Psychology and Economics[1]
14.13 Lectures 5 and 6: Time Preferences (Applications)

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[1]These lecture slides are partially based on notes by Botond Kőszegi and David Laibson I would like to thank them, without implicating them in any way, for sharing their materials with me.

. 1

Overview: applications of quasi-hyperbolic discounting

- Brief recap of quasi-hyperbolic discounting

- Demand for commitment

- Many applications
  - Work
  - Exercising
  - Credit cards
  - Savings behavior
  - Drinking
  - Smoking
  - Fertilizer

- Summary

Brief recap: what happened so far

- **Exponential Discounting:** at time t, the person aims to maximize

$$u_t + \delta u_{t+1} + \delta^2 u_{t+2} + \delta^3 u_{t+3} + \dots,$$

   where δ captures <u>both</u> short-term and long-term discounting.

- One of the main workhorse models in economics.
   - Tremendously important and successful (e.g. for understanding long-run growth)

- Implications:
   (1) Constant discounting: discount rates do not change with horizon.
   (2) Dynamic consistency: no preference reversals
   (3) No demand for commitment

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Quasi-Hyperbolic Discounting (aka present bias, or present focus)

- **Quasi-Hyperbolic Discounting:** at time t, the person aims to maximize

$$u_t + \beta\delta u_{t+1} + \beta\delta^2 u_{t+2} + \beta\delta^3 u_{t+3} + \ldots$$

  $0 < \beta \leq 1$ is *short-run discount factor*; $0 < \delta \leq 1$ is *long-run discount factor*.

  - β: additional time preference parameter that measures an individual's **present bias**.

- Example, if $\beta = 2/3$ and $\delta = 1$, discounted utility becomes

$$u_t + 2/3 \cdot u_{t+1} + 2/3 \cdot u_{t+2} + \ldots.$$

  - Relative to current period, all future periods worth much less (they get a factor of β).
  - Most (here, all) discounting is between the present and the future.
  - Little discounting between future periods (since $\delta \approx 1$).

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Sophistication vs. Naïveté

- Present bias creates time inconsistency.
  - When thinking ahead to the future, we want to be patient.
  - When the time actually comes, we are impatient.

- Key question: Do individuals understand their time inconsistency?

Two extreme assumptions

(1) **Full Naïveté:** $\hat{\beta} = 1$

- Individual does not realize that she will change her mind.
- Assume future selves will follow through on favorite plan.
- Surprises about future present bias
- False optimism about future patience: "This time is different."

(2) **Sophistication:** $\hat{\beta} = \beta$

- Individual understands perfectly that she will change her mind.
- She does the best given future selves' correctly anticipated behavior.
- No surprises about future present bias: rational expectations

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How can we tell whether a person is naïve or sophisticated?

- Mis-prediction of future behavior indicates (some) naïveté.

- Use of commitment devices indicates (some) sophistication.

- The same awareness issue doesn't arise with exponential discounting. Why?
    - No time inconsistency, so no question whether person is aware of it.

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Partial naïveté

- $\hat{\beta}$ measures beliefs about future β.

- So far, we considered two extreme cases:
    - Full sophistication ($\beta = \hat{\beta} < 1$)
    - Full naïveté ($\beta < \hat{\beta} = 1$)

- Intermediate case might be more relevant.
    - Partial naïveté ($\beta < \hat{\beta} < 1$)
    - Individuals understand they will experience present bias in the future.
    - But they underestimate their degree of future present bias.
    - Partial naïveté can lead to overcommitment.

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Demand for commitment[2]

- **Commitment device:** an arrangement entered into by an agent who restricts his or her future choice set by making certain choices more expensive, perhaps infinitely expensive.
    - The agent would, on the margin, pay something in the present to make those choices more expensive, even if he or she received no other benefit for the payment.
    - No strategic purpose with respect to others.

- Time-inconsistent preferences
    - Different selves differ in their assessment of the best course of action.
    - Each time period's decision maker would like to restrict the set of choices available to his or her future selves.

- Demand for commitment requires (at least partial) sophistication

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[2]See the excellent overview by Bryan, Karlan and Nelson (2010)

Example I: StickK (real)

Example II: Clocky (real)

Example III: Tocky (real)

Example IV: Donate to your favorite charity? (fake)

Example V: Antabuse? (real)

Generic Antabuse (<u>Disulfiram</u>)

<u>Alcoholism</u>

Generic Antabuse is used to treat chronic alcoholism. It interferes with the metabolism of alcohol resulting in unpleasant effects when alcohol is consumed.

Example VI: Self-Control (real)

Image by Charlie Stigler, Steve Lambert, Joseph Fusco et. al. Used with permission under the GNU GPL license.

Due to copyright restrictions, we aren't able to include the video "Frog and Toad – Cookies". However, you can watch it on YouTube here.

What did we learn?

- Substitution across temptation goods can mitigate usefulness of commitment.

    - Avoiding one temptation good may lead to increased consumption of another.

- Conditions required for a commitment device to be helpful for a person

    - The person needs to have a self-control problem ($\beta < 1$).
    - The person needs to be at least partially sophisticated ($\hat{\beta} < 1$).
    - The commitment device needs to be effective.
    - The person needs to think the commitment device is effective.

- Naïveté can lower effectiveness of commitment devices. A naive person underestimate their present bias and might thus:

    (i) not demand a commitment device that would help her.
    (ii) demand a commitment device that doesn't actually help.

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Ariely and Wertenbroch (2002)

- Experiment 1 in classroom:
  - Sophisticated people: 51 executives at Sloan (MIT);
  - High incentives: no reimbursement of fees if fail class
  - Submission of 3 papers, 1% grade penalty for late submission

- Two groups:
  - Group A: evenly-spaced deadlines
  - Group B: set own deadlines

- Demand for commitment
  - 68 percent set deadlines prior to last week
  - Implies sophistication

Results on completion and grades

- No late submissions (!)

- Grades in Group A (88.7) higher than grades in Group B (85.67)
  - Consistent with self-control problems

- Concern 1: Two sessions not randomly assigned
  - Why is that a problem?

- Concern 2: Only two sections.
  - Effective sample size: $n = 2$ (correlated shocks in two sections)
  - Example: better TA in group A than in group B

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Ariely and Wertenbroch (2002): Experiment 2

- Deals with above issues

- 21-day proofreading exercise

- 3 treatment groups ($N = 60$)

  (A) evenly-spaced deadlines
  (B) no deadlines
  (C) self-imposed deadlines

- Exponential discounter: $B = C > A$

  - Early imposed deadlines limit flexibility.
  - No need to self-impose deadlines

- Sophisticated present-biased: $C > A > B$

  - Deadlines can help with present bias (commitment).
  - Flexible deadlines preferable

- Fully naïve present-biased: $A > B = C$

  - No perceived need to choose deadlines
  - Deadlines nevertheless help.

- Partially naïve present-biased: $A > B$

  - Deadlines help ($A > B$). Some commitment should help (such that $C > B$), though individuals may also overcommit (such that $C < B$).

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Results on Performance: $A > C > B$
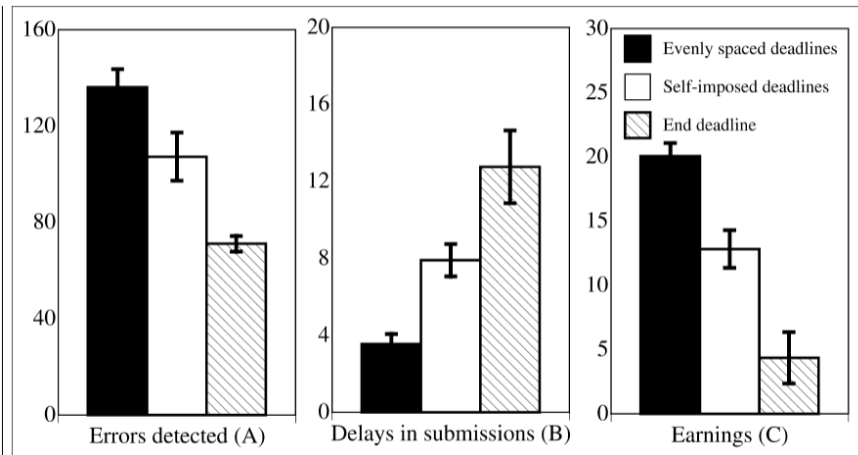
Fig. 2. Mean errors detected (a), delays in submissions (b), and earnings (c) in Study 2, compared across the three conditions (error bars are based on standard errors). Delays are measured in days, earnings in dollars.

Summary

- Result 1. Deadline-setting improves performance.
    - Evidence of present bias: $\beta < 1$
    - (Partial) sophistication: $\hat{\beta} < 1$

- Result 2. Deadline-setting is sub-optimal.
    - (Partial) Naïveté: $\beta < \hat{\beta}$

- Support for $(\beta, \hat{\beta}, \delta)$ model with partial naïveté

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Self-control at work: Kaur et al. (2015)

- Full-time data entry workers in India
  - Job is primary source of earnings
  - Similar to typical data entry recruit
  - Duration of study: 13 months

- Measuring output
  - Number of accurate fields entered in a day
  - Accuracy measured using dual entry of data

- Incentives
  - Workers paid a piece rate w in a weekly paycheck
  - No restriction on hours (can arrive, leave, take breaks at any time)
  - No penalties for absences

Data-entry task
Work Task: Data Entry

- View scanned images on screen

- Enter information into field in data entry software

- View scanned images on screen
- Enter information into fields in data entry software

Commitment device: dominated contracts
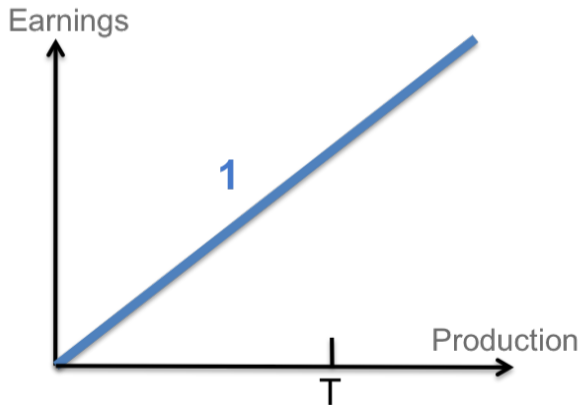
(1) Control contract: linear piece rate w

(2) Dominated contract:

- w if production exceeds T (target)
- $w/2$ if production is lower than T.[25]

Payday effects

- Randomization of payday (Tues, Thurs, Sat)
  - Allows to control for day-of-the-week effects

- What does the exponential discounting model predict?
  - Effort should be (close to) unrelated to paydays

- What does the quasi-hyperbolic model predict?
  - Higher effort on paydays (assuming liquidity constraints)
  - (Close to) no difference between other days

Results

(1) Demand for commitment (dominated contracts)

- Workers selected dominated contracts 36% of the time.
- Lower bound for the extent of time inconsistency. Why?

  - Individuals may be naïve.
  - Individuals may think commitment device is ineffective.
  - Individuals may prefer flexibility/be risk-averse.

(2) Offering dominated contracts increases output.

- Being *offered* commitment contract increases production by 2.3%
- Increase corresponds to 18% increase in piece-rate wage.

(3) Payday effects predict demand for commitment.

- Effort increases as the (randomly assigned) payday approaches.
- Payday effects are predictive of subsequent demand for commitment.

Payday effects

Figure 2
Production over the Pay Cycle
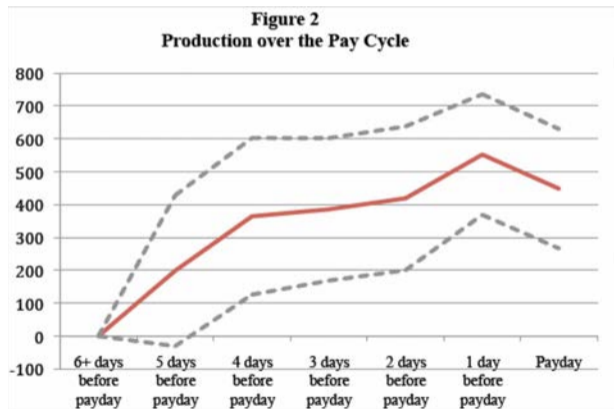
- Figure shows estimated output relative to day *after* payday.

- Payday effects consistent with present bias

Figure 6: **How the Demand for Dominated Contracts Changes with Experience**
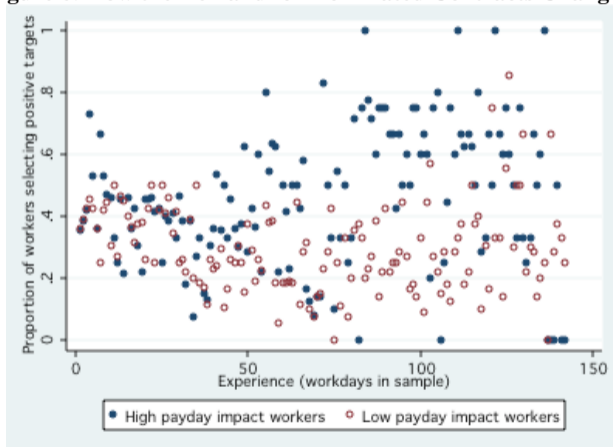
- High payday impact workers are more likely to choose commitment (positive targets).

- Fraction choosing commitment increases over course of the study, consistent with learning.

Exercise: DellaVigna and Malmendier (2006)

- Study gym-goers' behavior at three Boston-area health clubs.

- Customers had two options for how to pay for using the gym:
  (1) Monthly fee of over $70 for unlimited use of the gym.
  (2) Pay-per-visit fee of $10.

- Most gym-goers choose the monthly contract.
  - Those people exercise on average 4.3 times a month in the first year.
  - That's about $17 per visit.

- Before canceling, consumers go for 2.31 months on average without using the membership at all.

Does naïve quasi-hyperbolic discounting explain this behavior?

- Gym-goers would like to exercise a lot in the future.

- Being naïve, that's what they think they'll do.

- To save on gym costs, they buy the monthly membership.

- When it comes to exercising, their short-run impatience kicks in.

- They don't end up using the membership much.

Does sophisticated quasi-hyperbolic discounting explain this behavior?

- They also prefer to exercise a lot in the future.

- But they realize they won't want to do so later.

- They might get a monthly membership anyway. Why?
  - Membership lowers marginal costs of going.
  - This induces the future selves to exercise more often.

- Person realizes that it'll be more costly than the pay-per-visit membership, but might think the extra inducement is worth it.

Clever bundling of temptations: Milkman et al. (2014)

- Idea: combine investment good with leisure good
  - Investment good: exercising (hard to do as much as desired)
  - Leisure good: enjoying 'page-turner' audiobooks (hard to stop)

- Gym-only access to tempting audio novels (e.g. Hunger Games)

- 29% to 51% short-run increase in gym visits relative to control group

- 61% of participants willing to pay for this commitment device

Bundling temptations is effective... ...until Thanksgiving

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
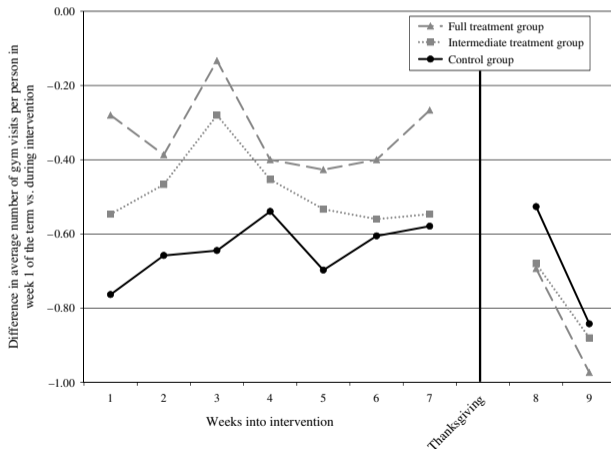
Courtesy of Katherine L. Milkman, Julia A. Minson, and Kevin G.M. Volpp. Used with permission.

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Substantial willingness to pay for commitment

Percentage of Study Participants Willing to Pay for a Temptation Bundling Device at a Given Price
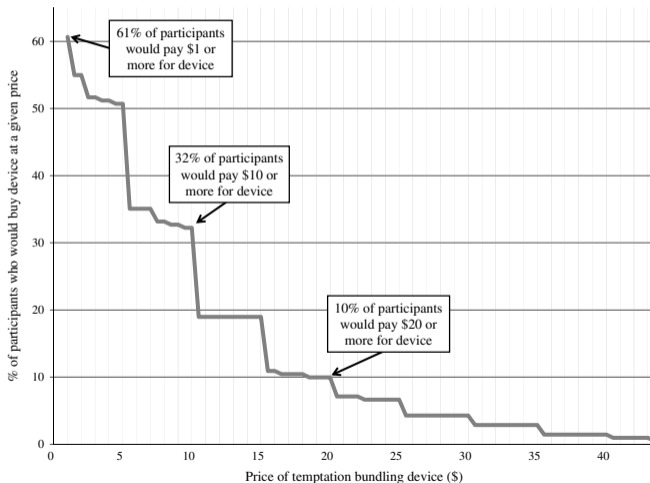
Courtesy of Katherine L. Milkman, Julia A. Minson, and Kevin G.M. Volpp. Used with permission.

Solving Problems with (Quasi-)Hyperbolic Discounting

- **Fully naïve** decision-makers ($\hat{\beta} = 1$):
  - (1) Start at the beginning.
  - (2) Solve for the optimal plan, assuming future selves will follow the plan.
  - (3) The person takes the first step in that plan.
  - (4) Go to the next period, and keep doing the same.

- **Fully sophisticated** decision-makers ($\hat{\beta} = \beta$):
  - (1) Start at the end.
  - (2) Solve for optimal action.
  - (3) Go back to the previous period.
  - (4) Solve for the optimal action, taking into account what happens in the next period.
  - (5) Go back to the previous period, and keep doing the same.

- **Partially naïve** decision-makers ($\beta < \hat{\beta} < 1$):
  - (1) Start at the end. Solve for what the person *thinks* she will do (using $\hat{\beta}$).
    [This is like solving for a fully sophisticated decision maker with a true β of $\hat{\beta}$.]
  - (2) Work your way to the first period using backward induction until period 2 (using $\hat{\beta}$).
  - (3) Then solve for the optimal action in period 1 (using the true β and the already derived prediction on future behavior).
  - (4) Then move to the next period, repeat steps (1) to (3).

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Consumption-savings choices with quasi-hyperbolic agents

- So far, we have considered discrete choices

- Pset 2 will consider continuous consumption-savings decisions.

- Principles from previous slide apply. Recitation will provide additional guidance and walk you through a previous pset question.

Credit-Card Teaser Rates: Ausubel (1991)

- Evidence on real-world credit-card usage
  - Large-scale field experiment run by a credit-card company
  - Mailing of two million solicitations!

- The company mailed randomized credit-card offers of three types:
  (1) Standard: 6.9% interest rate for six months and 16% thereafter
  (2) Teaser deal: 4.9% followed by 16%
  (3) Post-teaser deal: 6.9% followed by 14%

- Response rates and 21 months borrowing history for individuals who take the card
  - 2.5 times larger increase (relative to the standard offer) in take-up in the second group compared to the third group.
  - Given subsequent borrowing, the latter is a much better deal.

Explanations based on quasi-hyperbolic discounting?

(1) Naïve borrowers believe they'll repay the loan quickly, and hence think the teaser interest rate is the most important.

- They then borrow more than expected.

(2) Sophisticated borrowers don't want to use their cards much in future, so they choose high interest rate to restrain future borrowing.

- This would be a quite expensive commitment device.
- Substitution to other credit cards would undo this stragety

- What evidence can we collect to separate between these two stories?
  - Beliefs about future borrowing and demand for commitment
  - Alcott et al. (2020) find payday borrowers are quite sophisticated.
  - Most borrow only slightly more than expected and many demand commitment.

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How do credit card companies react to such behavior?

Credit Card Offers and Education
Less-educated more likely to be offered cards with higher late and over-limit fees

Source: Authors' calculations using Compremedia data
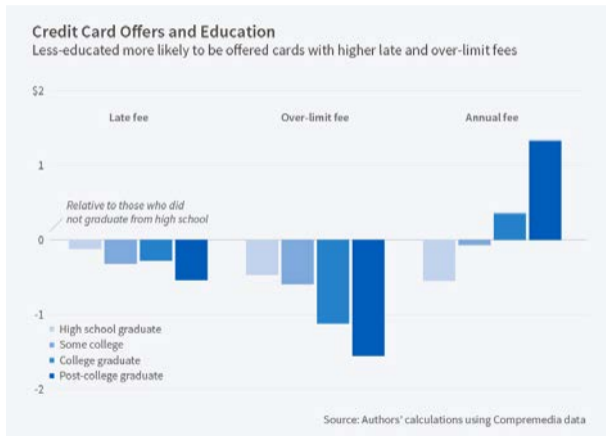
- Do credit-card companies screen for behavioral biases?

- Ru and Schoar (2017) analyze detailed dataset of mailed credit card offers.

- Education of zip code systematically related to back-loaded and hidden fees

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Do credit-card companies screen for behavioral biases?

- 'Less-sophisticated' (low-education) households are much more likely to be offered back-loaded or hidden-fee structures.
    - Low introductory/teaser rates
    - Photos, colors, fine print

- After introductory period, these cards feature higher rates, late fees, and over-limit fees.

- Firms employ these strategies more when credit risk of consumers decreases.
    - More backloaded fees, etc. as unemployment insurance increases
    - Firms exploit customers, but don't want them to go bankrupt.

Commitment savings: Ashraf et al. (2006)

- Clients of Philippine bank

- Randomly selected subset offered commitment savings product
  (1) *SEED Treatment:* Encouraged to save plus commitment offer: client can restrict access to deposits upon opening the account.
  (2) *Marketing Treatment:* Encouraged to save, no commitment offer
  (3) *Control Treatment:* Standard savings account (same interest rate)

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Clients' savings goals are date-based and amount-based.

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%

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Ashraf et al. (2006): Results

(1) 28.4% take-up rate of SEED account (either date-based or amount-based goal)

(2) Offering commitment savings product significantly increased savings.

(3) Survey responses to 'money now vs. money later' question predicts commitment take-up.

Schilbach (2019): Alcohol consumption among Indian low-income workers

Image by counterclockwise on flickr. CC: BY-NC-SA

- Large fractions of low-income workers in South India drink alcohol, often daily.

- Many say they would like to reduce their drinking or that they would be happier if liquor stores closed.

- Physical pain from work appears to contribute to self-control problems. Why?
  - Alcohol is a powerful anesthetic.
  - Pain increases short-run benefits of drinking while leaving long-run costs unaffected.

Day drinking among cycle-rickshaw drivers in Chennai

Breathalyzer scores during work hours (11 am to 5 pm)
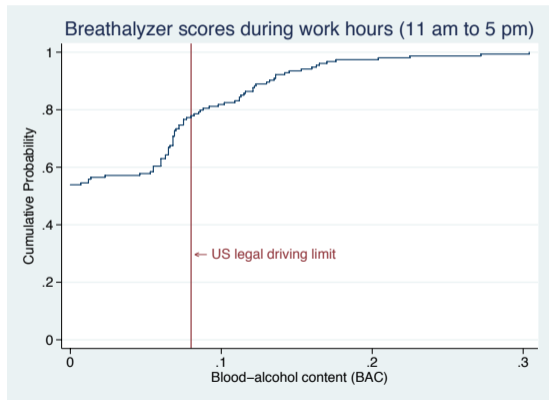
- Cycle-rickshaw drivers are often drunk during regular work hours

- About half have positive breathalyzer scores between 11 am and 5 pm!

- What commitment devices could one offer to reduce drinking (if desired)?

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Schilbach (2019): Incentives for sobriety

- Three-week field experiment with low-income workers in India

- Visit study daily between 6 pm and 10 pm

- Short survey and breathalyzer test

- Financial incentives for sobriety for random subset of individuals

Demand for incentives

- **Option A:** incentives for sobriety
  - Same payment structure as Incentive Group
  - Rs. 60 if BAC > 0, Rs. 120 if BAC $= 0$

- **Option B:** payment regardless of BAC

	Option A		Option B
	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

Demand for incentives

- **Option A:** incentives for sobriety
  - Same payment structure as Incentive Group
  - Rs. 60 if BAC > 0, Rs. 120 if BAC $= 0$

- **Option B:** payment regardless of BAC

	Option A		Option B
	BAC > 0	BAC $= 0$	regardless of BAC
(1)	Rs. 60	Rs. 120	Rs. 90
(2)	Rs. 60	Rs. 120	Rs. 120
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Demand for incentives

- **Option A:** incentives for sobriety
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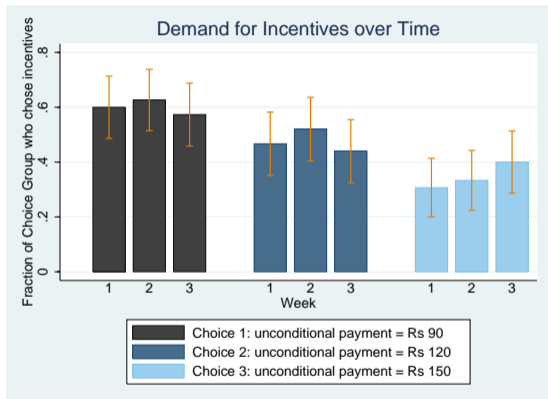- **Option B:** payment regardless of BAC

	Option A		Option B
	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

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Persistently high demand for commitment

Demand for Incentives over Time

Fraction of Choice Group who chose incentives

Week

Choice 1: unconditional payment = Rs 90
Choice 2: unconditional payment = Rs 120
Choice 3: unconditional payment = Rs 150

- Sobriety incentives reduce day drinking
  - Day drinking falls by about one third in treatment group.
  - But individuals mostly substitute to drinking later at nights.
  - No impacts of incentives on labor-market outcomes but increased savings

- About 50% choose options that are dominated in study payments.
  - About 1/3 willing to forego 10% of daily earnings to receive incentives.

- Consistent with naïve quasi-hyperbolic discounting

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Smoking: Gine et al. (2010)

- Voluntary commitment product (CARES) for smoking cessation. Smokers offered non-standard savings account:
  - Can deposit funds for six months. Then take urine tests for nicotine and cotinine
  - If pass, money is returned.
  - If fail, money is forfeited.

- Is this a good commitment contract?

- Results
  - 11% take-up
  - Smokers randomly *offered* CARES were 3 percentage points more likely to pass the 6-month test than the control group.
  - Effect persisted in surprise test at 12 months.

Do cigarette taxes make smokers happier?

- 8 out of 10 US smokers say they want to quit their habit.
  - Suggests demand for commitment to reduce smoking

- One way to accomplish reduced smoking: higher prices!
  - Why? Higher cigarette taxes (prices) can help people smoke less and curb self-control problems.

- Do higher cigarette taxes make smokers better off?
  - Gruber and Mullainathan (2002): Higher cigarette taxes in US and Canada are associated with higher self-reported wellbeing, among those likely to be smokers.
  - Caveat: (some of) the effects could be driven by smokers' spouses.

- Such effects are consistent with quasi-hyperbolic discounting but not with exponential discounting.

Fertilizer use: Duflo, Kremer and Robinson (2011)

- Fertilizer use in Western Kenya
  - Estimated high returns in previous field experiment
  - However, low adoption

- Possible explanation: farmers would like to purchase fertilizer, but they run out of money by the time the new season comes.

- Experiment (SAFI program):
  - Vary timing of purchase decision
  - Farmers can 'pre-buy' fertilizer around the time of harvest
  - 'Commitment device': early purchase of fertilizer (nobody resells)
  - Significant effect on fertilizer adoption

Commitment devices: summary

- Many examples of demand for commitment in research studies

  - Significant share of population struggle with self-control problems.
  - Many of them are at least partially sophisticated.

- High variation in fraction demanding commitment across settings. Why?

  - Uncertainty
  - Naïveté
  - Design of commitment devices varies across settings
  - Experience with commitment device

- Not much real-world evidence of commitment devices that actually help. Why?

  - (Partially) naïve agents have low perceived benefits of commitment.
  - Uncertainty depresses value of commitment (Laibson, 2015)
  - Transaction costs often high relative to (perceived) value of commitment

When commitment fails

- People often fail to follow through with their intended actions despite having chosen commitment devices.

  - Evidence of partial naïveté
  - Commitment contracts can do harm to partially naïve individuals.

- John (2020): Field experiment in Philippines (very similar to SEED above)

  - Positive average effect of *offering* commitment contract on savings
  - But over half of clients default on commitment contract!
  - Those people would likely be better off if they hadn't chosen the commitment option.

- Bai et al. (2020): similar evidence on health commitment products in India

  - Relatively low fraction of people demand commitment.
  - Among those who choose comment, many fail to follow through and thus lose money

Are time preferences malleable?

- Can think of commitment devices as providing choice options to alleviate the negative consequences of present bias, with limited success so far.

- Potential alternative: alleviate present bias directly by tackling its sources.
  - Schilbach (2019): higher sobriety increased savings among rickshaw drivers in Chennai (for given resources)
  - Bessone et al. (2020): increased sleep (napping) reduced present bias in real-effort tasks and increased savings
  - Hershfield (2011): increase people's focus/attention to the future by showing them pictures of their future selves.

Figure 3. Example of age progression procedure. (Left) Photo of the author; (Middle) computerized rendering of the author using Facegen and Photoshop; and (Right) age-progressed version of the same photo.

Time preferences: summary

- Exponential discounting
  - Workhorse model of modern economics
  - Many important applications
  - Model helps explain many facts of the world.
  - But some facts are hard to match with exponential discounting

- Quasi-hyperbolic discounting
  - Simple modification of exponential discounting model
  - Additional parameter β to capture emphasis on present
  - Can explain many observed behaviors more accurately.
  - Commitment devices may help improve outcomes but few examples of real-world products that actually help people – much ongoing research in this area!

What's next?

- Lectures next week: risk preferences!
  - Readings for Monday (Feb 24): Rabin and Thaler (2001)
  - Readings for Wednesday (Feb 26): Sydnor (2010).

- Recitation this week: more on time preferences (briefly) and intro to risk preferences

References used in this lecture I

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