Experimental Economics
Intertemporal decision-making

Ernesto Reuben
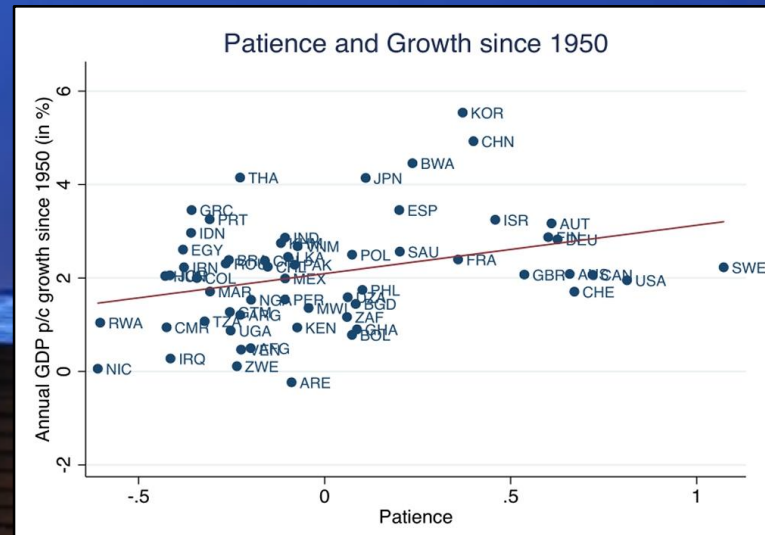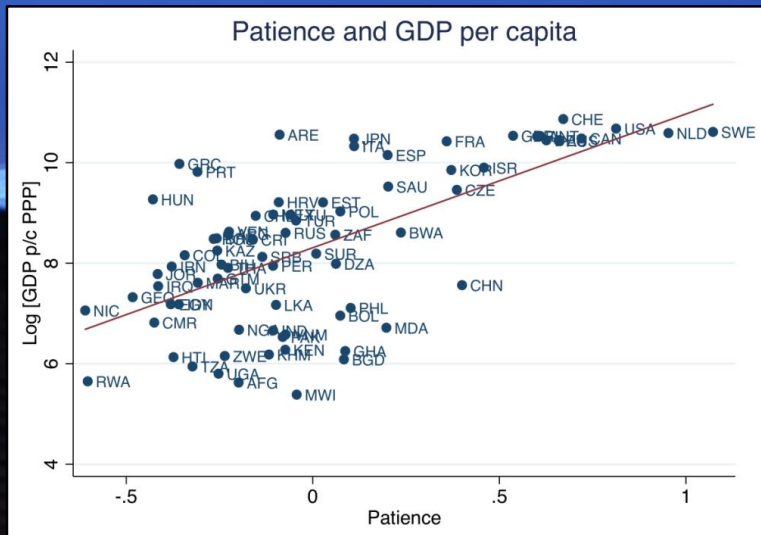
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IS BEING PATIENT IMPORTANT?

Dohmen et al. (2015)

Is being patient important?

Dohmen et al. (2015)
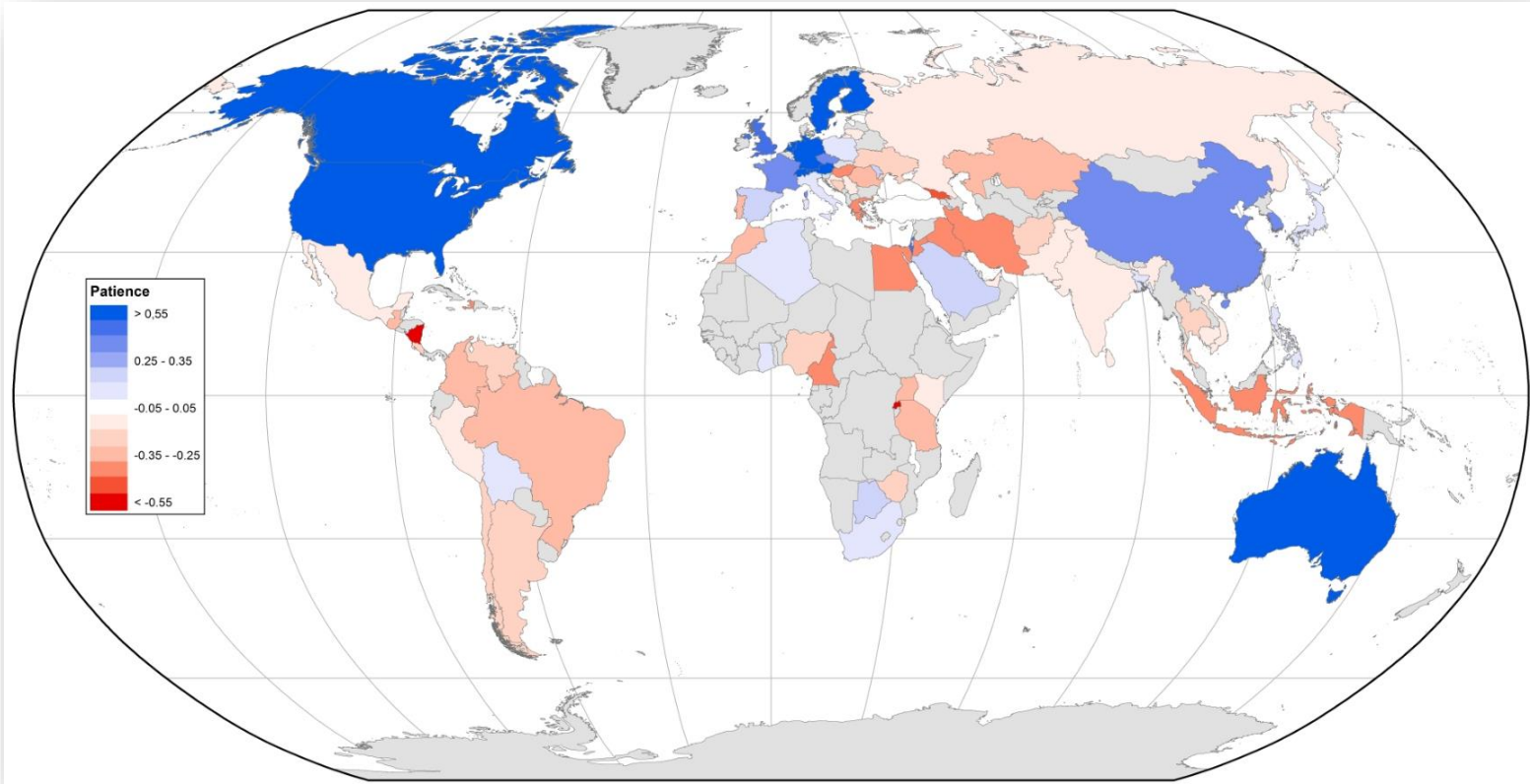
IS BEING PATIENT IMPORTANT?

Table 2: Patience and national income in sub-samples

	Africa & Middle East (1)	Europe & C. Asia (2)	SE Asia & Pacific (3)	Ameri-cas (4)	OECD (5)	Non-OECD (6)	Colo-nized (7)	Not colonized (8)
	Dependent variable: Log [GDP p/c PPP] in...							
Patience	2.83***	1.82***	3.76***	2.42***	1.02***	1.43**	2.54***	2.23***
	(0.76)	(0.33)	(1.04)	(0.32)	(0.21)	(0.65)	(0.36)	(0.51)
Constant	7.84***	9.09***	7.40***	8.55***	9.75***	7.77***	8.10***	8.87***
	(0.34)	(0.19)	(0.33)	(0.20)	(0.15)	(0.20)	(0.16)	(0.30)
Observations	20	27	14	15	22	54	54	22
R^2	0.274	0.448	0.430	0.592	0.498	0.073	0.313	0.434
Adjusted R^2	0.234	0.426	0.383	0.560	0.473	0.055	0.300	0.406

OLS estimates, robust standard errors in parentheses. $*\ p < 0.10$, $**\ p < 0.05$, $***\ p < 0.01$. In the first column, the sample includes Africa and the Middle East, in the second column Europe and Central Asia, in the third South-East Asia and Pacific, in the fourth the Americas, in the fifth (sixth) all (non-) OECD members, and the seventh (eigth) all formerly colonized (never colonized) countries.

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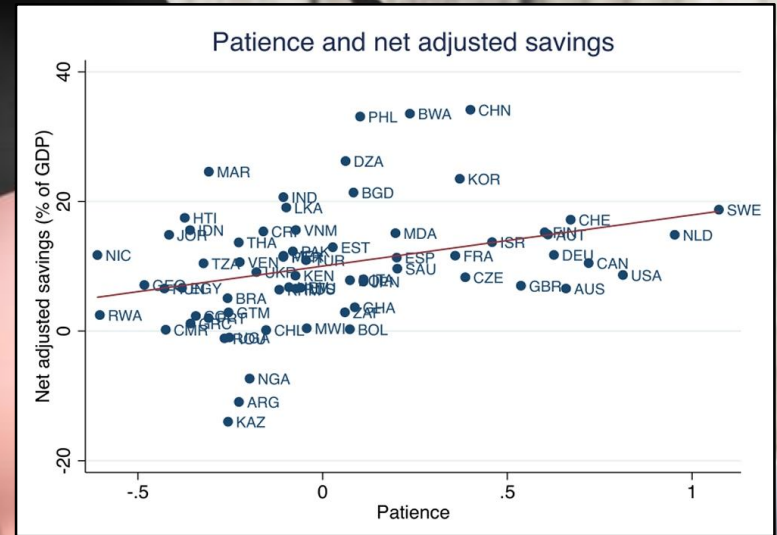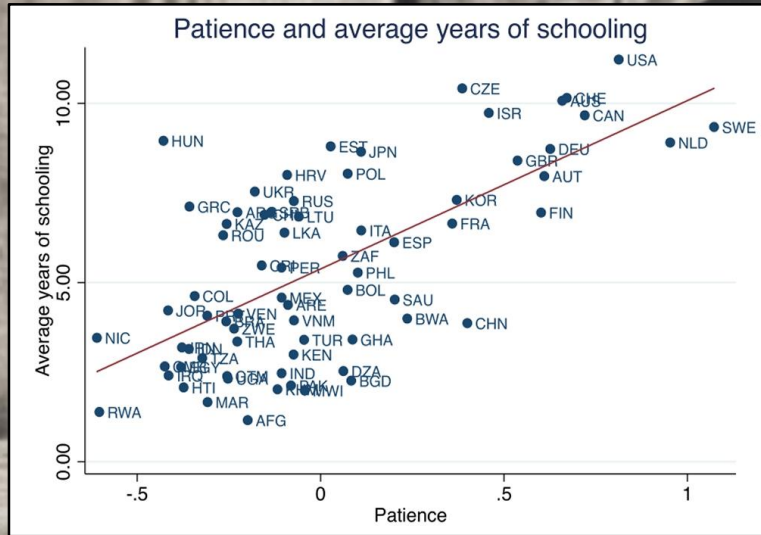NYU ABU DHABI

Dohmen et al. (2015)

IS BEING PATIENT IMPORTANT?

Table 3: Patience and alternative development measures

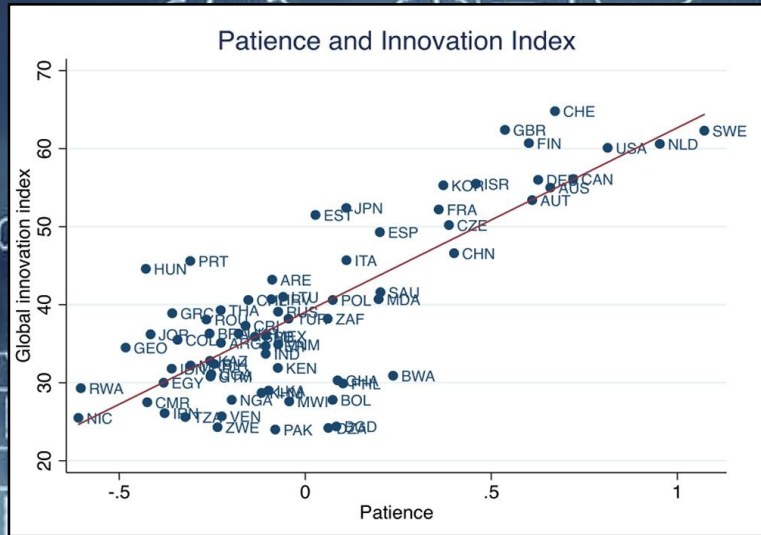|	Log [GDP per worker PPP]		Human Development Index		Subjective happiness	
	(1)	(2)	(3)	(4)	(5)	(6)
Patience	1.59***	0.66***	0.23***	0.13***	0.13***	0.21***
	(0.21)	(0.24)	(0.03)	(0.03)	(0.03)	(0.04)
Constant	9.84***	-61.2*	0.70***	-11.5**	0.72***	-11.4**
	(0.11)	(30.63)	(0.01)	(5.05)	(0.01)	(5.47)
Additional controls	No	Yes	No	Yes	No	Yes
Observations	71	69	76	74	76	74
R^2	0.309	0.896	0.335	0.881	0.140	0.741
Adjusted R^2	0.299	0.849	0.326	0.833	0.129	0.637

Dependent variable:

OLS estimates, robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. See column (7) of Table 1 for a complete list of the additional controls.

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Dohmen et al. (2015)

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IS BEING PATIENT IMPORTANT?

Dohmen et al. (2015)

Patience and Innovation Index

Patience and R&D expenditure

Dohmen et al. (2015)

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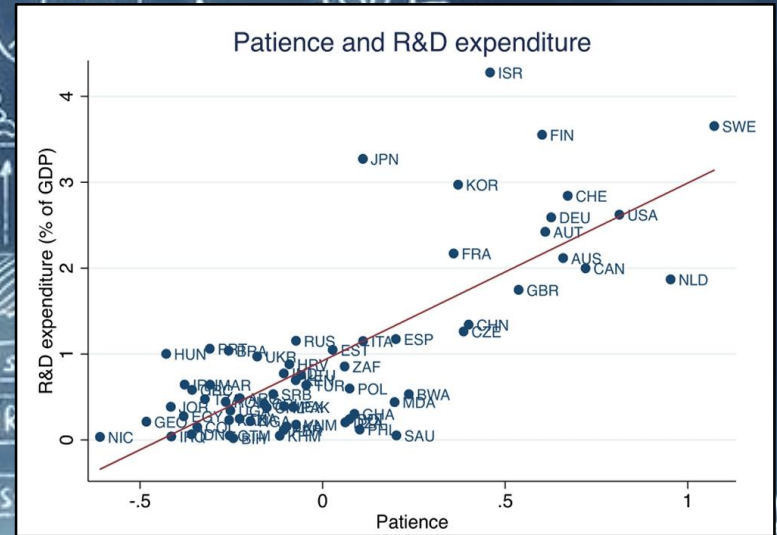
Is being patient important?

Table 9: Patience, proximate determinants, and national income

| | Dependent variable: Log [GDP p/c PPP] | | | | |
	(1)	(2)	(3)	(4)	(5)
Patience	2.66***	0.82***	0.58***	1.07***	0.71**
	(0.26)	(0.31)	(0.18)	(0.40)	(0.35)
Average years of schooling		0.40***			
		(0.05)			
Log [Capital stock p/c]			1.00***		
			(0.07)		
Total factor productivity				3.71***	
				(0.66)	
Property rights					0.037***
					(0.01)
Democracy					0.053
					(0.05)
Constant	8.31***	6.20***	-1.68**	6.29***	6.18***
	(0.14)	(0.32)	(0.68)	(0.36)	(0.34)
Observations	76	71	71	60	72
R^2	0.397	0.662	0.908	0.750	0.602
Adjusted R^2	0.389	0.652	0.905	0.741	0.584

OLS estimates, robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
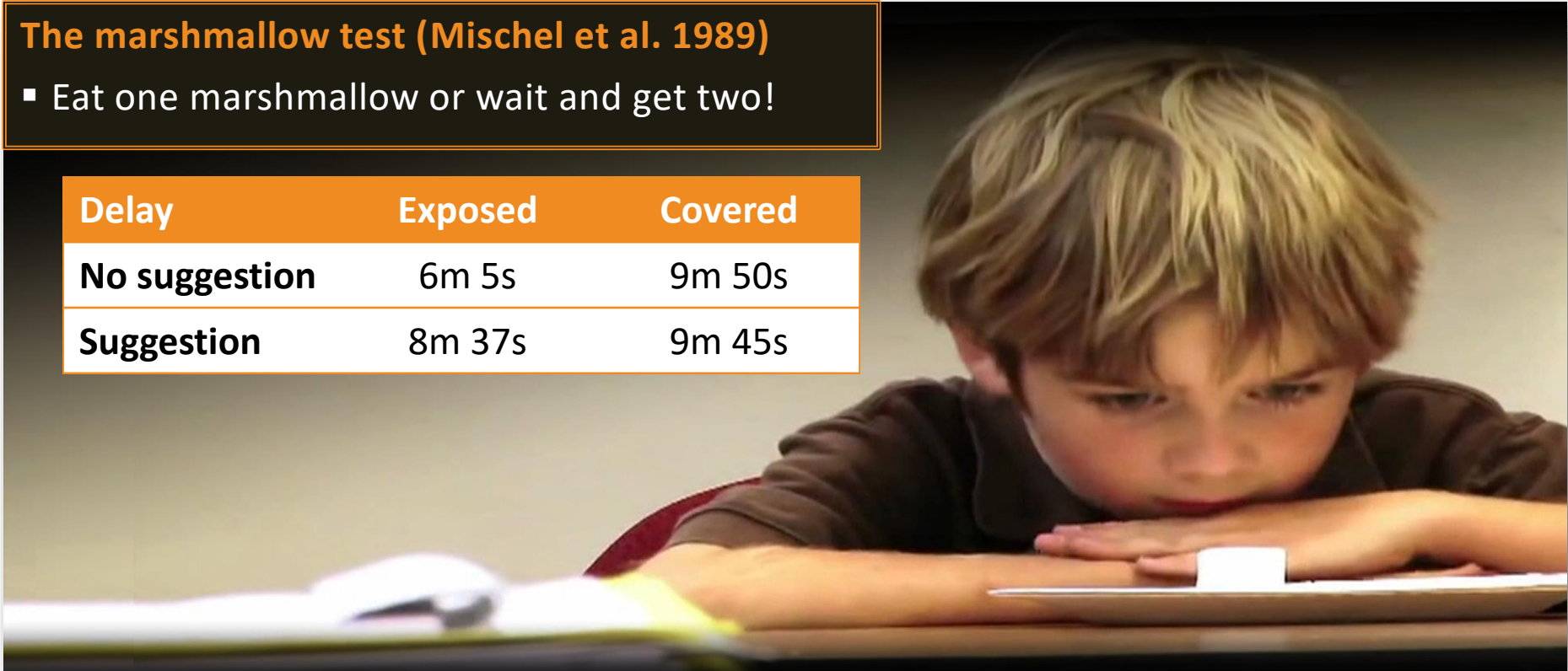
Dohmen et al. (2015)

Is impatience a stable individual trait?

The marshmallow test (Mischel et al. 1989)

- Eat one marshmallow or wait and get two!

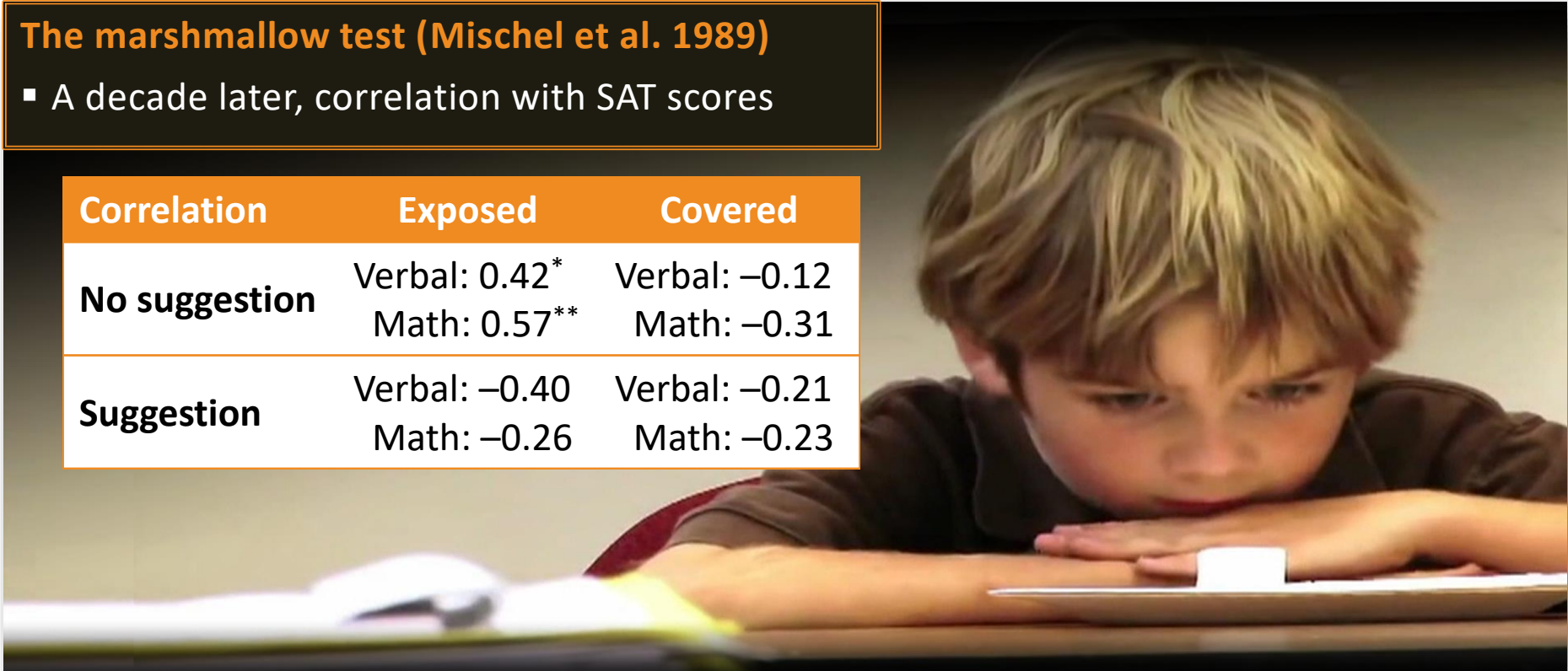| Delay	Exposed	Covered
No suggestion	6m 5s	9m 50s
Suggestion	8m 37s	9m 45s

IS IMPATIENCE A STABLE INDIVIDUAL TRAIT?

The marshmallow test (Mischel et al. 1989)

- A decade later, correlation with SAT scores

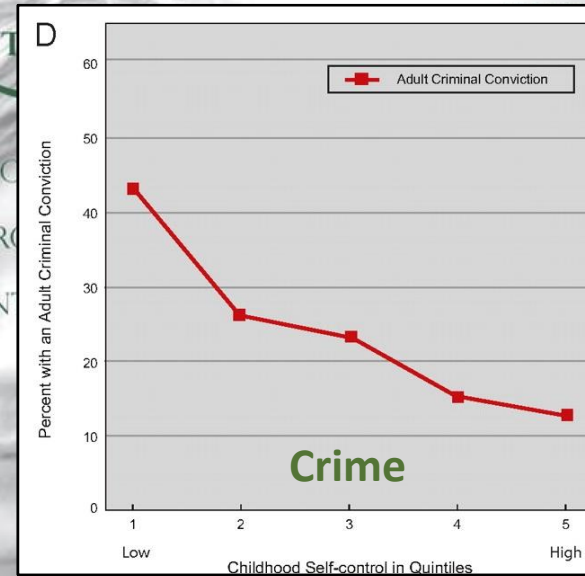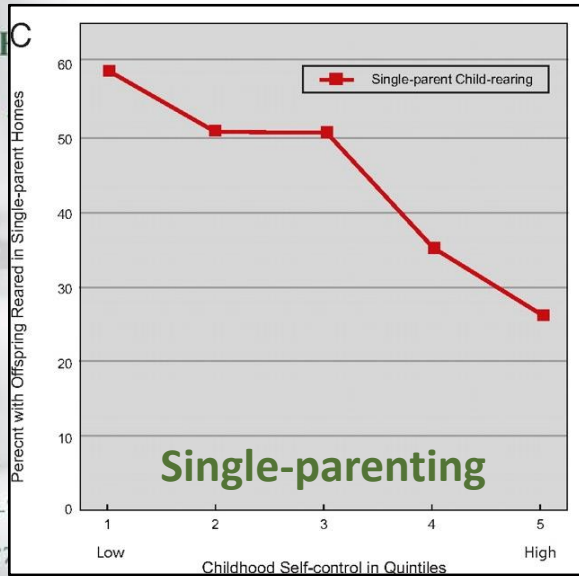| Correlation	Exposed	Covered
No suggestion	Verbal: 0.42* Math: 0.57**	Verbal: –0.12 Math: –0.31
Suggestion	Verbal: –0.40 Math: –0.26	Verbal: –0.21 Math: –0.23

Is impatience a stable individual trait?

Dunedin multidisciplinary health and development study (Moffitt et al. 2011)

- Self-control measured with reports by the subjects, teachers, and parents
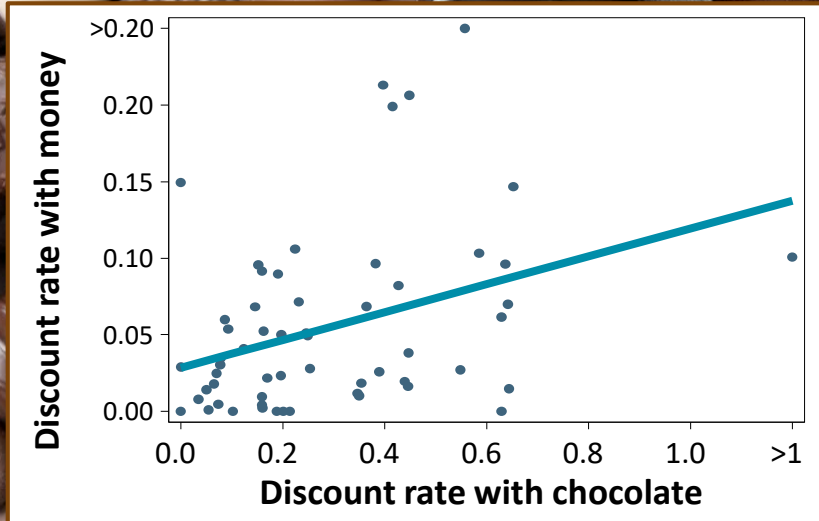
Is impatience a stable individual trait?

Discounting for primary and monetary rewards (Reuben et al. 2010)

- Choose between *x* now and (1+*r*)*x* in one week when *x* equals $50 and when it equals 5 large chocolates

| Subjects who …		Correlation
All		*r* = 0.354, *p* = 0.007
are hungry	**like chocolate**	
No	Dislikes	*r* = 0.280, *p* = 0.405
Yes	Dislikes	*r* = 0.492, *p* = 0.123
No	Likes	*r* = 0.295, *p* = 0.287
Yes	Likes	*r* = 0.553, *p* = 0.012

Is impatience a stable individual trait?

Table 11: Individual patience, human capital, and income

	Dependent variable:							
	Log [Household income p/c]				Education level			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Patience	0.35*** (0.05)	0.053*** (0.01)	0.046*** (0.01)	0.047*** (0.01)	0.20*** (0.03)	0.13*** (0.01)	0.14*** (0.01)	0.097*** (0.01)
Age				0.0052*** (0.00)				0.020*** (0.01)
Age squared				-0.000037* (0.00)				-0.00040*** (0.00)
1 if female				-0.094*** (0.02)				-0.13*** (0.03)
Constant	7.88*** (0.13)	6.35*** (0.00)	5.93*** (0.00)	5.87*** (0.03)	1.00*** (0.05)	2.27*** (0.04)	3.06*** (0.05)	3.30*** (0.14)
Country FE	No	Yes	No	No	No	Yes	No	No
Regional FE	No	No	Yes	Yes	No	No	Yes	Yes
Observations	79267	79267	79239	78984	79357	79357	79334	79125
R^2	0.053	0.601	0.634	0.636	0.015	0.116	0.149	0.176
Adjusted R^2	0.053	0.601	0.629	0.631				

Columns (1)-(4) contain OLS and columns (5)-(8) ordered probit estimates. Standard errors (clustered at country level) in parentheses. The dependent variable in (5)-(8) is educational attainment as a three-step category. Here, the R^2 is a Pseudo-R^2. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Distribution of patience at individual level
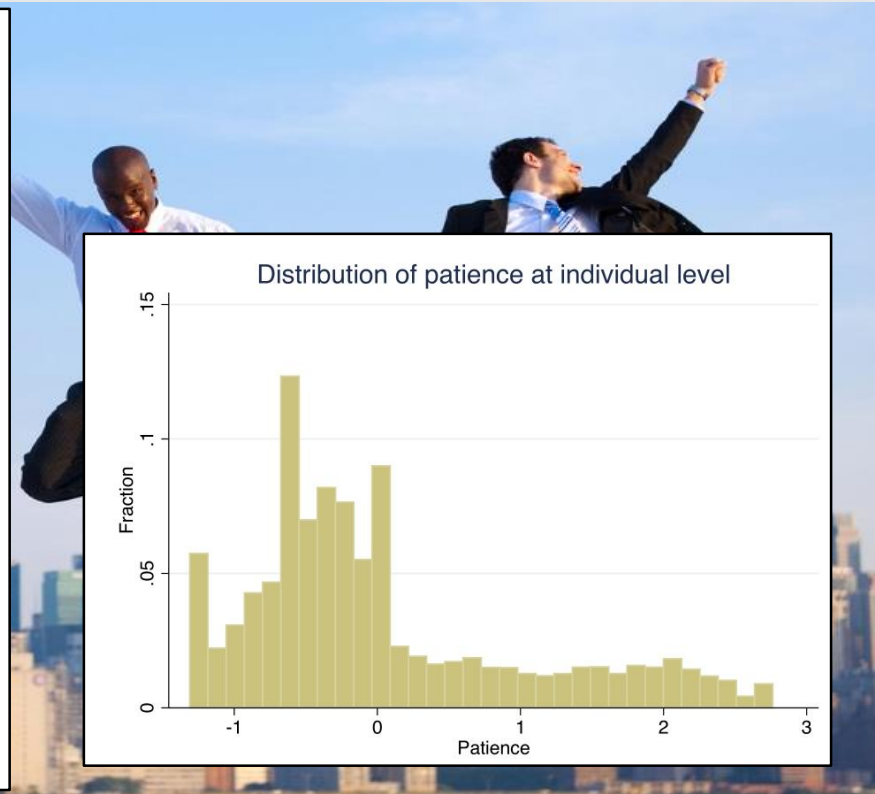
Dohmen et al. (2015)

HOW TO ELICIT DISCOUNT FACTORS?

Reuben et al. (2015)

- Asked 544 MBAs to choose the timing of a payment

  $100 today or $100 in two weeks
  $100 today or $101 in two weeks
  $100 today or $102 in two weeks
  $100 today or $103 in two weeks
  $100 today or $104 in two weeks
  $100 today or $105 in two weeks
  $100 today or $106 in two weeks
  $100 today or $107 in two weeks
  $100 today or $108 in two weeks
  $100 today or $109 in two weeks
  $100 today or $110 in two weeks
  $100 today or $111 in two weeks
 $100 today or $112 in two weeks

	Mean	Median
Switching point	4.98%	4.00%

How to elicit discount factors?

- Problem of single multiple-price lists → ignores the concavity of utility functions

- **Andersen et al. (2008)**

  - **Multiple price lists:** elicit the curvature of utility functions (e.g., Holt & Laury 2002) and discount factors separately

- **Andreoni & Sprenger (2012)**

  - **Convex time budgets:** measure curvature of utility functions and discount factors with a single set of choices

- Higher discount factors once concavity of the utility function is taken into account

  - but convex time budgets can show high degree of GARP violations **(Chakraborty et al. 2017)** that correlate with parameter estimates **(Choi et al. 2015)**
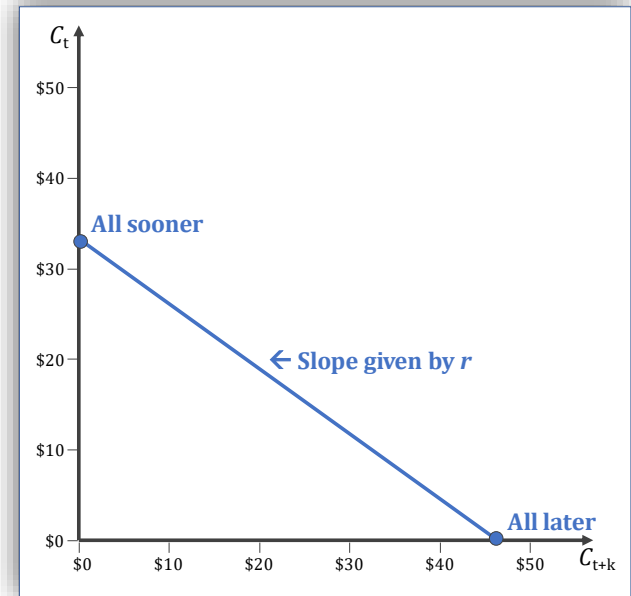
IS IT A MEASUREMENT PROBLEM?

"Money now vs. later" has many confounds (Chabris et al. 2008)

- Unreliability of future rewards (trust in the experimenter)

- Transaction costs of delayed reward

- Framing effects (response scale)

- Timing of consumption (liquidity constraints)

- Discount factors elicited with visceral goods tend to be even lower!

  - Receiving monetary rewards is also intrinsically satisfying **(Kable & Glimcher 2007)**

SHORT-TERM DISCOUNT FACTORS

- What are we eliciting with short time-horizons?
  - Which option would you prefer?

    $u(\$15) > \delta u(\$20) \rightarrow \delta^{month} \leq 0.75$

  - What about the following choices?

    $u(\$15) > \delta^{6\text{-}months}u(\$84)$

    $u(\$15) > \delta^{1\text{-}year}u(\$470)$

    $u(\$15) > \delta^{2\text{-}year}u(\$14,900)$

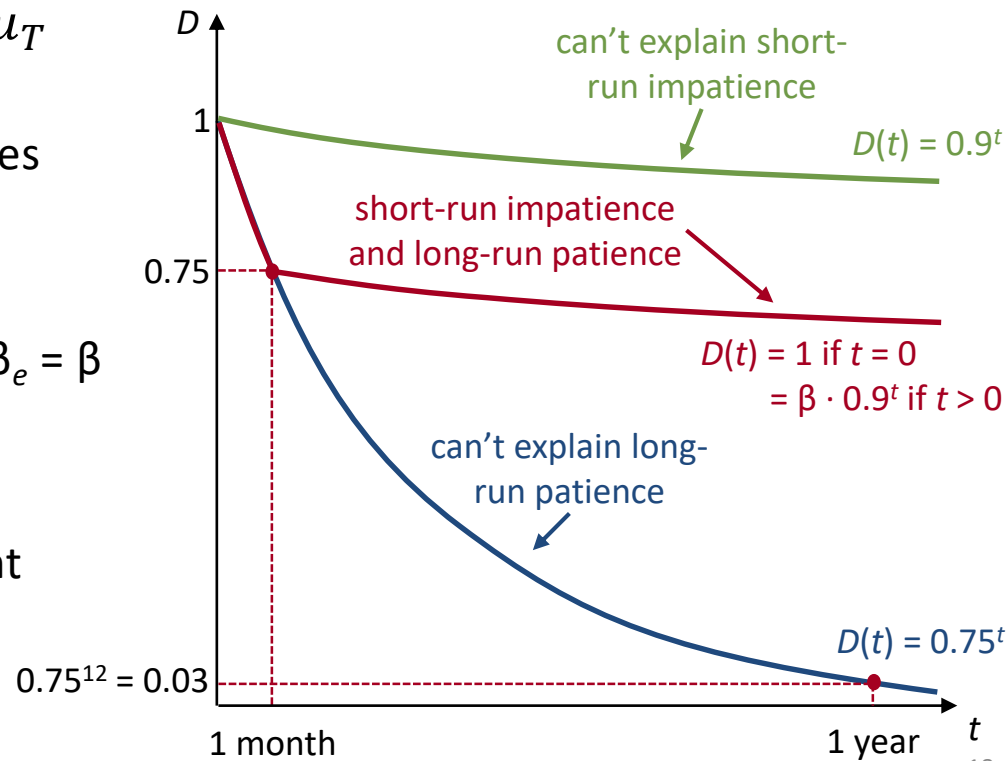 $u(\$15) > \delta^{5\text{-}year}u(\$470,000,000)$

Quasi-hyperbolic discounting (Laibson 1994; O'Donoghue & Rabin 2001)

$$U_0 = u_0 + \beta\delta u_1 + \beta\delta^2 u_2 + \cdots + \beta\delta^T u_T$$

- If β < 1 then impatience for choices that involve the present but patient for choices that involve only the future

- **Exponentials:** β = 1

- **Sophisticated:** β < 1 and at $t = 0$ expect $\beta_e = \beta$

- **Naïve:** β < 1 and at $t = 0$ expect $\beta_e = 1$

- Predicts preference reversals over time, procrastination, demand for commitment

D

can't explain short-run impatience

$D(t) = 0.9^t$

short-run impatience and long-run patience

$D(t) = 1$ if $t = 0$
$= \beta \cdot 0.9^t$ if $t > 0$

1

0.75

can't explain long-run patience

$D(t) = 0.75^t$

$0.75^{12} = 0.03$

1 month   1 year t

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TIME INCONSISTENCY IN SNACKING?

Read & van Leeuwen (1998)

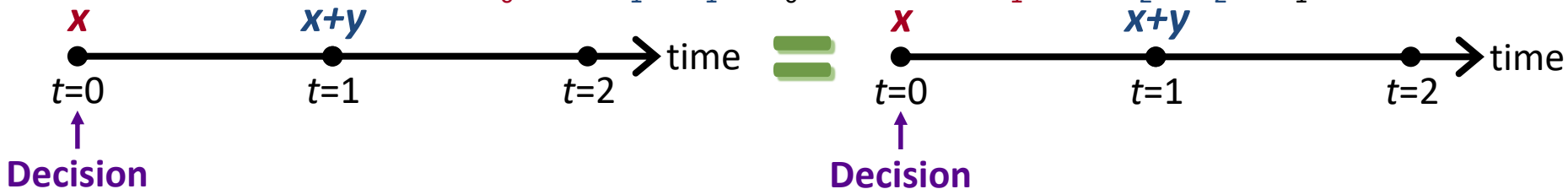- Asked 200 employees what snack they would you like to eat **now** or in one week

Now
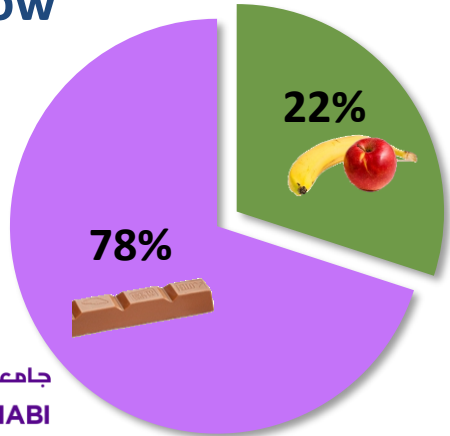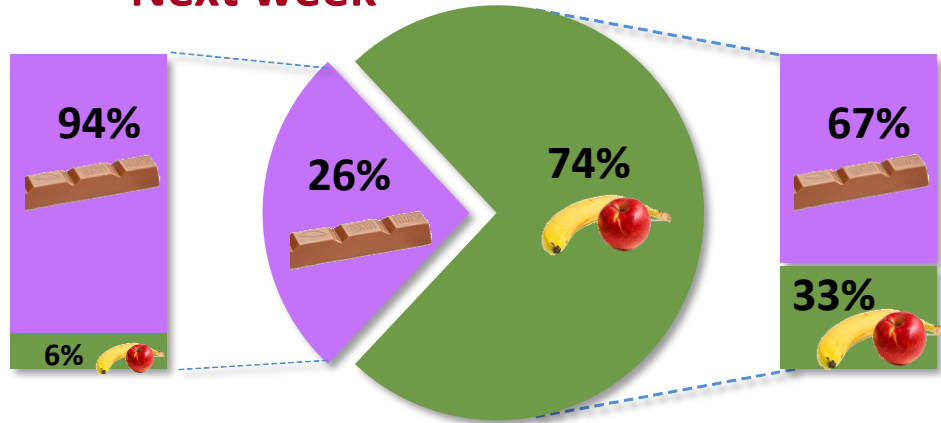
22%

78%

Next week

94%

6%

26%

74%

67%

33%

Halevy (2015)

- 117 subjects make large-stake and small-stake choices between an **early** reward **$x** and a **delayed** reward of **$(x + y)** to test violations of three concepts

- **Time invariance:** choose x_0 over $x_1 + y_1$ in t_0 → choose x_1 over $x_2 + y_2$ in t_1

x $x+y$

$t=0$ $t=1$ $t=2$ time

↑
Decision

$=$

x $x+y$

$t=0$ $t=1$ $t=2$ time

↑
Decision

- **Stationarity:** choose x_0 over $x_1 + y_1$ in t_0 → choose x_1 over $x_2 + y_2$ in t_0

x $x+y$

$t=0$ $t=1$ $t=2$ time

↑
Decision

$=$

x $x+y$

$t=0$ $t=1$ $t=2$ time

↑
Decision

Halevy (2015)

- 117 subjects make large-stake and small-stake choices between an **early** reward **$x** and a **delayed** reward of **$(x + y)** to test violations of three concepts

- **Time consistency:** choose x_1 over $x_2 + y_2$ in t_0 → choose x_1 over $x_2 + y_2$ in t_1
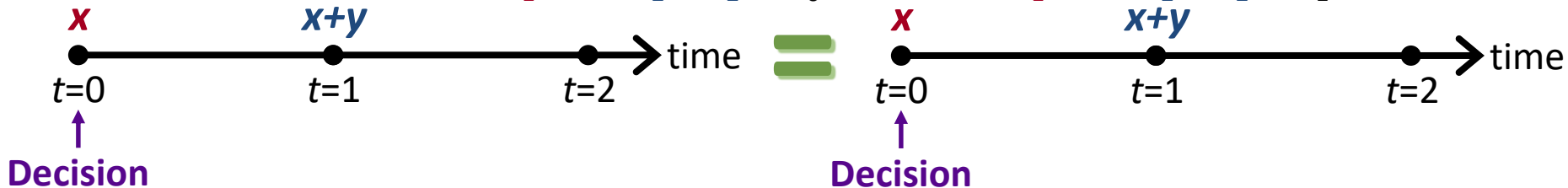
Note that:

- Quasi-hyperbolic discounting complies with time invariance but violates non-stationarity and time inconsistency but it's support comes mostly from violations of stationarity

- You can be time consistent without stationarity → changing tastes

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TIME CONSISTENCY, STATIONARITY, AND TIME INVARIANCE

Time invariant	Stationary	Time consistent	Large	Small
Yes	Yes	Yes	39%	43%
Yes	No	No	15%	8%
No	Yes	No	17%	21%
No	No	Yes	15%	22%
No	No	No	14%	6%

Halevy (2015)

- Largest fraction are **exponentials** ≈ 40%

- Only a small fraction are "true" **quasi-hyperbolics** < 15%

- If one uses violations of stationarity as evidence of **quasi-hyperbolics** then one misclassify them as being three times more common

SELF-COMMITMENT TO AVOID TEMPTATION IS AN OLD IDEA
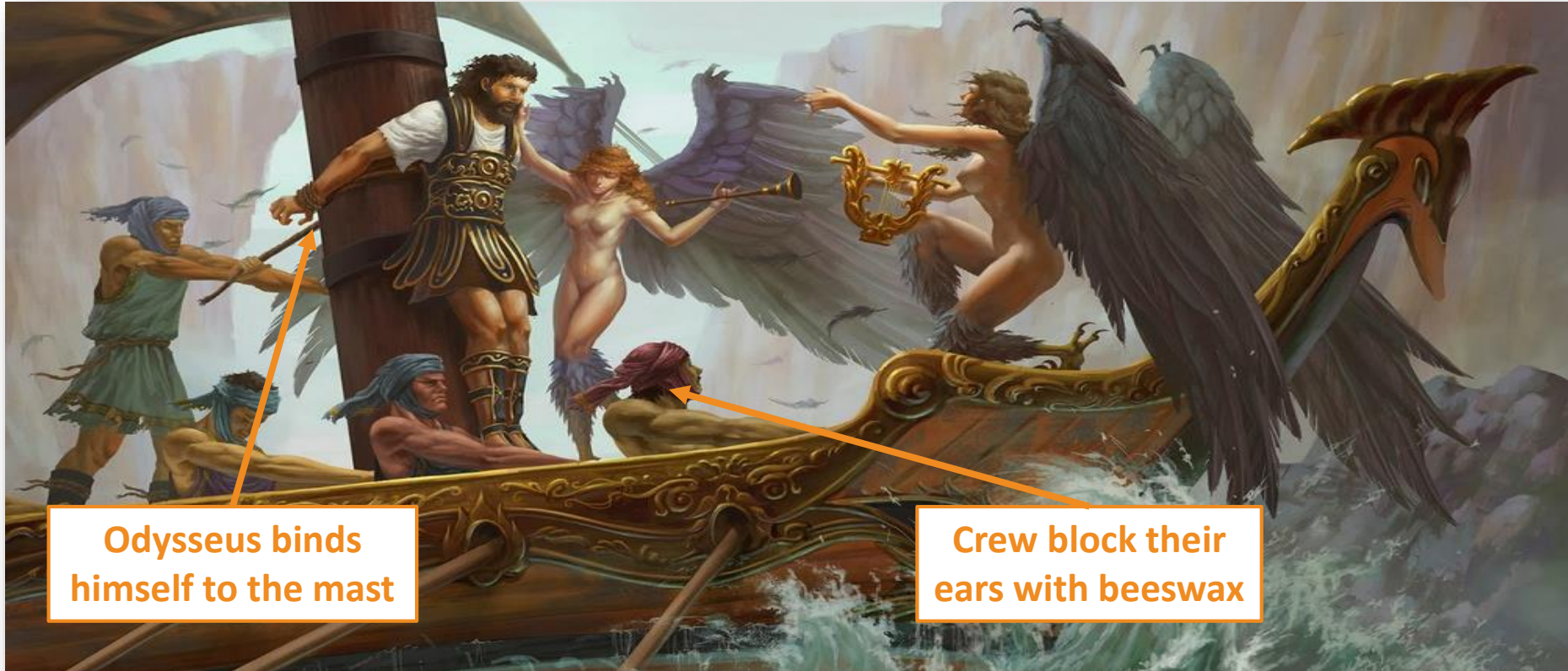
Odysseus binds himself to the mast
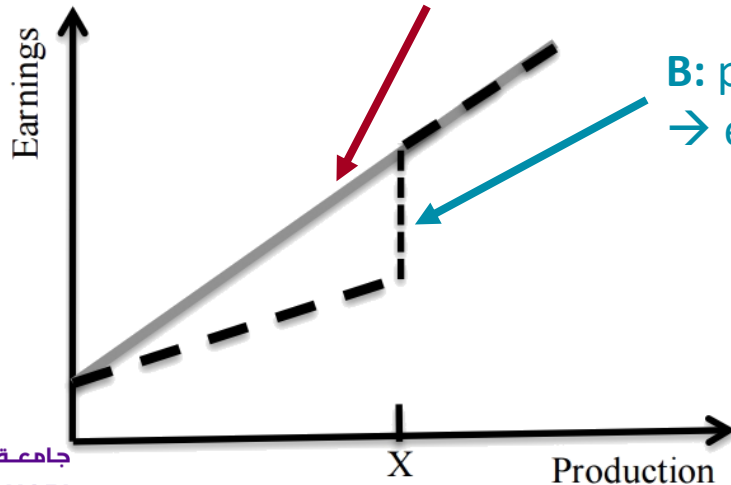
Crew block their ears with beeswax

COMMITMENT IN THE WORKPLACE

Kaur et al. (2015)

- Suppose you are hired for a boring job that pays you at the end of each week

- Two available contracts:

A: Piece-rate → earn w per unit

B: piece-rate + penalty
→ earn w per if $Q \geq X$, else earn $\frac{1}{2}w$ per unit

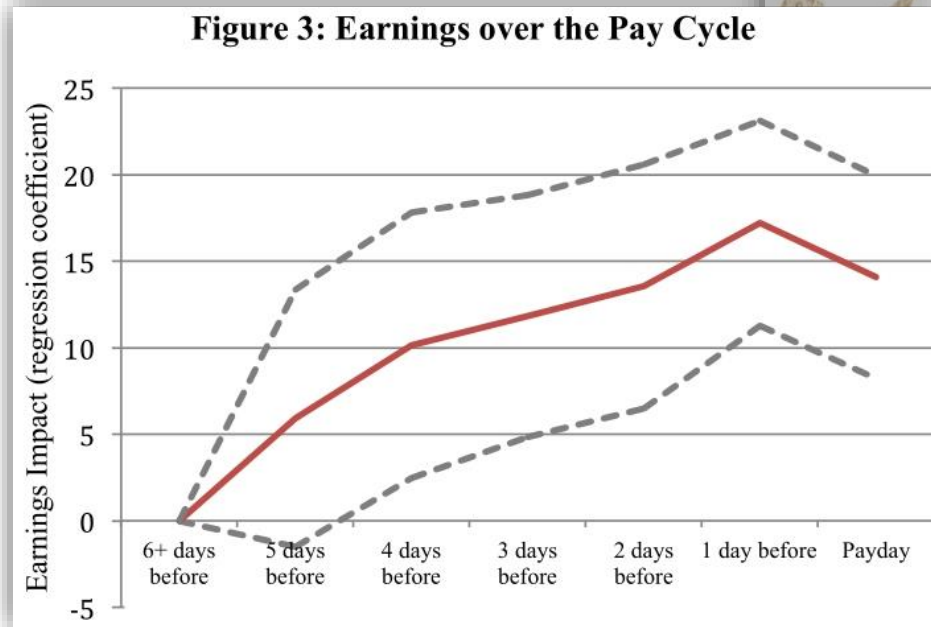You never earn more under B and you may earn much less!
Why would you choose B instead of A?

COMMITMENT IN THE WORKPLACE

Kaur et al. (2015)

- **Pay-day effects and present-biased workers**
  - Some workers work harder as paydays approach
  - Would they like to commit to work harder at the beginning of the week?
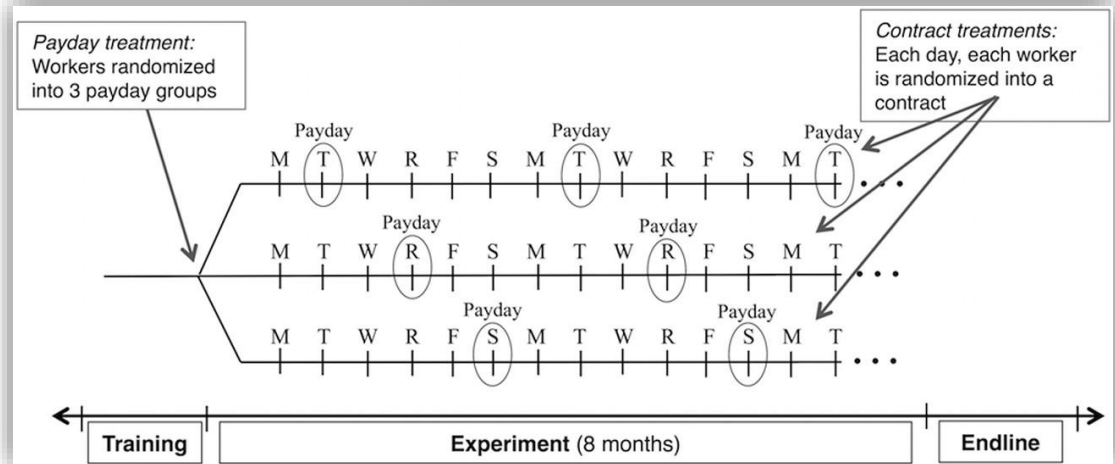

Figure 3: Earnings over the Pay Cycle

COMMITMENT IN THE WORKPLACE

Kaur et al. (2015)

- 102 works over 8 months in a 3×4 treatment design

  - Payday (between-subjects): **Tue**, **Thu**, or **Sat**

  - Contract (within-subjects): daily assignment to

    - **Piece-rate**

    - **Piece-rate + penalty** with **imposed** target

    - **Piece-rate + penalty** with **chosen** target that day

    - **Piece-rate + penalty** with **chosen** target the day before
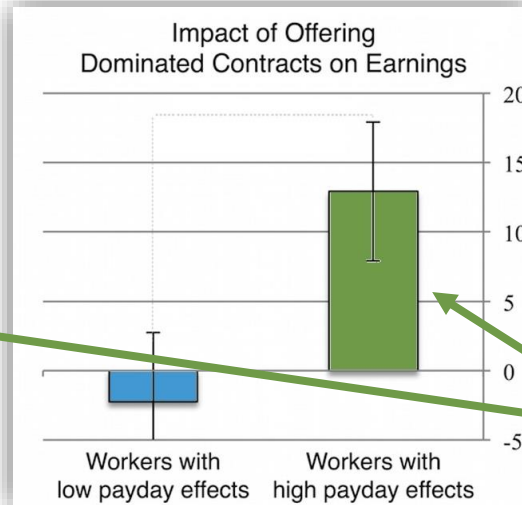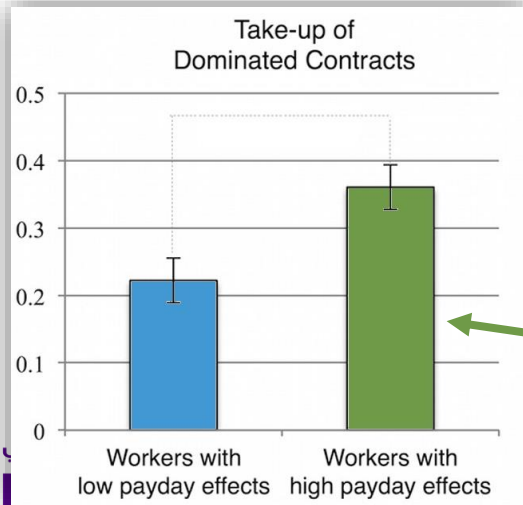
Kaur et al. (2015): Results of the piece-rate + penalty contract

- Chosen 28% of the time

- Increases production without reducing quality if target is imposed or chosen the day before

- Increases earnings if target is chosen the day before

Take-up of Dominated Contracts

Impact of Offering Dominated Contracts on Earnings

Contract Treatments: Treatment Effects of Contracts	Dependent Variable	
	Production	Earnings
Option to choose dominated contract		
Evening option to choose dominated contract	150	4.60
	(69)**	(2.17)**
Morning option to choose dominated contract	73	2.32
	(69)	(2.17)
Target imposed:		
Level 1 target	3	−1.55
	(90)	(2.88)
Level 2 target	213	3.13
	(91)**	(2.89)
Level 3 target	334	5.01
	(150)**	(4.80)
Observations: worker-days	8,423	8,423
R^2	.59	.57
Dependent variable mean	5,337	172

Effects are driven by workers with self-control problems

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DEMAND FOR COMMITMENT

Augenblick et al. (2015)

- 102 subjects decide allocations of effort for two (boring) jobs over seven weeks

Job 1: Greek transcription

Job 2: Partial Tetris

DEMAND FOR COMMITMENT

Augenblick et al. (2015)

Week 1

1. Allocate tasks for weeks 2 & 3

Job 1 Transcription

Please use the sliders to allocate tasks between Week 2 and Week 3.

Decision 1: TASK RATE 1 : 1.50 — Week 2: 0 — Week 3: 33

Decision 2: TASK RATE 1 : 1.25 — Week 2: 10 — Week 3: 32

Decision 3: TASK RATE 1 : 1.00 — Week 2: 19 — Week 3: 31

Decision 4: TASK RATE 1 : 0.75 — Week 2: 18 — Week 3: 42

Decision 5: TASK RATE 1 : 0.50 — Week 2: 44 — Week 3: 12

Submit

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DEMAND FOR COMMITMENT

Augenblick et al. (2015)

Week 1

1. Allocate tasks for weeks 2 & 3
2. Allocate $$$ among weeks 1 & 4 and 4 & 7

Week 4

1. Allocate tasks for weeks 5 & 6
2. **Commitment choice**

Week 3

...asks (if any)

Week 6

10% from Week 4 (90% from Week 5)			90% from Week 4 (10% from Week 5)
+$10	○	○	
+$6	○	○	
+$4	○	○	
+$2	○	○	
+$1	○	○	
+$0.50	○	○	
+$0.25	○	○	
+$0	○	○	+$0
	○	○	+$0.25
	○	○	+$0.50
	○	○	+$1
	○	○	+$2
	○	○	+$4
	○	○	+$6
	○	○	+$10

DEMAND FOR COMMITMENT

Augenblick et al. (2015)

Timeline of the study

Week 1

Week 2

Week 3

1. Allocate tasks for weeks 2 & 3
2. Allocate $$$ among weeks 1 & 4 and 4 & 7

1. Allocate tasks for weeks 2 & 3
2. Realization (90% chance of an allocation from week 2)
3. Do allocated tasks (if any)

1. Do allocated tasks (if any)

Week 4

Week 5

Week 6

Payment

1. Allocate tasks for weeks 5 & 6
2. **Commitment choice**
3. Allocate $$$ among weeks 4 & 7

1. Allocate tasks for weeks 5 & 6
2. Choice realization
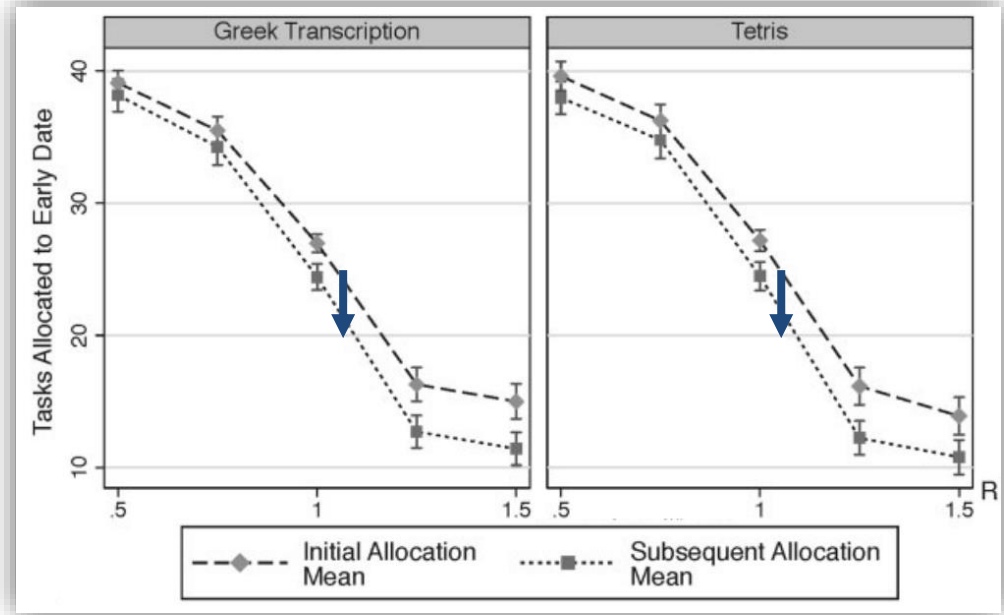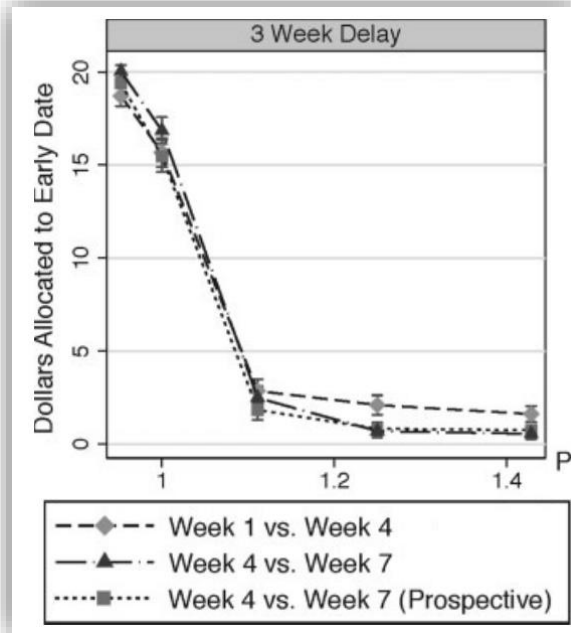3. Do allocated tasks (if any)

1. Do allocated tasks (if any)

Augenblick et al. (2015)

- Evidence of **present-bias** with **effort** but not with **money**

β = 0.97 δ = 0.99

β = 0.89 δ = 1.00

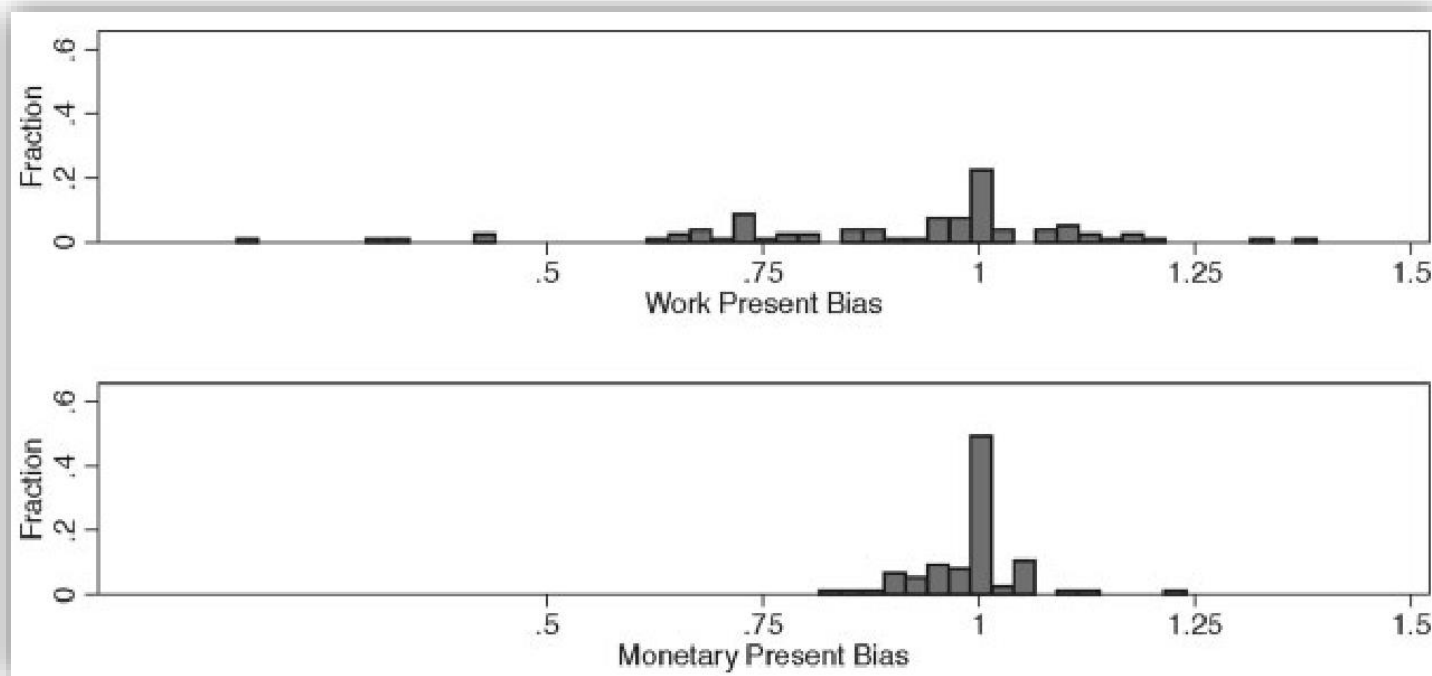**Augenblick et al. (2015)**

- Evidence of **present-bias** with **effort** but not with **money**

Distributions of β

Demand for commitment

Augenblick et al. (2015)

- **59% choose commitment** when it is free
  - Chosen by those with more present bias
- But no willingness to pay for commitment or flexibility
  - Median willingness to pay is **only $0.125 for commitment**
  - 91 percent prefer flexibility when the price of commitment is $0.25
  - 90 percent prefer commitment when the price of flexibility is $0.25
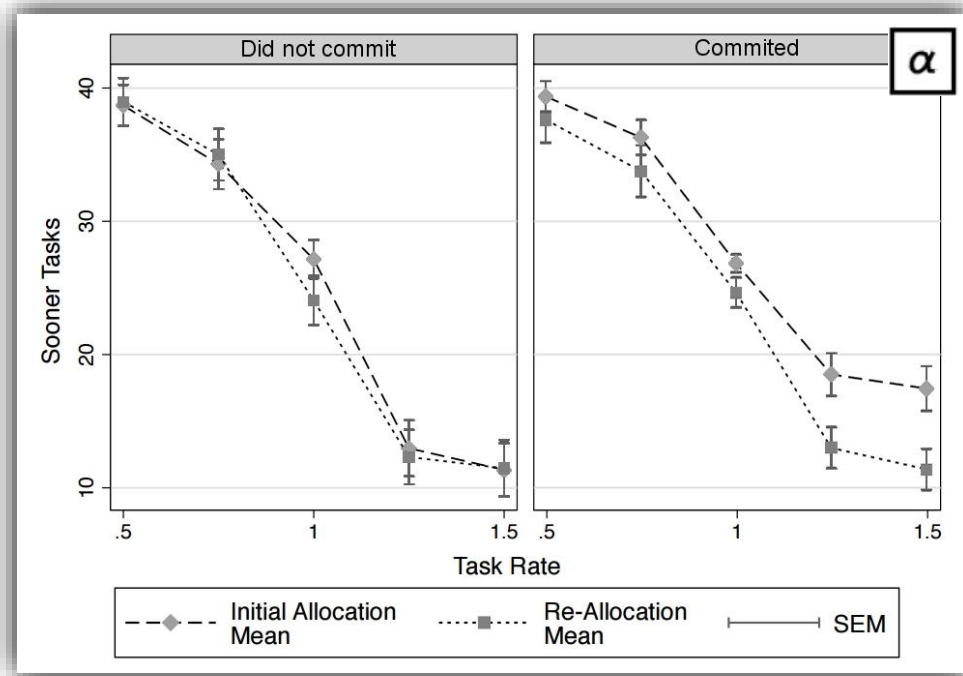
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