



MIT SLOAN SCHOOL OF MANAGEMENT
15.483 CONSUMER FINANCE AND FINANCIAL
PRODUCTS

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Lecture Notes 3

**Behavioral Economics and
Financial Decisions I**

Lecture outline

1. Mis-estimation of probabilities
2. Self-control and temptation
3. Retirement saving example
4. Product design brainstorm
5. Beliefs, Heuristics and Biases

Probabilities, the standard model, biases

- Implicit in decision-making under uncertainty is estimation of the relative likelihood of different outcome.
 - **Implicit:** the pool players example

The canonical rational model: people follow Bayesian law

$$P(A | B) = P(B | A) P(A) / P(B)$$

- Suppose disorder occurs in 1 in 10,000 people, and the test always finds disease if present but has a 1% false positive rate. What are the chances you have disease if you test positive?

Example: A= have disease, B=Test positive for disease. Want $P(A | B)$.

$P(A) = 0.0001$, $P(B) = 0.0101$, $P(B | A) = 1$, so $P(A | B) = 0.0099 \approx 1\%$

Alternative: people do not follow Bayesian law

1. Errors: Probabilistic reasoning is hard
 - [Monte Hall Problem](#) – next slide
2. Bounded rationality → use heuristics or “short-cuts”
 - Heuristics are useful ways to try to implement optimal decisions
 - But use less information, so less accurate decisions, and so can result in biases
 - Example: Heuristics and markets – lines at restaurant

The Monte Hall Problem

Vox. “The math problem that stumped thousands of mansplainers.” Dec 1, 2015. YouTube:

<https://www.youtube.com/watch?v=ggDQXlinbME&start=39&end=68&autoplay=1>

Another probability bias

Self-evaluation Bias and overconfidence

- Overconfidence
 - Overestimation of probability of good outcomes
 - How much you are make post MBA?
 - Does this match with your estimation prior to taking MBA?
 - Overplacement: I am better than average, are you?
 - Overpercision: underestimation of risk
 - Overconfidence test
- Exception: Underconfidence about easy tasks
 - Planning fallacy example
- How might this matter for consumer finance?

Self-evaluation Bias

Overconfidence can arise from specific avenues:

- Self-serving bias
 - A number of belief biases that are different in nature
 - Example: people tend to ascribe their successes to their own ability, but ascribe failures to situational factors and actions of other people or bad luck
- Visceral fit
 - People tend to be emotionally attached to their own belief
 - And base that belief too much on own experience and not enough on other people's experiences or beliefs
 - Example: do you believe in global warming? Ask someone in Singapore vs. ask someone in Boston last week

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The importance of the present

- Consider how much you would pay to have an enjoyable treat right now vs. tomorrow?
 - E.g. hot chocolate? Doughnut? 5 minute break from my lecturing?
 - What does this imply about annual discounting?
- Similar thought experiment: put off unpleasant task to tomorrow, then when tomorrow arrives, put it off again
- Suppose you wanted hot chocolate or doughnut but didn't want the calories and chose to decline. How much you would pay not to observe your neighbor enjoying them?
 - Rational exponential model has no cost of self-control, no suffering from the presence of unchosen options
- People sometimes pay to constrain their future selves

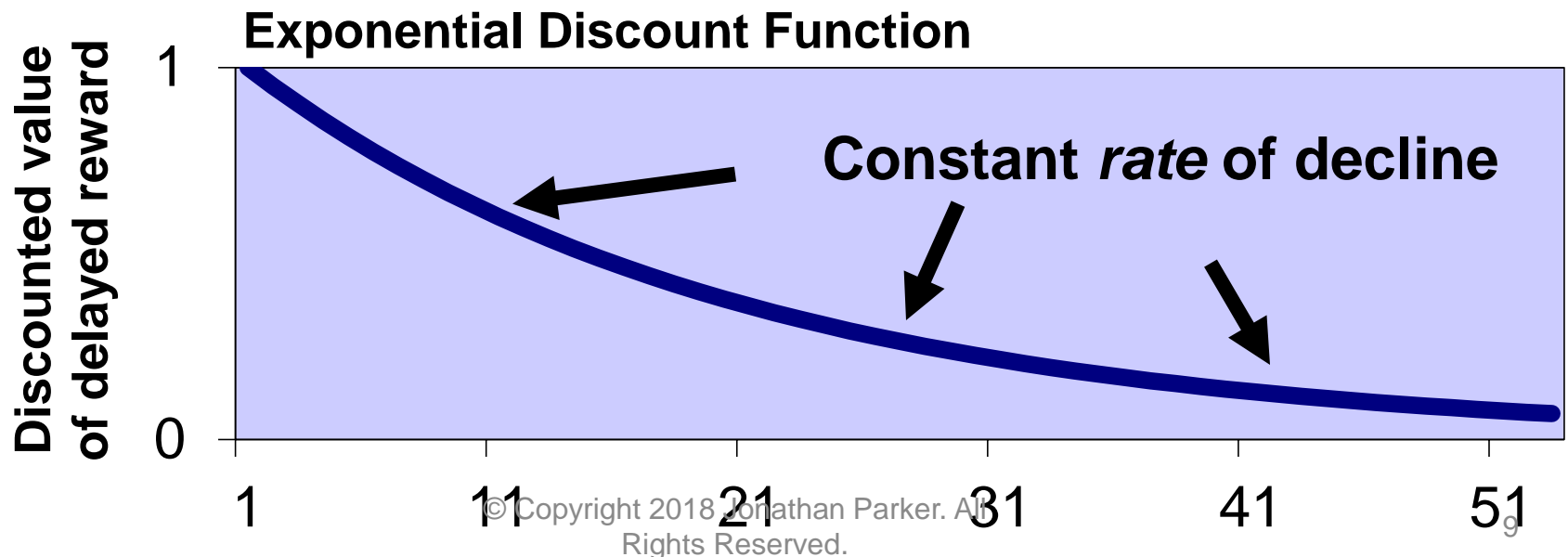
Discounting from our rational model

- Classical functional form: **exponential** functions:
 - Discount factor from rational lecture

$$D(t) = \beta^t \quad \text{or} \quad D(t) = 1, \beta, \beta^2, \beta^3, \dots$$

$$U_t = u_t + \beta u_{t+1} + \beta^2 u_{t+2} + \beta^3 u_{t+3} + \dots$$

- Exponential function is time consistent: ratio of utility at $t+1$ to utility at t is always β



But: an exponential discounting paradox

Suppose people discount at least 1% between today and tomorrow.

Suppose their discount functions were exponential.

Then 100 utils in t years are worth $100 * e^{(-0.01) * 365 * t}$ utils today.

- What is 100 today worth today? 100.00
- What is 100 in a year worth today? 2.55
- What is 100 in two years worth today? 0.07
- What is 100 in three years worth today? 0.00

An Alternative Functional Form

Quasi-hyperbolic discounting

(Phelps and Pollak 1968, Laibson 1997)

$$D(t) = 1, \beta\delta, \beta\delta^2, \beta\delta^3, \dots$$

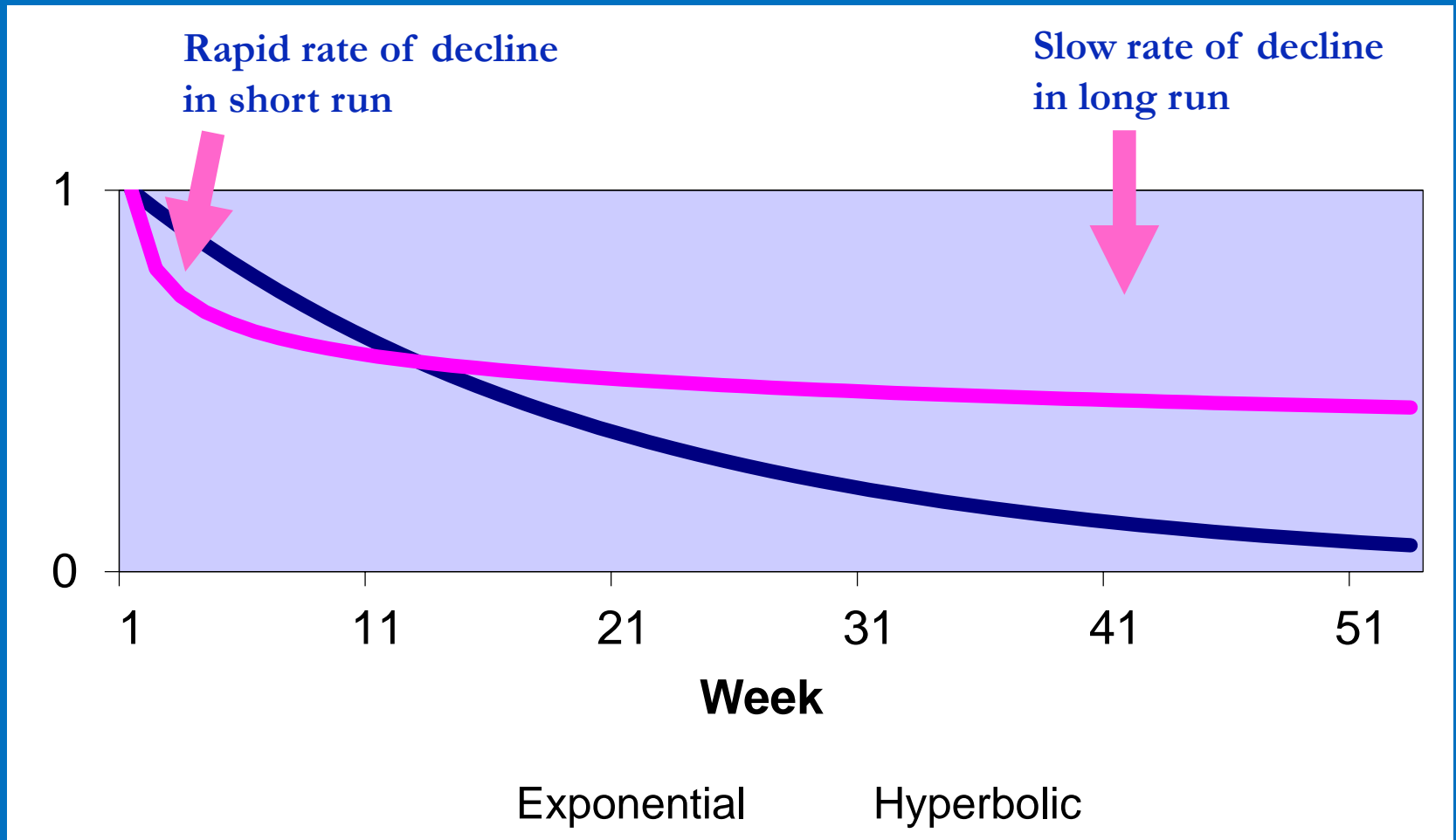
$$U_t = u_t + \beta\delta u_{t+1} + \beta\delta^2 u_{t+2} + \beta\delta^3 u_{t+3} + \dots$$

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

β uniformly discounts all future periods relative to today

δ exponentially discounts all future periods relative to the period before

Hyperbolic Discount Functions



A basic and quite useful version

Let $\beta = 1/2$ and $\delta = 1$

- Discounted utility function becomes

$$U_t = u_t + 1/2 [u_{t+1} + u_{t+2} + u_{t+3} + \dots]$$

- Discounted utility from the perspective of time $t+1$.

$$U_{t+1} = u_{t+1} + 1/2 [u_{t+2} + u_{t+3} + \dots]$$

- Discount function reflects **dynamic inconsistency**: preferences held at date t do not agree with preferences held at date $t+1$

Application to massages (why not money?)

NPV in current minutes

$$\beta = \frac{1}{2} \text{ and } \delta = 1$$

Amount of Massage

A 15 minutes now

B 20 minutes in 1 hour

C 15 minutes in 1 week

D 20 minutes in 1 week plus 1 hour

Present value

15 minutes now

10 minutes now

7.5 minutes now

10 minutes now

Preference reversal! What you want in a week now is different from what you will actually want in a week.

Do people understand their changing preferences?

- If people are **naive**: mistakenly believe that their plans to be patient will be perfectly carried out. They think that $\beta=1$ in the future.
 - “I will start doing Yoga next week, though I’ve failed to do so every week for five years.”
 - Every period they will consume too much and save too little: “I will start saving for retirement next years, this year I am vacationing in Aruba”
- If people are **sophisticated**: know that their plans to be patient tomorrow won’t pan out.
 - “I won’t start Yoga next week, though I would like to”
 - Still save too little now, because they know they will just spend more next vacation if they save more instead of spending on a nice vacation now.

(Strotz, 1957)

There is value in providing commitment

- If people are **naive**: mistakenly believe that their plans to be patient will be perfectly carried out. They think that $\beta=1$ in the future.
 - Will see no need for commitment
 - Products like Social Security have value, but voluntary products do not
- If people are **sophisticated**: know that their plans to be patient tomorrow won't pan out.
 - Will choose strategies to commit their future selves to be patient
 - Products like commitment saving devices have value
- Can be partway in between (O'Donoghue and Rabin, 2001)

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Application: Retirement saving

Change in employee enrollment for 401k saving plans

One group gets standard choices for 401k contributions which requires active enrollment or no 401k saving

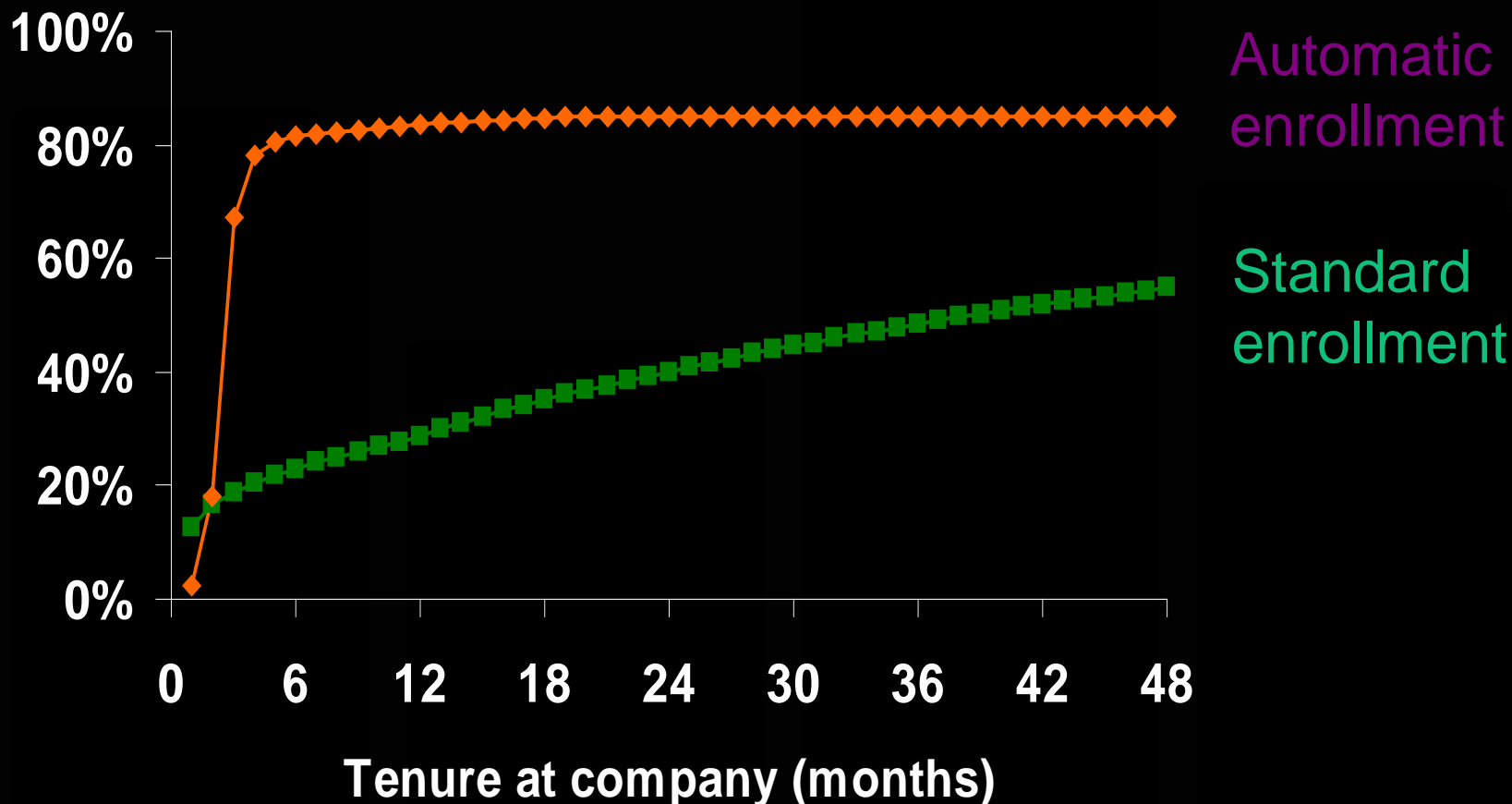
- Small cost today to save a lot tax-free and raise standard of living in the future
- If “hyperbolic” may value the cost today much more than the saving in the future.

One group gets new automatic enrollment:

- Welcome to the company, if you don't do anything
 - You are automatically enrolled in the 401(k)
 - You save 2% of your pay
 - Your contributions go into a default fund
 - Call this phone number to opt out of enrollment or change your investment allocations
- Small cost is now about **not** saving instead of saving

Small change in present costs has **big** effects on saving

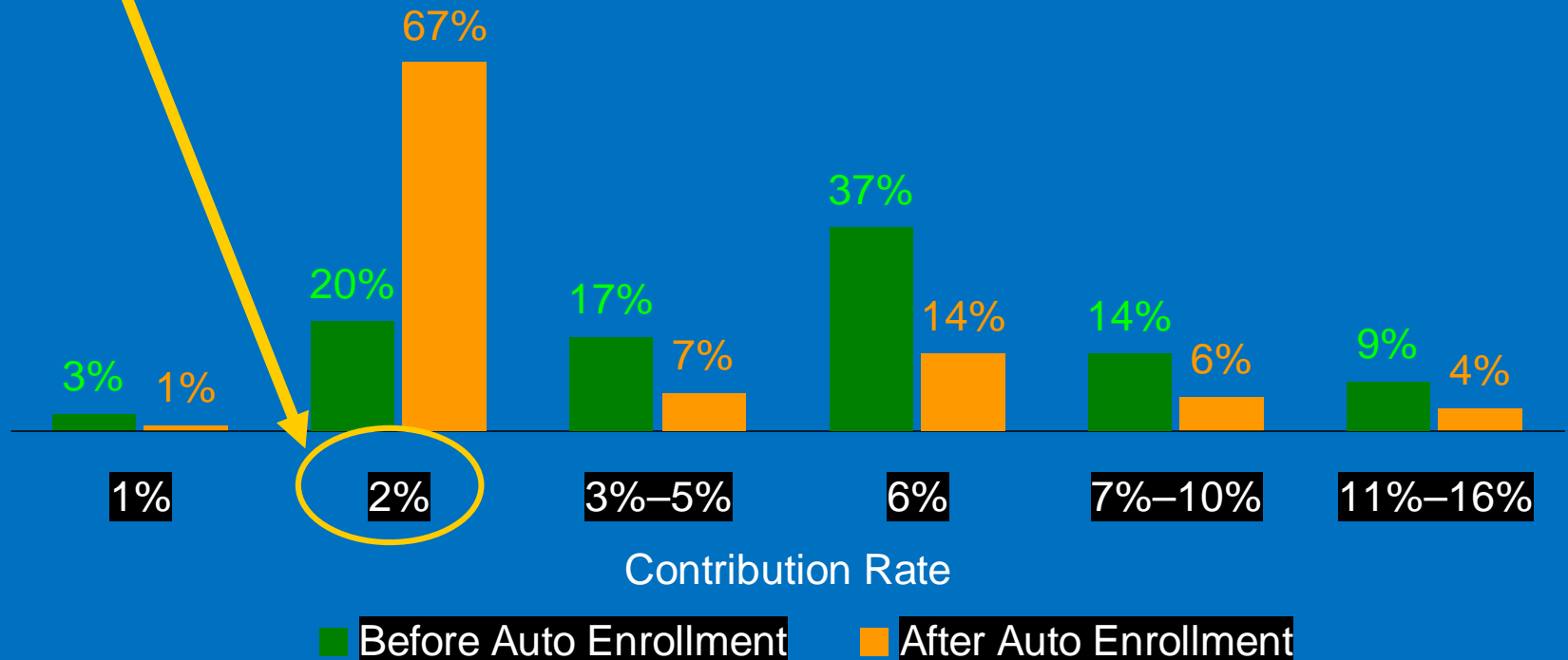
401(k) participation by tenure at firm



Potential Harm: Among enrolled, employees enrolled under automatic enrollment cluster at default contribution rate.

Default contribution rate under automatic enrollment

Fraction of Participants at different contribution rates:



Do people like a little paternalism?

Survey given to workers who were subject to automatic enrollment:

“You are glad your company offers automatic enrollment.”

Agree? Disagree?

- Enrolled employees: 98% agree
- Non-enrolled employees: 79% agree
- All employees: 97% agree

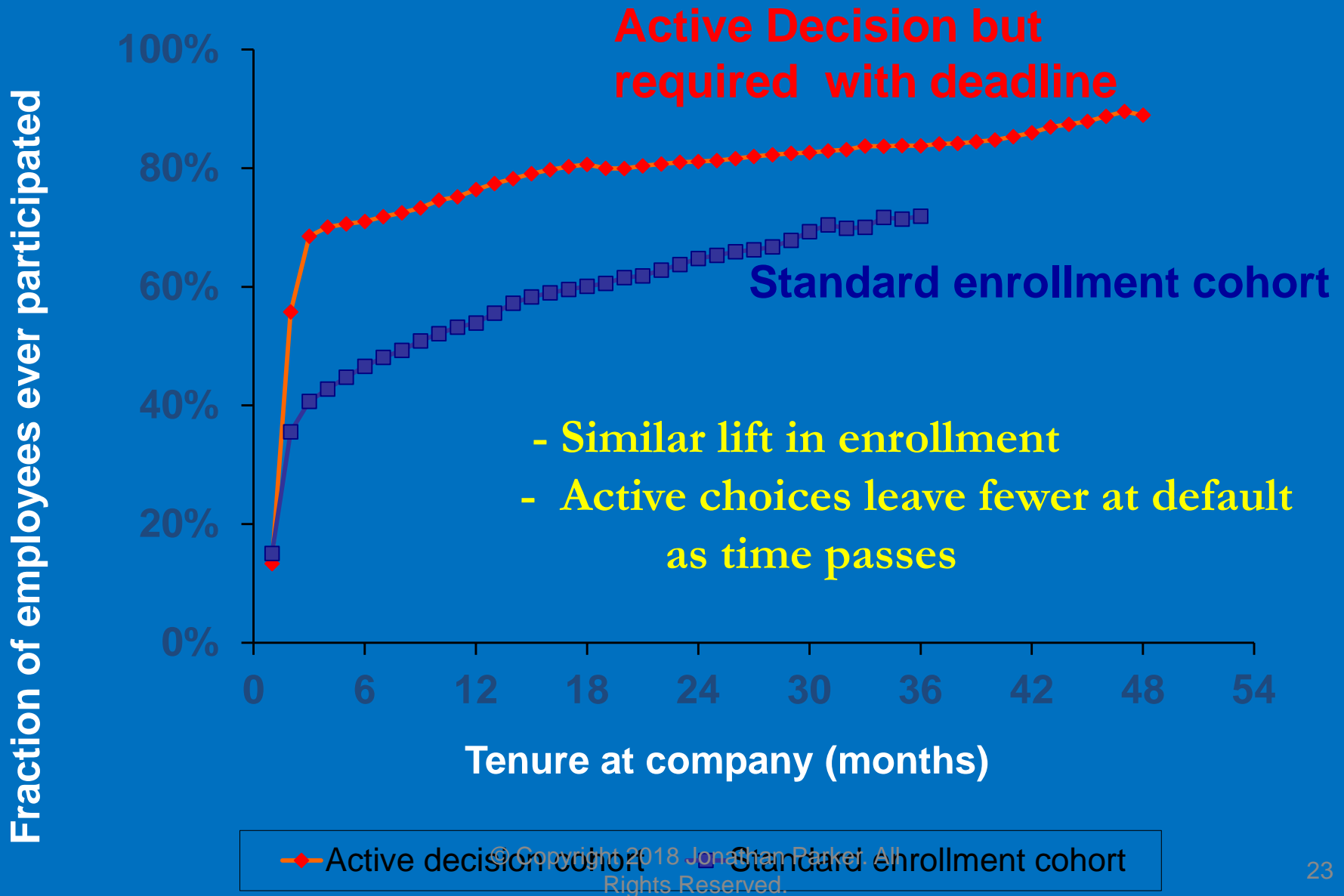
Maybe do better with **forced** active decision

Carroll, Choi, Laibson, Madrian, Metrick (2004)

Active decision mechanisms require employees to make an active choice about 401(k) participation.

- Welcome to the company
- You are *required* to submit this form within 30 days of hire, *regardless* of your 401(k) participation choice
- If you don't want to participate, indicate that decision
- If you want to participate, indicate your contribution rate and asset allocation
- Being passive is *not* an option

401(k) Participation by Tenure



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Suppose people are sophisticated and
suffer time inconsistent preferences

Can we design and sell a product to them?

Suppose people are naïve and suffer
time inconsistent preferences

Can we design and sell a product to them?

To their employers?

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1. Beliefs, Heuristics and Biases

A set of commonly-found biases in probabilistic reasoning, many are plausibly related to each other:

- A. Salience and availability heuristics
- B. Representative and base rate bias
- C. Law of small numbers
- D. Projection bias
- E. Magical beliefs
- F. Causes of irrationality

Probability Mis-estimation Redux

A. Salience and the availability heuristic

- Overestimate probability of well-publicized or more salient outcomes
 - Common source of error in experiments
 - How do you make inference about frequency from
 - **limited** and
 - **selected** data?
 - Examples/effects on behavior
 - Increased purchase of earthquake insurance following quake
 - Interpretation: buying too much insurance? Or useful reminder?
 - CA lottery: matching 6 numbers b/w 1 and 51 to win
 - How do we know they overestimate?
 - If people use their own experiences to improve probability estimation, then this bias matters most for most infrequently experienced events where true probabilities are not learned
 - How might this matter for consumer finance?

B. Representativeness & Base Rate Bias

- Representativeness: how representative something is in a set affects how likely it is perceived to belong to that set
 - Example: Sarah loves to listen to New Age music and faithfully reads her horoscope each day. In her spare time, she enjoys aromatherapy and attending a local spirituality group. Based on the description above, is Sarah more likely to be a school teacher or a holistic healer?
 - Teachers are **much** more common than holistic healers. People tend to underweight the **base rate**
 - If you know Sarah was a holistic healer, this seems like a likely description. **Does not** imply the reverse.
- Base rate bias can occur without representativeness
 - Example: disease test a few slides ago
- How might this matter for consumer finance?

C. The Law of Small Numbers

- Heuristic: mis-apply infinite population ideas to small samples
 - The “gambler’s fallacy” effect
 - Coin toss situation: play 10 times, should be 5 H, 5 T. So if see 3 H in a row, what is the probability of H for the next draw? 0.5? Or 0.286 (2/7)?
 - Central limit theorem: share of heads is one half
 - But number of heads is a random walk (with drift)
 - The “hot hand ” effect
 - Basketball player’s chance of hitting a shot is greater following a hit than following a miss on the previous shot
 - Synthesis → lead to both effect
 - In the short term investors follow the gambler’s fallacy believing that a series of identical signal like stock price rising will be followed by a fall → do not invest (underact)
 - However after a longer sequence, the investors overinfer and expect a trending regime (expect stock price continue to rise) → overinvest
 - These inferences are correct if occasional (unobserved) shifts in “regime” – e.g. is the basketball player injured today
 - How might this matter for consumer finance?

D. Projection Bias

- People expect their future preference to be too close to the present ones
 - Example: A study of office workers. These workers were asked to select a healthy snack (apple) or an unhealthy snack (French fries) to be delivered in the late afternoon
 - One group was asked before lunch → 78% chose fries
 - One group was asked after lunch → 42% chose fries
- Hindsight bias: events seem more predictable in retrospect than in prospect

E. Magical Beliefs

- Tempting fate: arousal and misattribution of probability
 - If you don't take umbrella to work, it is bound to rain?
 - More likely to be cold called if you don't read case?
- Disgust contagion: expanding feelings about one thing to surrounding
 - Really a preference
 - Examples:
 - Paying a lot for guitar Eric Clapton payed (like the music, so enjoy owning the guitar)
 - 2010 BP oil spill in the Gulf of Mexico → bird coated in oil → anti-BP and other oil companies/anti-British
- The Full-Magical: Elvis is still alive, and other superstitions

F. Why?

Causes of biased belief processing:

- Emotion; clouds processing
- Memory; forget pertinent information
- Cognitive dissonance; get disutility from certain beliefs
 - E.g. “What I am doing is really dangerous as well as fun”
- Threat to self-esteem, get utility from certain beliefs
 - E.g. “I am really good at ...”
- Failure of self-regulation
- Decision fatigue
 - Lots of evidence that decision quality declines when people are tired or distracted
- Unhappiness, interpersonal rejection, self-destructive behavior
- Evolutionary arguments = optimal in some environments . . .



ADAPTIVE MARKETS

Financial Evolution at the
Speed of Thought

ANDREW W. LO

Conclusions

- Overconfidence and time-inconsistent preferences seem to be widespread
 - Present costs much more important than future benefits
 - Slightly delayed costs are not so important
 - People may demand products -- e.g. commitment savings -- to overcome
- Lessons from design brainstorm
- A set of probability & decision errors shows in experiments & observed in human behavior
 - Arguments why sub-optimal saving, portfolios, borrowing, contract choice etc.

Implication:

1. If these decision errors cause poor outcomes
2. If you can explain and demonstrate this
3. Then and you can potentially create value with products to eliminate these biases in decision making

Be careful. Test, evaluate, study before concluding a behavior is a mistake. And before concluding it is optimal.

Appendix

Question	Your Answer	Correct Answer
1 Martin Luther King -		39
2 Nile River	- KM	6736.883 KM
3 OPEC	-	13
4 Old Testament	-	39
5 Moon diameter	- KM	3475.44 KM
6 747 weight	- KG	176904 KG
7 Mozart	-	1756
8 Elephant	-	645
9 Tokyo-London	- KM	9588.031 KM
10 Ocean depth	- M	11033.1504 M

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