Is disease prevention related to discount rates?

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Preview of Main Claims

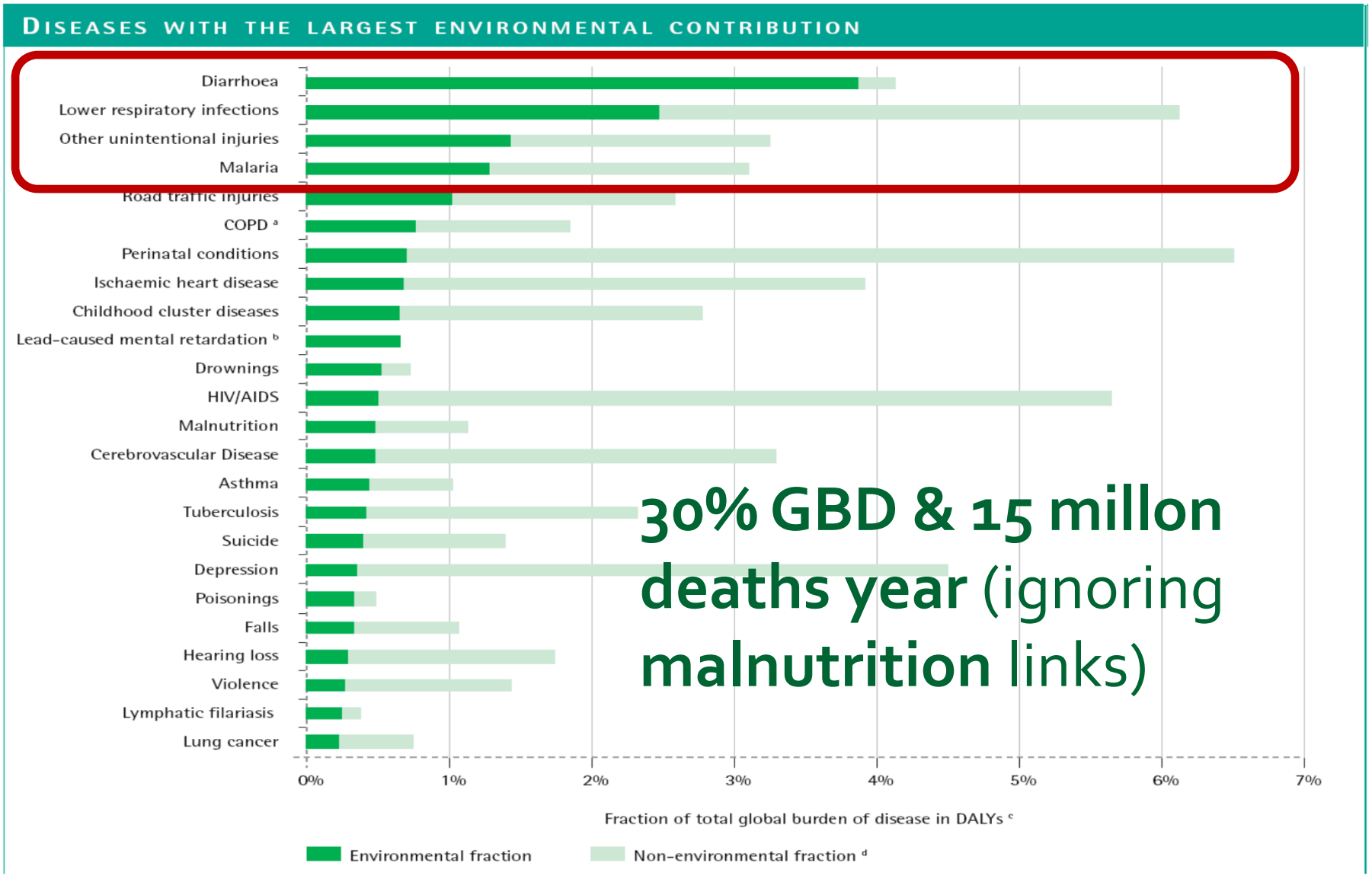
I. Environmental health falls through the cracks because of potentially very large (e.g., epidemiological) externalities. But the solution hinges on behavior change, which is sticky & tricky

II. Impatience is often suggested as a possible explanation for low rates of seemingly cheap and simple disease prevention behaviors, but empirical evidence lacking.

III. Use a sample of 10,000 households from rural India to explain
   - ✓ *who is impatient*: affected by age, gender, income, and credit access
   - ✓ *how impatience affects behavior*: less likely to wash hands, treat drinking water (and avoid tobacco & *paan*)

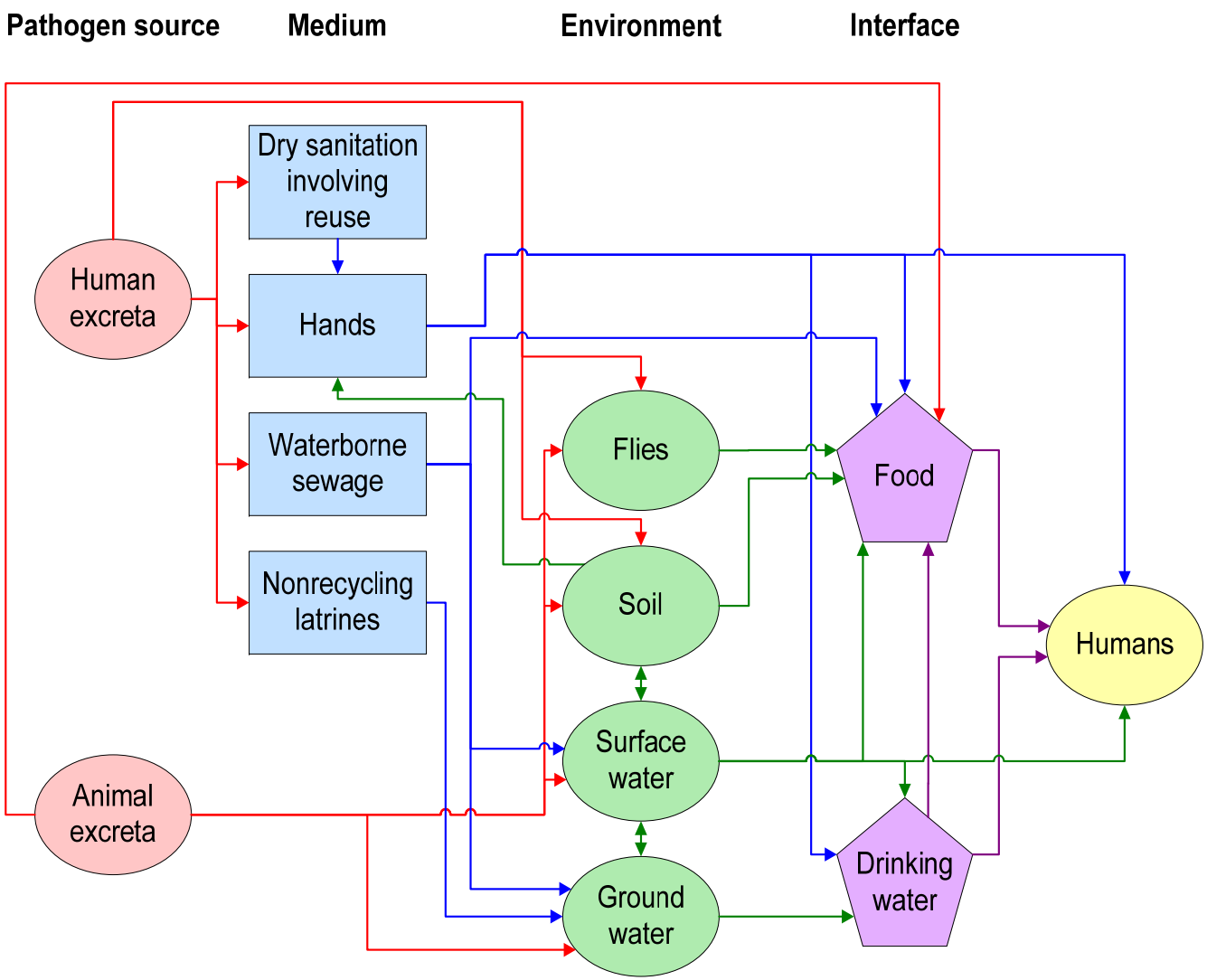
IV. Drawing on the theory of endogenous time preferences, encourage people to become more far-sighted - e.g. by improving their access to credit and education

Major environmental health concerns



30% GBD & 15 millon deaths year (ignoring **malnutrition** links)

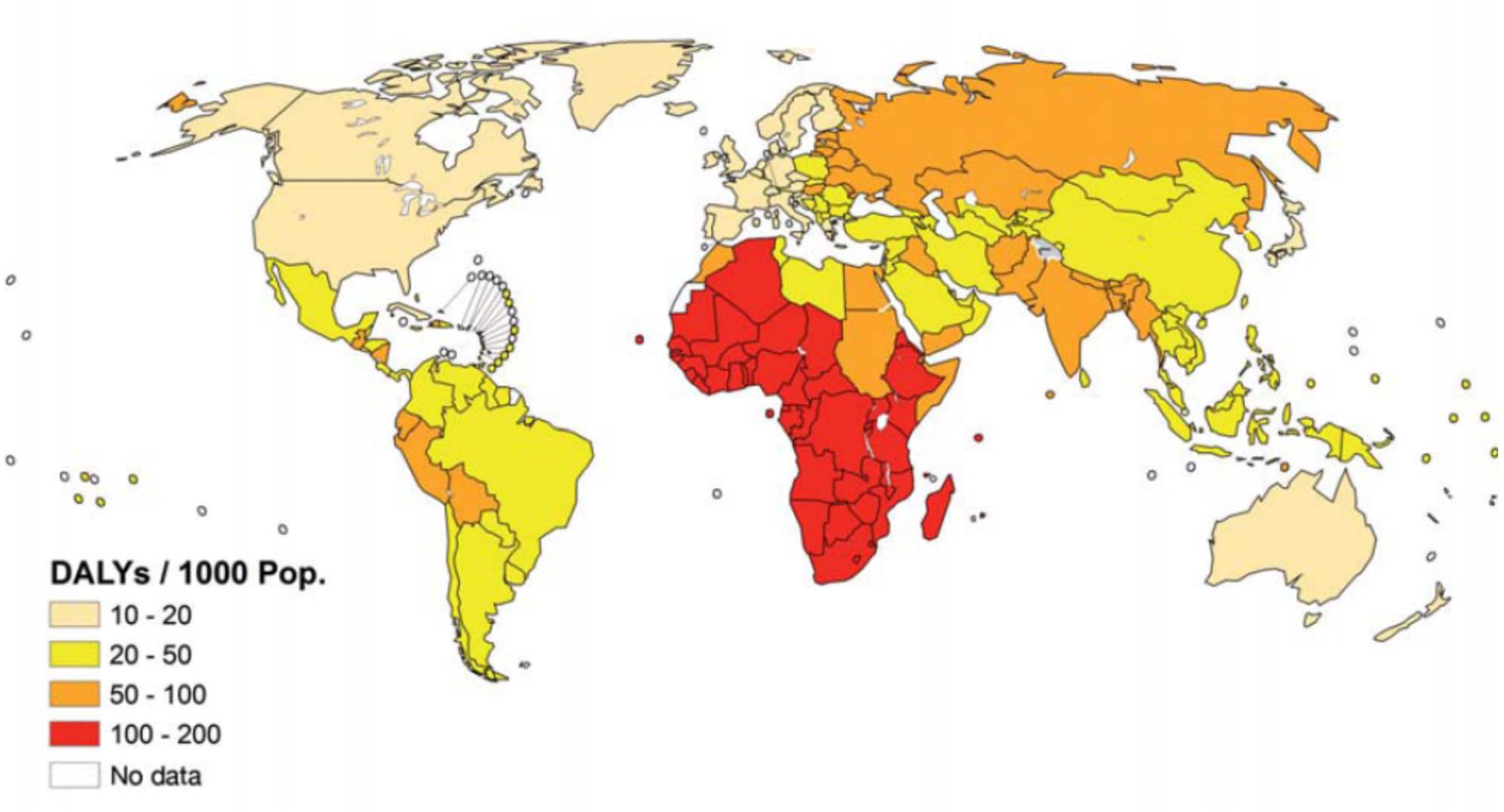
Transmission pathways of diarrhea



What should we normally do?

- Preston (1996): about 50% of gain in life expectancy from 1930-60s attributed to public health intervention
  - ***Macro public health*** = filtering and chlorinating water supplies, building sanitation systems, draining swamps, pasteurizing milk and undertaking mass vaccination campaigns.
  - ***Micro public health*** = behavioral changes by individuals but encouraged by the public sector, including boiling bottles and milk, protecting food from insects, washing hands, ventilating rooms and keeping children's vaccinations up to date.
- Cutler and Miller (2005): water purification alone can explain half of the mortality reduction in the United States in the first third of the twentieth century

Environmental disease burden (2002)



"Implementation Science" for Environmental Health

- Fresh focus on prevention
  - "new" germ theory
  - epigenetic & fetal stress
  - limits to case-management
  - challenges to immunization
- Behaviors dominated by infection & prevention externalities
  - individuals (& families) face bewildering array of constraints
  - institutions (governments, markets, NGOs, donors) competing & complicated incentives - complementary roles
- Thin, scattered, and poor quality empirical research on key parameters regarding ***valuation*** of clean air and water and ***evaluation*** of behavior change interventions …

Why do so few adopt cheap behaviors & use simple technologies?

can't pay *don't know* *don't care*

selfish **impatient** **risk averse** **conformists** **constrained**

Pattanayak & Pfaff, 2009. *Ann Rev Res Econ.*

Simple Analytics of Env Health – II

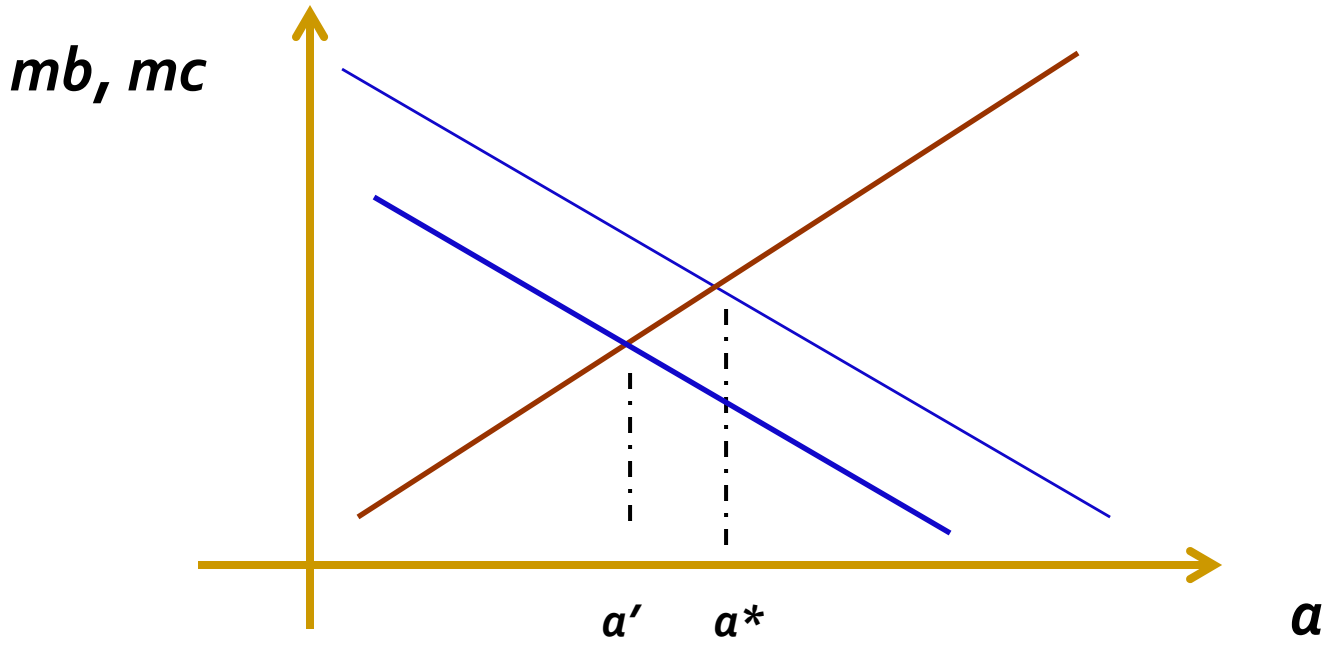
$$L_{l,t,c,k,m,\lambda,\mu} = Max\, u[l, c, s(a, G, e\{a, G\}); \theta]$$
$$-\lambda[f(a,t,m,k)] + \mu[y - c - p.m - r.k + w(T - s - l - t)]$$

$$\underbrace{\frac{u_S.s_e.e_a}{\mu}}_{\text{health benefits}} \underbrace{- w.s_a.e_a}_{\text{productivity loss}} = \underbrace{w \cdot a_t + p \cdot a_M + r \cdot a_K}_{\text{time \& material costs}}$$

Simple Analytics IV: Impatience

$$\left[\frac{u_S.s_e.e_a}{\mu} - w.s_a.e_a\right] exp(-\delta t) = w \cdot a_t + p \cdot a_M + r \cdot a_K$$

mb' mc



Pattanayak & Pfaff, 2009. *Ann Rev Res Econ.*

What does discount rates depend on?

- Demographics, education, SES, and credit access
  - Endogenous time preference: age, education, wealth
  - Evolutionary biology: age & gender
  - Behavioral psychology: income & morbidity
- Empirical testing in developing countries
  - Anderson et al., 2004, EDCC: age, gender
  - Ashraf et al. 2006. QJE: income, gender
  - Kirby et al. 2002. JEconPsy: age, gender, educ
  - Pender, 1996. JDE: credit
  - Rubalcava et al. 2009. EDCC: gender, age
  - Tanaka et al. AER, 2010: educ, age, gender, income

Discount rate estimation in developing countries

Author/Year (by Author)	Stated /Obs	Good	Disc.Rate/Yr
Pender, 1996	Stated ($)	Rice	26-91%
Holden et al., 1998 (Indonesia)	Stated	Money	93%
Holden et al., 1998 (Ethiopia)	Stated	Money	104-116%
Holden et al., 1998 (Zambia)	Stated	Money, Maize	53%
Poulos and Whittington, 2000 (Ethiopia)	Stated	Life saved	28-49%
Poulos and Whittington, 2000 (Mozambique)	Stated	Life saved	15-46%
Poulos and Whittington, 2000 (Uganda)	Stated	Life saved	46%
Poulos and Whittington, 2000 (Indonesia)	Stated	Life saved	45-57%
Poulos and Whittington, 2000 (Ukraine)	Stated	Life saved	206%
Poulos and Whittington, 2000 (Bulgaria)	Stated	Life saved	38-45%
Kirby et al., 2002	Stated ($)	Money, Candy	4380% -5110%
Anderson et al., 2004	Stated	Money	0.6-67%
Botelho et al., 2006	Stated ($)	Money	12.7%

Study Design

- Quasi-experimental sample of 242 villages from 4 dry districts (~10,200 households)
- Pre-matching communities on propensity scores of participation
- 3 hour survey with primary care giver
- Modules on (a) KAP, (b) demog & health, (c) water-sanitation, (d) SES & (e) time-preferences

Pattanayak et al. 2009. *J Water & Health*

Survey to elicit discount rates

- Imagine that the person giving you this gift offered you a choice:

  Option A: you could either have Rs. 1,000 now,

  Option B: you could have Rs. 2,600 in 15 months

  Implied rate = 6.4%

  Imagine that there is absolutely no risk of not receiving any of the amounts in the future. There are no right or wrong choices regarding how you decide about the future. Which option would you chose?

[1] ***A****smaller sooner*, **[2]** ***B*** *larger later* [3] *Uncertain*

- Each respondent answered five questions: Smaller Sooner (SS) vs. Larger Later (LL)

Implied monthly discount rates

Version	Q	Option SS		Option LL		Implied Rate (ρ_q)	% Choose SS [a]
		P_{SS}	t_{SS}	P_{LL}	t_{LL}		
A	1	1000	0	2600	15	6.4%	65%
A	2	1000	0	2600	12	8.0%	64%
A	3	1000	0	1350	3	10.0%	61%
A	4	1000	3	1500	12	4.5%	64%
A	5	1000	3	2200	15	6.6%	61%
B	1	1000	0	2000	15	4.6%	67%
B	2	1000	0	2000	12	5.8%	65%
B	3	1000	0	1250	3	7.4%	63%
B	4	1000	3	1500	12	4.5%	65%
B	5	1000	3	1400	15	2.8%	65%
C	1	1000	0	1600	15	3.1%	68%
C	2	1000	0	1600	12	3.9%	67%
C	3	1000	0	1175	3	5.4%	64%
C	4	1000	3	1220	12	2.2%	68%
C	5	1000	3	1500	15	3.4%	66%
D	1	1000	0	1250	15	1.5%	70%
D	2	1000	0	1250	12	1.9%	69%
D	3	1000	0	1150	3	4.7%	66%
D	4	1000	3	1200	12	2.0%	69%
D	5	1000	3	1100	15	0.8%	70%

Descriptive Statistics

Variable Name	mean
Personal Characteristics	
Gender: Female	91%
Can do household accounts	72%
Caste: Low/Middle/High	38%/ 18%/ 33%
Age	28.7
Household Characteristics	
Can access formal credit	24%
Owns land	59%
Household size	6.4
Total monthly household expenditure	₹3,066
Monthly household expenditure: Staple foods (Rice, gram/pulses, cereals)	₹ 176
Health perceptions & water source	
Gets water from improved water source	65%
Believes diarrhea is preventable	26%
Believes diarrhea is caused by dirty water	77%

2 Stage Econometric Model

- Stage 1: Estimate discount rates using survey responses to SS-LL questions
  - Discount rates as a function of household characteristics (Z):

$$r_j = \sum_{k=1}^{K} \beta_k \cdot Z_{k,j}^{r} + \varepsilon_j$$

  - But we only observe lower and upper limits of the discount rate:

$$L = \prod_j \left[\phi\left(\frac{u_j - \beta Z_j}{\sigma} \right) - \phi\left(\frac{l_j - \beta Z_j}{\sigma} \right) \right]$$

- Stage 2: Estimate behavior as a function of predicted discount rates (bootstrap):

$$P(a) = \alpha_1 . \rho_{est} + \alpha_k . Z_k + \varepsilon$$

Stage 1: Who discounts more?

Variables	Coeff	significance
Intercept	0.188	***
Female	-0.079	**
Age	-0.001	*
Female*Age	0.001	*
Can do accounts	-0.001	
Can access credit	-0.017	***
Household size	0.002	*
Food ratio	0.001	***
Wealth index (principal component)	-0.005	**

- Avg estimated discounted 16% (7% – 29%)
- Women have relatively constant ρ; Men more patient with age
- Access to credit associated with lower ρ
- Wealth, smaller family and food security reduces ρ

Stage 2: Do discount rates predict behaviors?

	Treat Water		Wash Hands		*Paan* & Tobacco		Vaccinate	
Predicted discount rates	—	*	—	***	+	***	+	
Concerned about disease	+	***	+	***	—		—	
Recent crisis	+		+	**	—	***	+	
Believes diarrhea is preventable	+	***	—	***				
Believes vaccines cause diarrhea							—	
Distance to village health post	—	***	—		—	***	+	***
Distance to village center	+	***	—	**	—	***	—	
Can read newspapers (literate)	+		+	***	+	**	—	
Years of formal education	+	***	+	*	+	***	—	
Have improved water source	—	***	+	***				
Total household expenditures	+	***	+		—	***	+	***
intercept	+	***	—		—	***	—	***

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