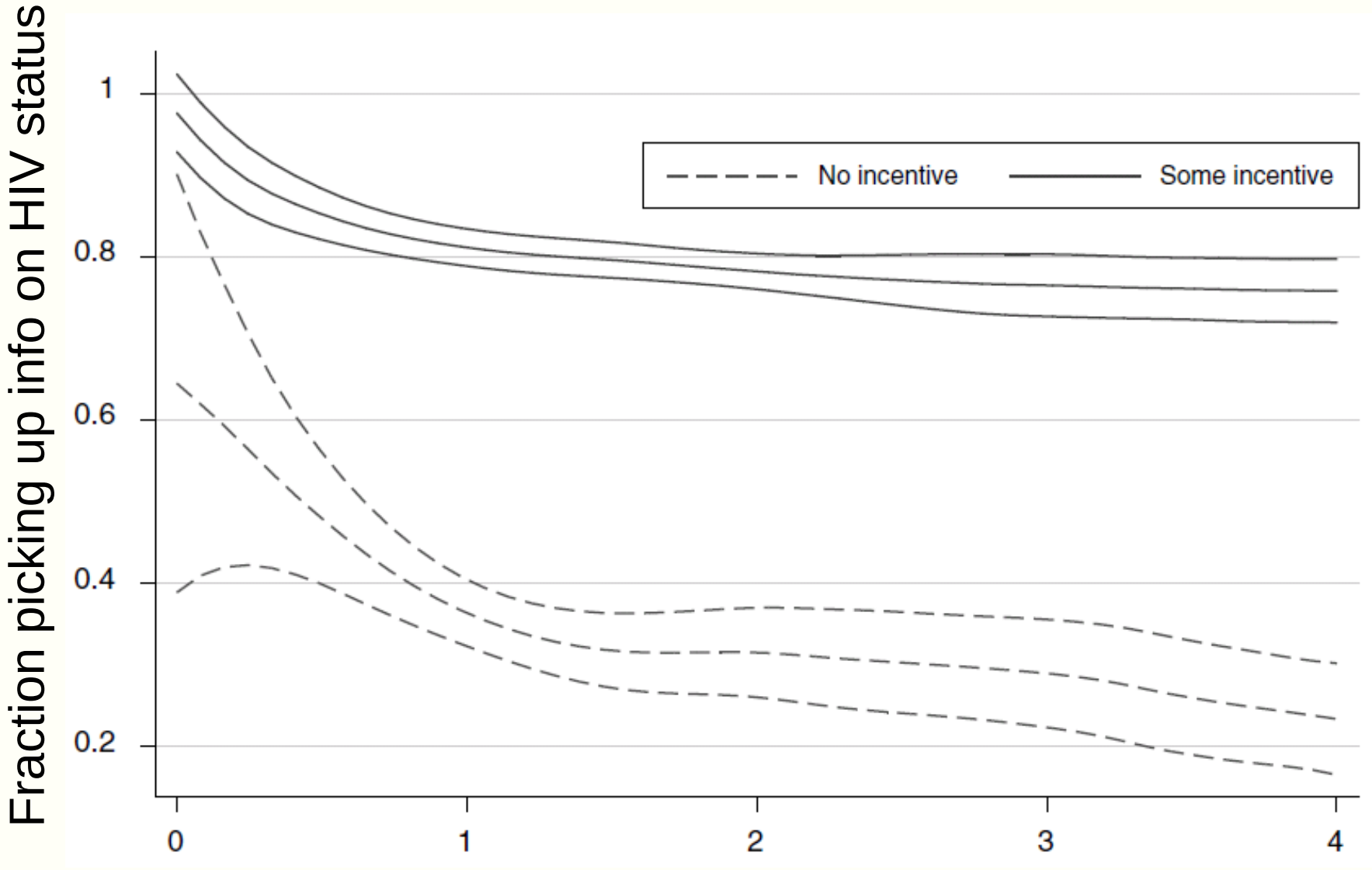
The data can reject a number of alternative hypotheses.

- Households that shop for food more frequently do not display a smaller decline in intake over the month, casting doubt on depreciation stories.
- Individuals in single-person households experience no less of a decline in caloric intake over the month than individuals in multi-person households.
- Survey respondents are not more likely to eat in another person's home toward the end of the month.
- The data show no evidence of learning over time

Small immediate rewards: Thornton (2005)



Small immediate costs: Thornton (2005)



Other qualitative papers:

- Oster and Scott-Morton (2004)
  - *People* sold on the news stand at a high price relative to subscription
  - *Foreign Affairs* sold on the news stand at a low price relative to subscription
  - But *People* is sold disproportionately on the news stand and *Foreign Affairs* is sold disproportionately by subscription.

- Wertenbroch (1998): consumers buy temptation goods in small packages, foregoing volume discounts.

Laibson, Repetto, and Tobacman (2007)

Use MSM to estimate discounting parameters:

- Substantial illiquid retirement wealth: W/Y = 3.9.
- Extensive credit card borrowing:
  - 68% didn't pay their credit card in full last month
  - Average credit card interest rate is 14%
  - Credit card debt averages 13% of annual income
- Consumption-income comovement:
  - Marginal Propensity to Consume = 0.23
    (i.e. consumption tracks income)

LRT Simulation Model

- Stochastic Income
- Lifecycle variation in labor supply (e.g. retirement)
- Social Security system
- Life-cycle variation in household dependents
- Bequests
- Illiquid asset
- Liquid asset
- Credit card debt

- Numerical solution (backwards induction) of 90 period lifecycle problem.

LRT Results:

$$U_t = u_t + \beta [\delta u_{t+1} + \delta^2 u_{t+2} + \delta^3 u_{t+3} + ...]$$

- $\beta = 0.70$ (s.e. 0.11)
- $\delta = 0.96$ (s.e. 0.01)
- Null hypothesis of $\beta = 1$ rejected (t-stat of 3).
- Specification test accepted.

Moments:

	Empirical	Simulated (Hyperbolic)
%Visa:	68%	63%
Visa/Y:	13%	17%
MPC:	23%	31%
f(W/Y):	2.6	2.7

LRT Intuition

- Long run discount rate is $-\ln(\delta) = 4\%$, so save in long-run (illiquid) assets.
- Short-run discount rate is $-\ln(\beta\delta) = 40\%$, so borrow on your credit card today.
- Indeed, you might even borrow on your credit card so you can “afford” to save in your 401(k) account.

Other studies

- Della Vigna and Paserman (2005): job search
- Duflo (2009): immunization
- Duflo, Kremer, Robinson (2009): commitment fertilizer
- Meier and Sprenger (2010): correlation with credit card borrow
- Milkman et al (2008): video rentals return sequencing
- Oster and Scott-Morton (2005): magazine marketing/sales
- Sapienza and Zingales (2008,2009): procrastination
- Shui and Ausubel (2006): credit cards
- Trope & Fischbach (2000): commitment to medical adherence
- Wertenbroch (1998): individual packaging

Outline

1. **Motivating thought experiment**
2. **Preference reversals**
3. **Commitment**
4. **Other evidence**

A copy of these slides will soon be available on my Harvard website.

Bibliography:

Ashraf, Nava. “Tying Odysseus to the Mast: Evidence from a Commitment Savings Product in the Philippines.” (with Dean Karlan and Wesley Yin) *Quarterly Journal of Economics 121, no. 2, 2006.*