2019 Investment Seminar
October 27, 2019
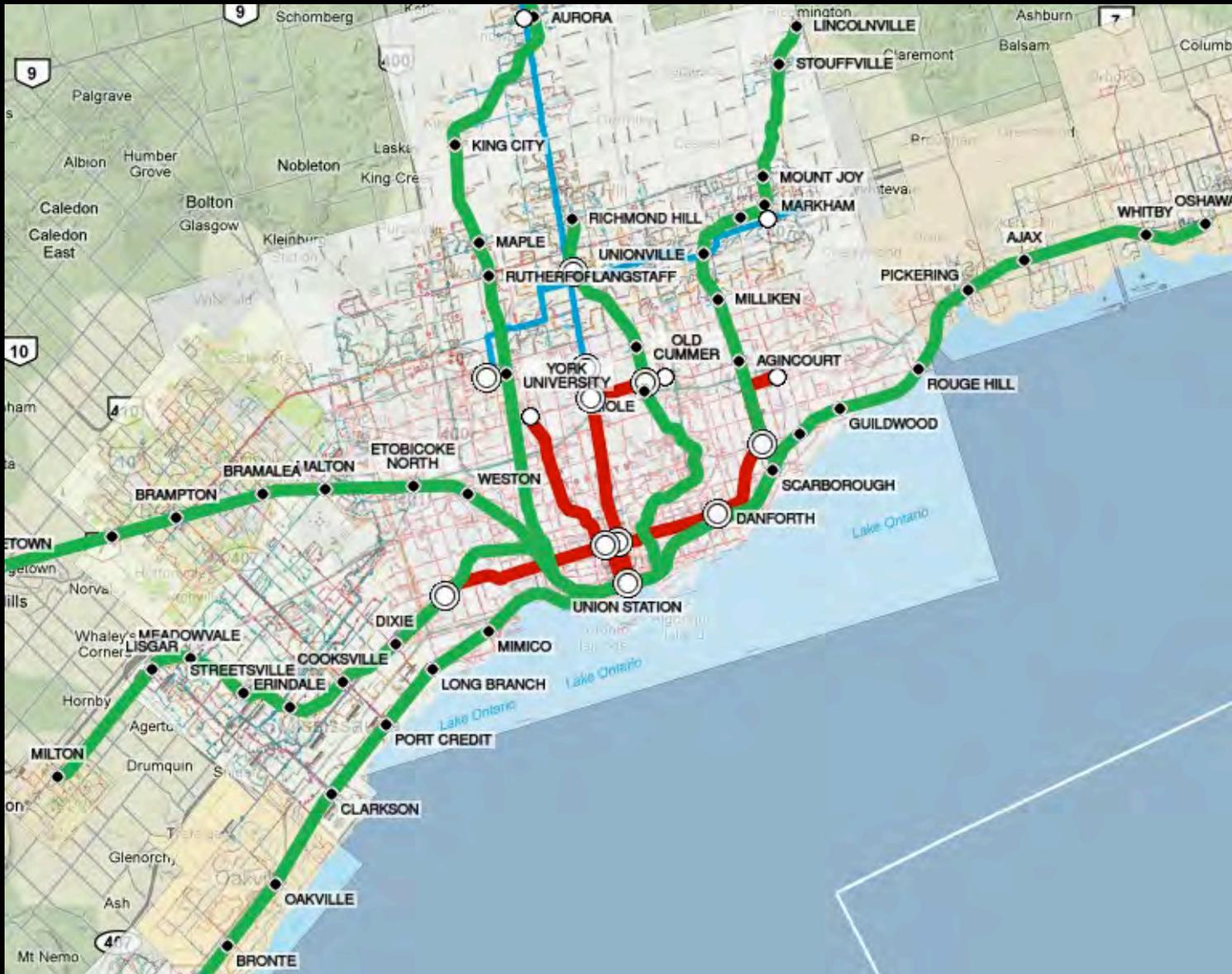### Toronto, Canada

General Session 1: Keynote Economic Address
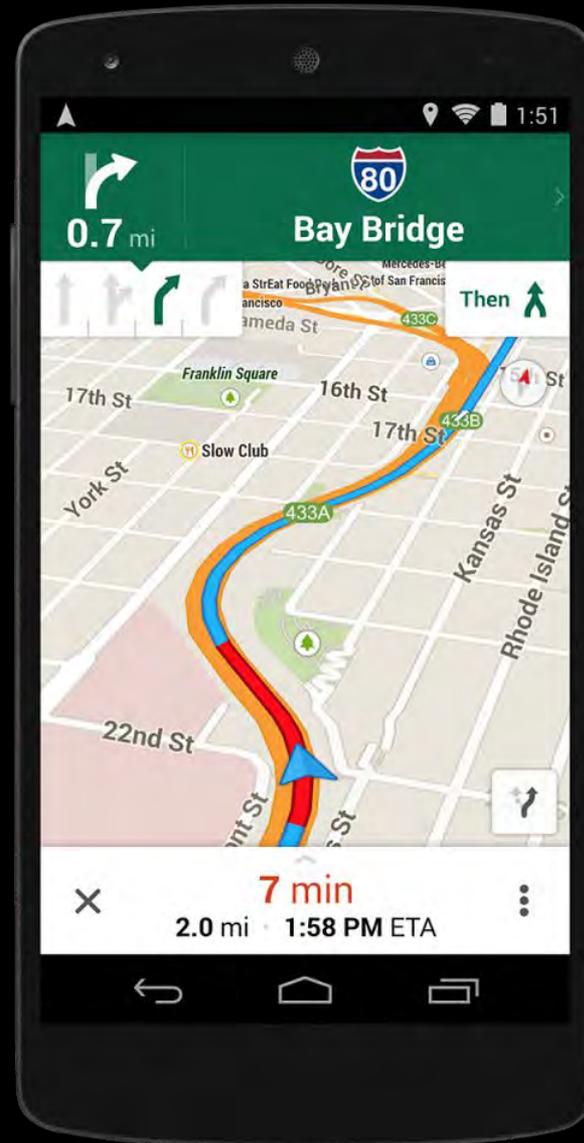
My Drive Home From Work

My Last Mile Problem

My Last Mile Problem

Focusing on the Last Mile = Focusing on Implementation!

First Mile	Last Mile
• Strategy • Focus on the *what*: played out in boardrooms, research and development facilities, and planning committee sessions • New product development • Policy development • Welfare program design	• Tactics • Focus on the *how* and *when* played out in retail spaces, customer service locations, webpages, and online/telephone support • New product adoption and use • Policy implementation and delivery • Welfare program adoption and take-up

Source: Soman, D. (2015). *The Last Mile*, p. 11

Can Understanding Human Irrationality Improve Actuarial Science?

Improving prediction & optimizing profits by identifying market inefficiencies

Avni M. Shah

Assistant Professor in Marketing
University of Toronto

The Two Systems of Thinking

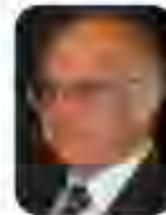"A bat and a ball cost $1.10 in total. The bat costs $1 more than the ball. How much does the ball cost?"

System 1 Thinking

"A bat and a ball cost $1.10 in total. The bat costs $1 more than the ball. How much does the ball cost?"

"People are not accustomed to thinking hard, and are often content to trust a plausible judgement that quickly comes to mind."
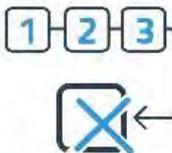
Daniel Kahneman,
Nobel Prize Winner

System 1

Fast

Unconscious

Automatic

Everyday
Decisions
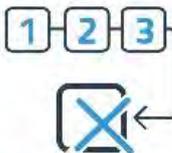
Error prone

System 2

24	Slow
	Conscious
	Effortful
	Complex Decisions
1 2 3	Reliable

System 1	System 2
Fast	Slow
Unconscious	Conscious
Automatic	Effortful
Everyday Decisions	Complex Decisions
Error prone	Reliable
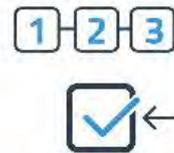
System 1	System 2
Fast	Slow
Unconscious	Conscious
Automatic	Effortful
Everyday Decisions	Complex Decisions
Error prone	Reliable

Who are we accounting for?

15.B.2 Consider an E Box with consumers w/ C-D utility:

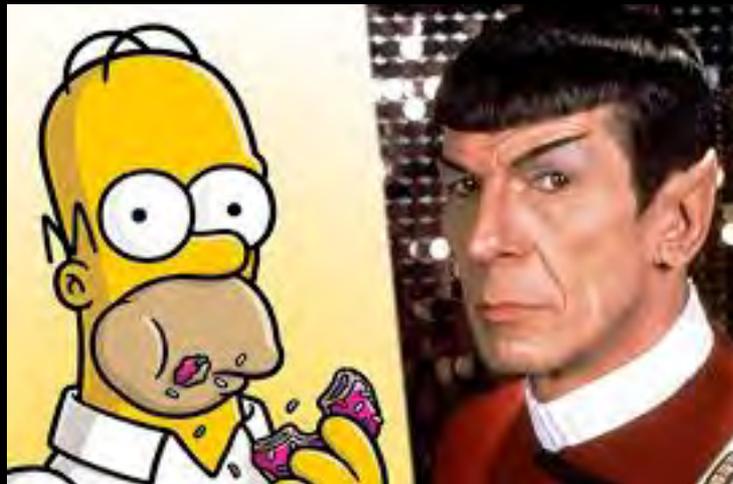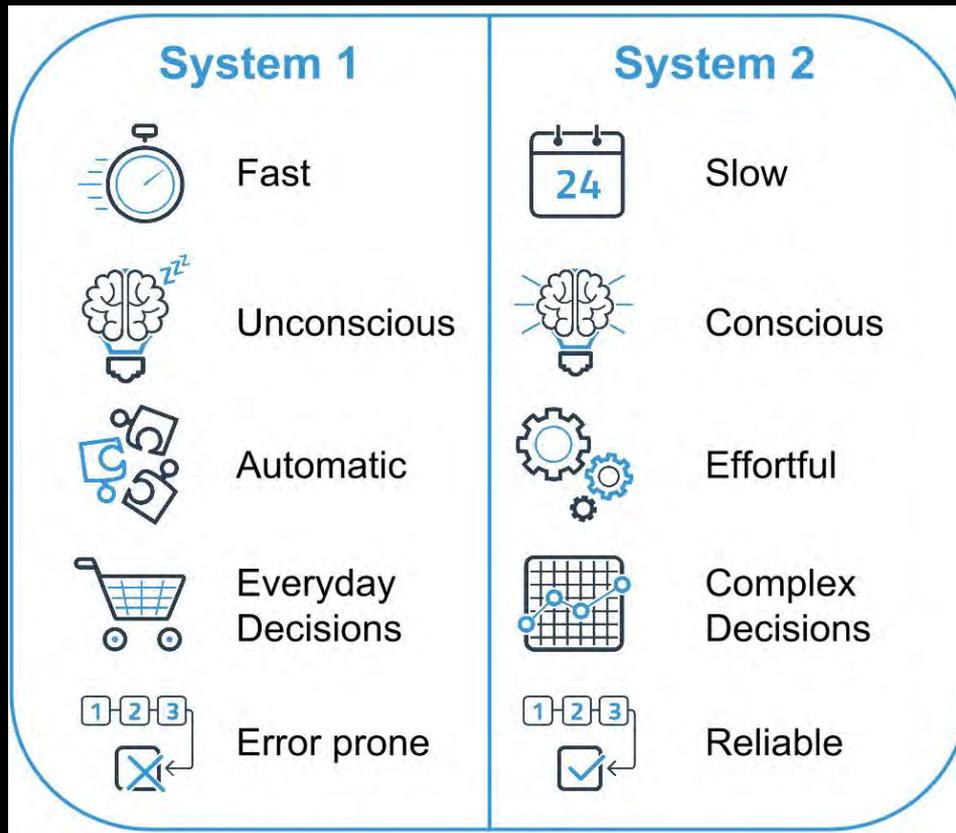$$u_1(x_{11}, x_{21}) = x_{11}^\alpha x_{21}^{1-\alpha} \qquad u_2(x_{12}, x_{22}) = x_{12}^\beta x_{22}^{1-\beta} \qquad (\omega_{1i}, \omega_{2i}) >> 0$$

Solve for equilibrium price ratio + allocations.

How do these change w/ a differential Δ in ω_{11}?

Consumer 1: $\max_x U(x) : x_{11}^\alpha x_{21}^{1-\alpha} - \lambda[p_1 x_{11} - p_2 x_{21} - p\omega_1]$

FOC: $\partial u/\partial x_{11}: \alpha x_{11}^{\alpha-1} x_{21}^{1-\alpha} - \lambda p_1 = 0$

$\partial u/\partial x_{21}: (1-\alpha) x_{11}^\alpha x_{21}^{-\alpha} - \lambda p_2 = 0$

$$\frac{\alpha x_{11}^{\alpha-1} x_{21}^{1-\alpha} = \lambda p_1}{(1-\alpha) x_{11}^\alpha x_{21}^{-\alpha} = \lambda p_2} \Rightarrow \frac{\alpha}{(1-\alpha)} x_{11}^{-1} x_{21} = \frac{p_1}{p_2} \Rightarrow x_{21} = \frac{p_1}{p_2} x_{11}\left(\frac{1-\alpha}{\alpha}\right)$$

$p_1 x_{11} + p_2 x_{21} - p\omega_1 \Rightarrow p_1 x_{11} + p_2\left[\frac{p_1}{p_2} x_{11}\left(\frac{1-\alpha}{\alpha}\right)\right] - p\omega_1$

$$p_1 x_{11}\left[\frac{1}{\alpha}\right] = p\omega_1 \Rightarrow x_{11} = \frac{\alpha p\omega_1}{p_1}, \quad x_{21} = \frac{(1-\alpha) p\omega_1}{p_2}$$

15.B.2 Consider an E Box with consumers w/ C-D utility:

$u_1(x_{1i}, x_{2i}) = x_{1i}^\alpha x_{2i}^{1-\alpha}$ $u_2(x_{1i}, x_{2i}) = x_{1i}^\beta x_{2i}^{1-\beta}$ $(w_{1i}, w_{2i}) >> 0$

Solve for equilibrium price ratio + allocations.

How do these change w/ a differential Δ in w_{1i}?

consumer 1: $\max_x u(x) \ x_{1i}^\alpha x_{2i}^{1-\alpha} - \lambda[p_1 x_{1i} - p_2 x_{2i} - p w_1]$

FOC: $\partial u/\partial x_{1i}: \alpha x_{1i}^{\alpha-1} x_{2i}^{1-\alpha} - \lambda p_1 = 0$

$\partial u/\partial x_{2i}: (1-\alpha) x_{1i}^\alpha x_{2i}^{-\alpha} - \lambda p_2 = 0$

$\dfrac{\alpha x_{1i}^{\alpha-1} x_{2i}^{1-\alpha} = \lambda p_1}{(1-\alpha) x_{1i}^\alpha x_{2i}^{-\alpha} = \lambda p_2} \Rightarrow \dfrac{\alpha}{(1-\alpha)} x_{1i}^{-1} x_{2i} = \dfrac{p_1}{p_2} \Rightarrow x_{2i} = \dfrac{p_1}{p_2} x_{1i} \left(\dfrac{1-\alpha}{\alpha}\right)$

$p_1 x_{1i} + p_2 x_{2i} = p w_1 \Rightarrow p_1 x_{1i} + p_2 \left[\dfrac{p_1}{p_2} x_{1i} \left(\dfrac{1-\alpha}{\alpha}\right)\right] = p w_1$

$p_1 x_{1i} \left[\dfrac{1}{\alpha}\right] = p w_1 \Rightarrow x_{1i} = \dfrac{\alpha p w_1}{p_1}, \ x_{2i} = \dfrac{(1-\alpha) p w_1}{p_2}$

$$\max_{x_i^t \in X_i} \sum_{t=0}^{\infty} \delta^t \sum_{s_t \in S_t} p(s_t) \, U\left(x_i^t | s_t\right).$$

- X_i is set of "life-time strategies", S_t is set of state spaces
- $p(s_t)$ are rational beliefs, $\delta \in (0, 1)$ is time-consistent discount factor
- $u(\cdot, s, t)$ is true utility at time t in state s

Plan and account for humans, not just for econs....

Humans ≠ Econs

- The gap is widening!

  - Econs are getting smarter for a particular set of problems, humans are not!

  - What is irrationality?

    - Lack of compliance with normative decisions
    - Lack of compliance with own decisions
    - Belief that humans = econs

Updating notions of rationality

1.0   People do silly things

Updating notions of rationality

1.0   People do silly things

2.0   I'm silly because I expected others not to be silly
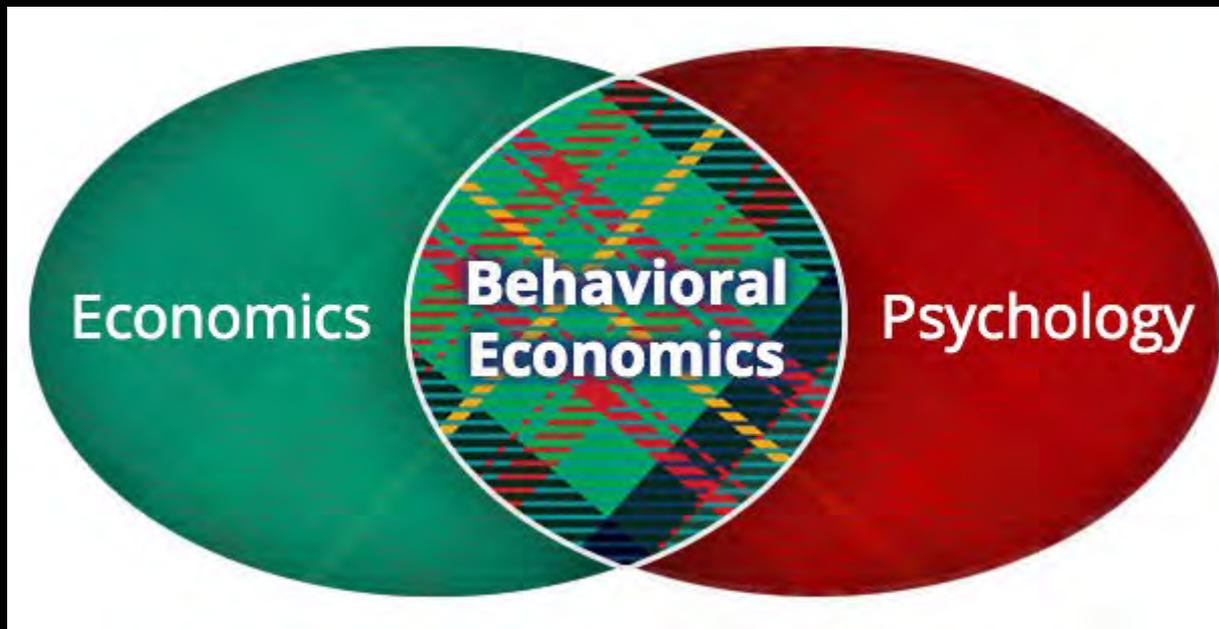
Updating notions of rationality

1.0   People do silly things

2.0   I'm silly because I expected others not to be silly

3.0   I'm silly because I didn't plan for others to be silly

What is Behavioural Economics?

A method of economic analysis that applies psychological insights into human behaviour to explain economic decision-making

Outline for Today

Outline for Today

- **Building a More Behaviourally Informed Future**
    - Limited Attention
    - Present Bias/Myopia
    - Mental Accounting
    - Emotions
    - Availability Bias & Herding
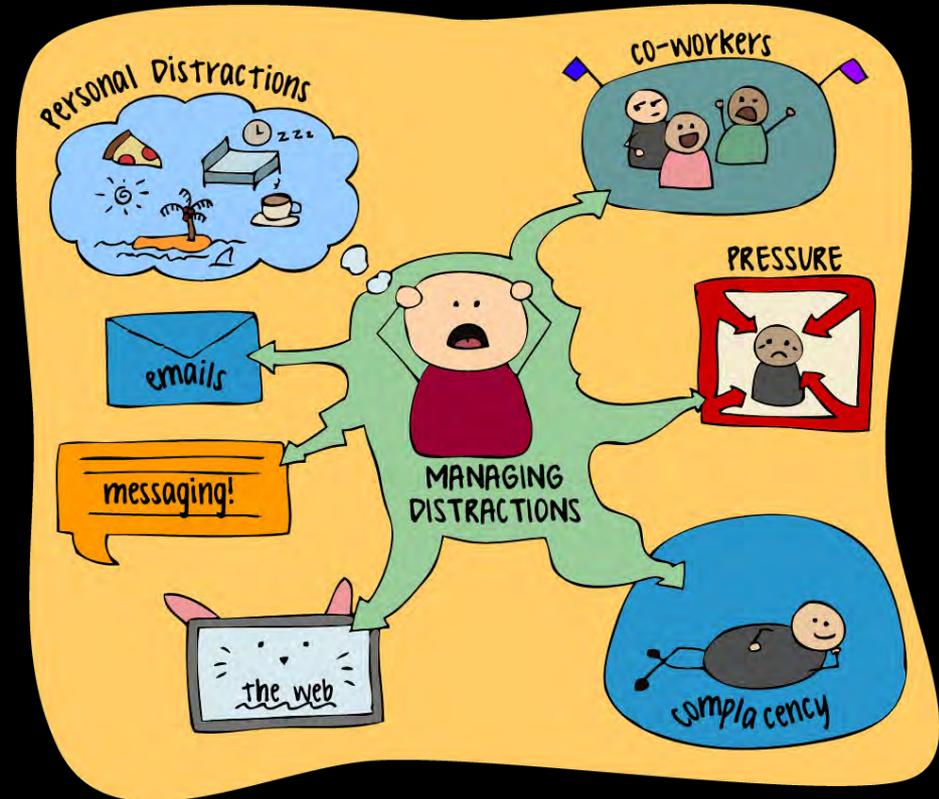   - Choice Overload

Outline for Today

- **Building a More Behaviourally Informed Future**
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  - Emotions
  - Availability Bias & Herding
  - Choice Overload

- **Pension Reform in Mexico: Customizing Interventions**
  - Using the combined powers of BE, Big Data, and AI/ML for a (more) optimal tomorrow
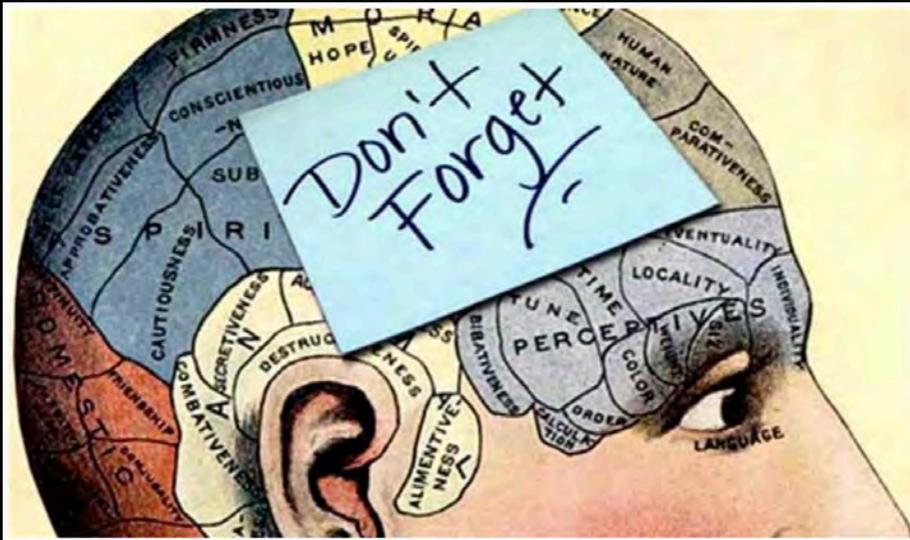
The Problem of Limited Attention

The Problem of Limited Attention
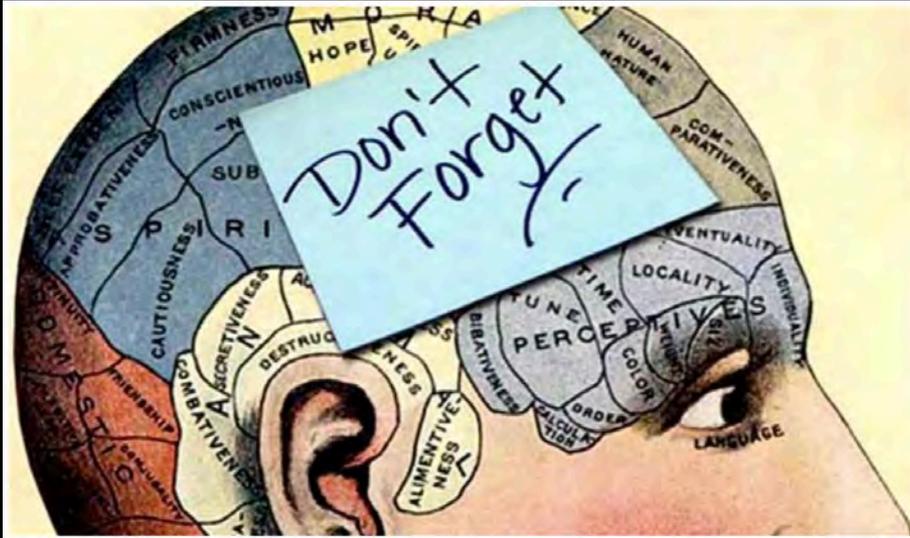
The Problem of Limited Attention

Never worry about paying your bill on time.

The Problem of Limited Attention

Automated and Quick Approvals

Users can monitor up-coming approvals, close bottlenecks and prioritize any approvals that are urgent or overdue. Access to an approval is only accessible to those on the approval routing chain. Unlike other approval management systems, users have more control to determine accessibility on a per approval basis.

Automatic notifications are sent when a user has an action to complete and in-app features connect teams and encourage users to maintain consistency in communications around an approval. Administrators can find the status of any approval and support the resolution of bottlenecks..

Present Bias & Myopia

Present Bias & Myopia
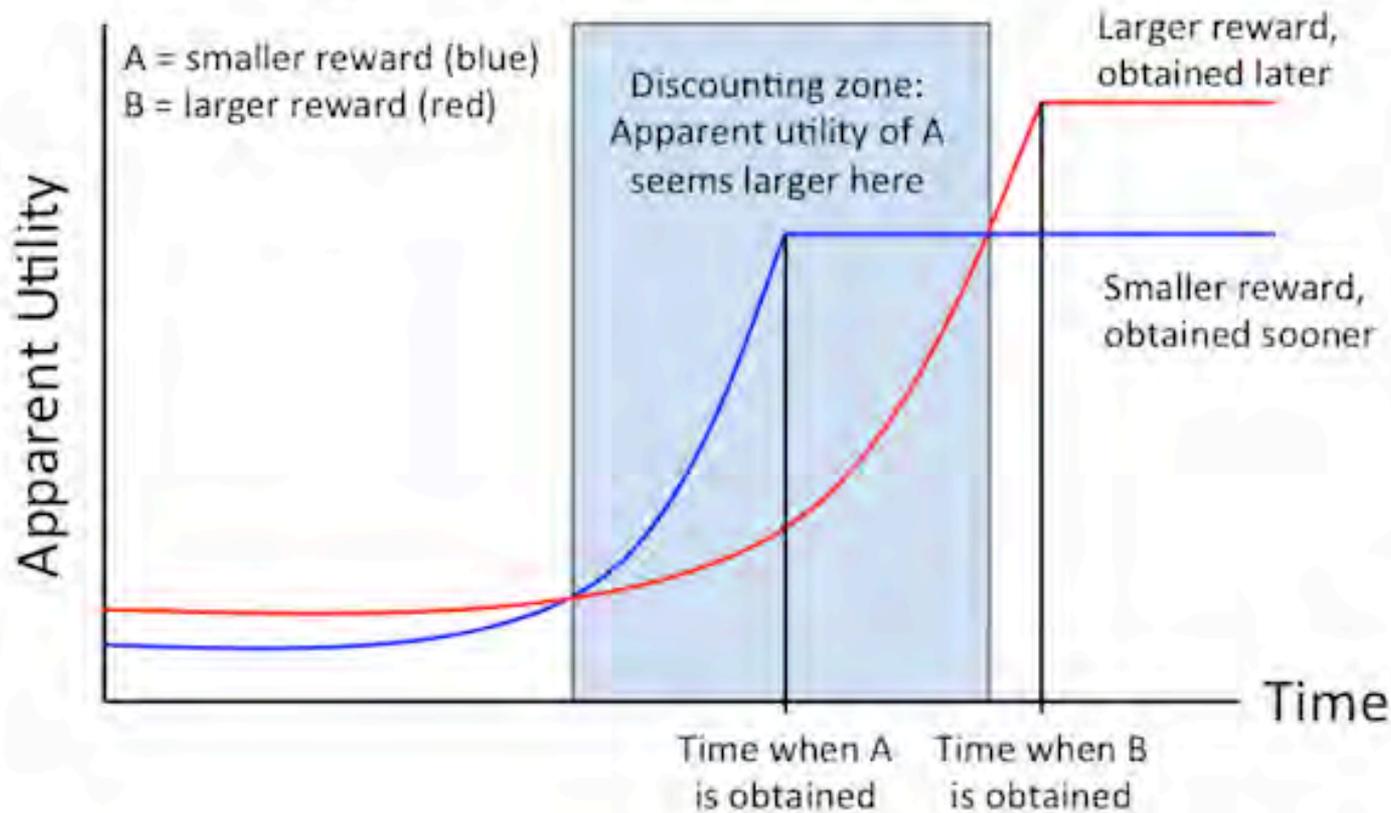
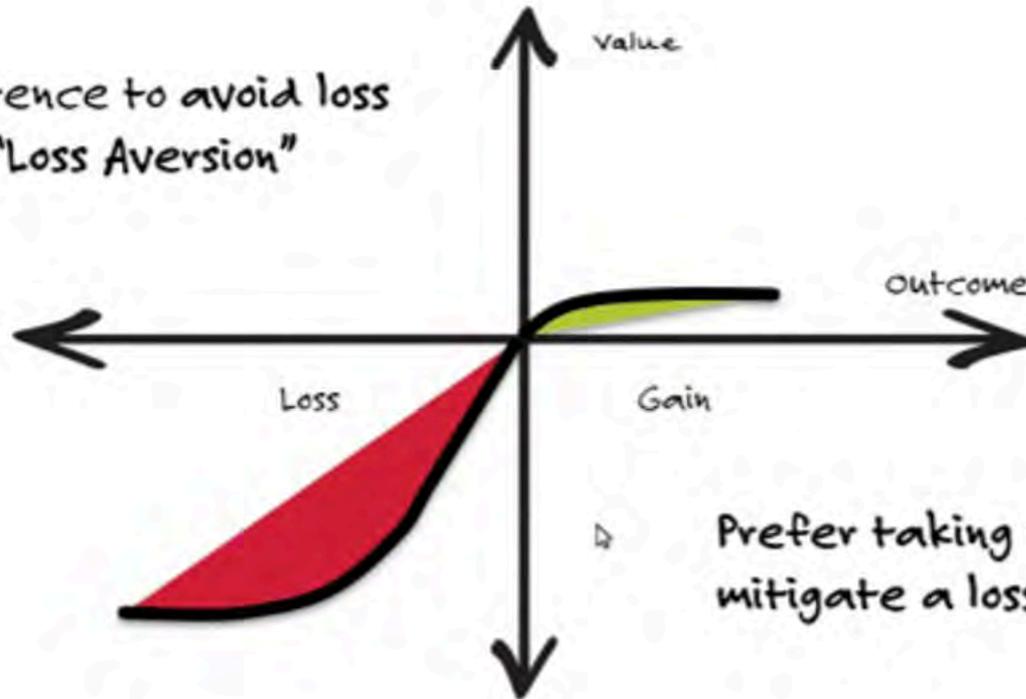# Humans really hate losing!

The importance of reference points...

Use Losses to our Advantage!

Accounting as a way to evaluate and balance spending decisions

Mental Accounting Matters

RICHARD H. THALER
Graduate School of Business, University of Chicago, USA

ABSTRACT

Mental accounting is the set of cognitive operations used by individuals and households to organize, evaluate, and keep track of financial activities. Making use of research on this topic over the past decade, this paper summarizes the current state of our knowledge about how people engage in mental accounting activities. Three components of mental accounting receive the most attention. This first captures how outcomes are perceived and experienced, and how decisions are made and subsequently evaluated. The accounting system provides the inputs to be both *ex ante* and *ex post* cost–benefit analyses. A second component of mental accounting involves the assignment of activities to specific accounts. Both the sources and uses of funds are labeled in real as well as in mental accounting systems. Expenditures are grouped into categories (housing, food, etc.) and spending is sometimes constrained by implicit or explicit budgets. The third component of mental accounting concerns the frequency with which accounts are evaluated and 'choice bracketing'. Accounts can be balanced daily, weekly, yearly, and so on, and can be defined narrowly or broadly. Each of the components of mental accounting violates the economic principle of fungibility. As a result, mental accounting influences choice, that is, it matters. Copyright

End-of-Day Effect and preference for longshots is suggestive of the importance of reference points...

McGlothlin 1956; Ali 1977

End-of-Day Effect and preference for longshots is suggestive of the importance of reference points…

McGlothlin 1956; Ali 1977

The last race on one day is not fundamentally different yet individuals have a propensity to want to have a zero-daily profit

Calendar Effects as a product of mental accounting

Any market anomaly or economic effect which appears to be related to the calendar.

Are investors more likely to make risky decisions at the end of a period?

"Prosper is one of the pioneers of peer-to-peer, or marketplace lending, which connects good-credit borrowers
with investors who can choose to fund their loans"

Are investors more likely to make risky decisions at the end of a period?

Competitive Returns

AA	A	B	C	D	E	HR
5.48%	6.78%	9.47%	11.14%	10.74%	11.35%	10.78%

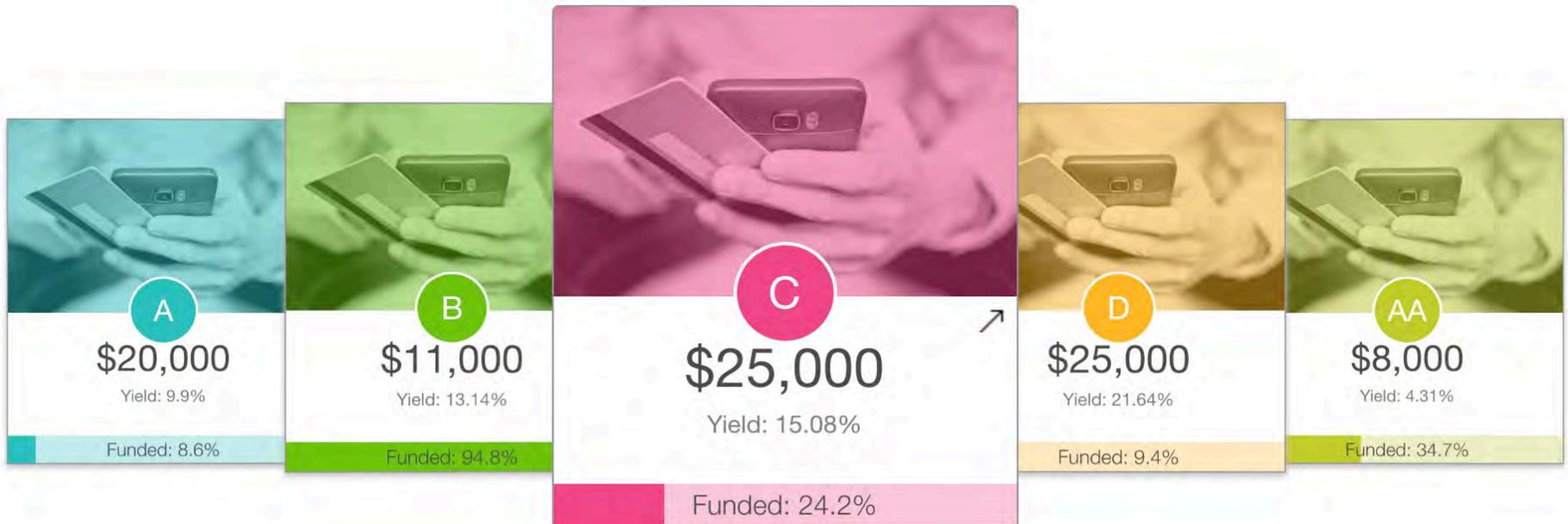Lower Risk ————————————————————→ Higher Risk

Seasoned Returns* by Prosper Rating

Are investors more likely to make risky decisions at the end of a period?

Browse loans[3]

Build a portfolio by searching for individual loans that meet your criteria

A
$20,000
Yield: 9.9%
Funded: 8.6%

B
$11,000
Yield: 13.14%
Funded: 94.8%

C
$25,000
Yield: 15.08%
Funded: 24.2%

D
$25,000
Yield: 21.64%
Funded: 9.4%

AA
$8,000
Yield: 4.31%
Funded: 34.7%

Are investors more likely to make risky decisions at the end of a period?

- IV: End of period

- DV: Interest rate of loan (risky choice)

Table 3: Interest Rates and Default Probabilities

Reserve Interest Rate	<15%	15%-20.03%	20.03%-28%	>28%
Borrower Default Rate	15.72%	32.52%	45.69%	54.30%
Lender Rate of Return	9.02%	16.05%	22.86%	32.30%

Note: 15%, 20.03%, 28% are the 25%, 50% and 75% quantiles of borrower reserve interest rates in the data. Default rate is the rate of borrowers who fail to repay their loans. Lender rate is the interest rate lenders lenders receive on the loans.

Are investors more likely to make risky decisions at the end of a period?

Multi-level Regression Model:

Lender-Level Controls:
- Home bias, experience (time), experience (frequency)

Loan and Time Shock Controls:
- Avg. Interest of the Loans available, number available, loan value, State, Macroeconomic shocks, Month, Stock index performance
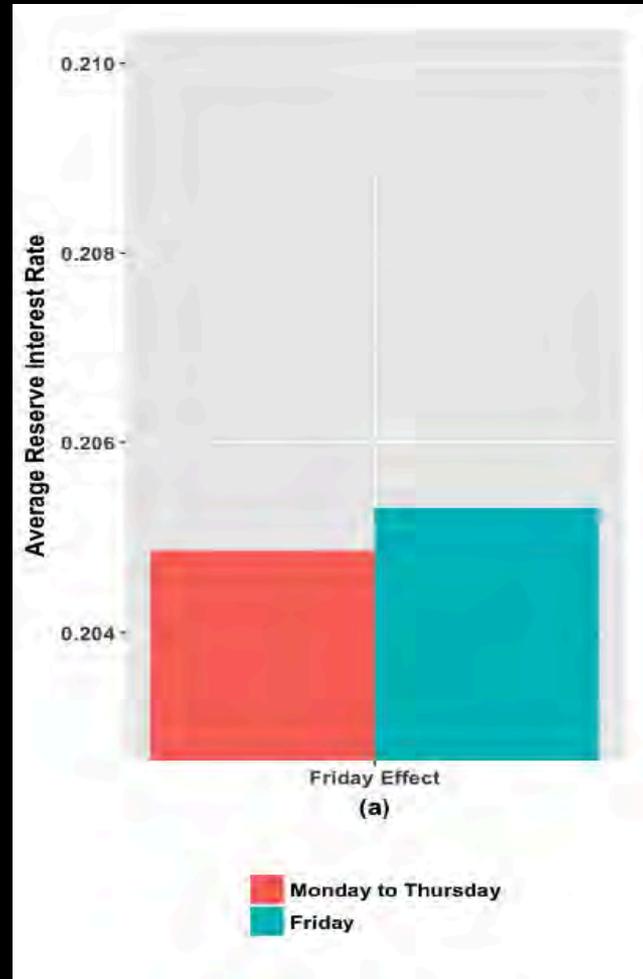
- IV: Weekend End of Period (relative to weekday)

- DV: What is the likelihood of bidding on a riskier investment ?

Even with these controls, weekend investments are associated with riskier investment choice ($p < .001$)

Are investors more likely to make risky decisions at the end of a period?
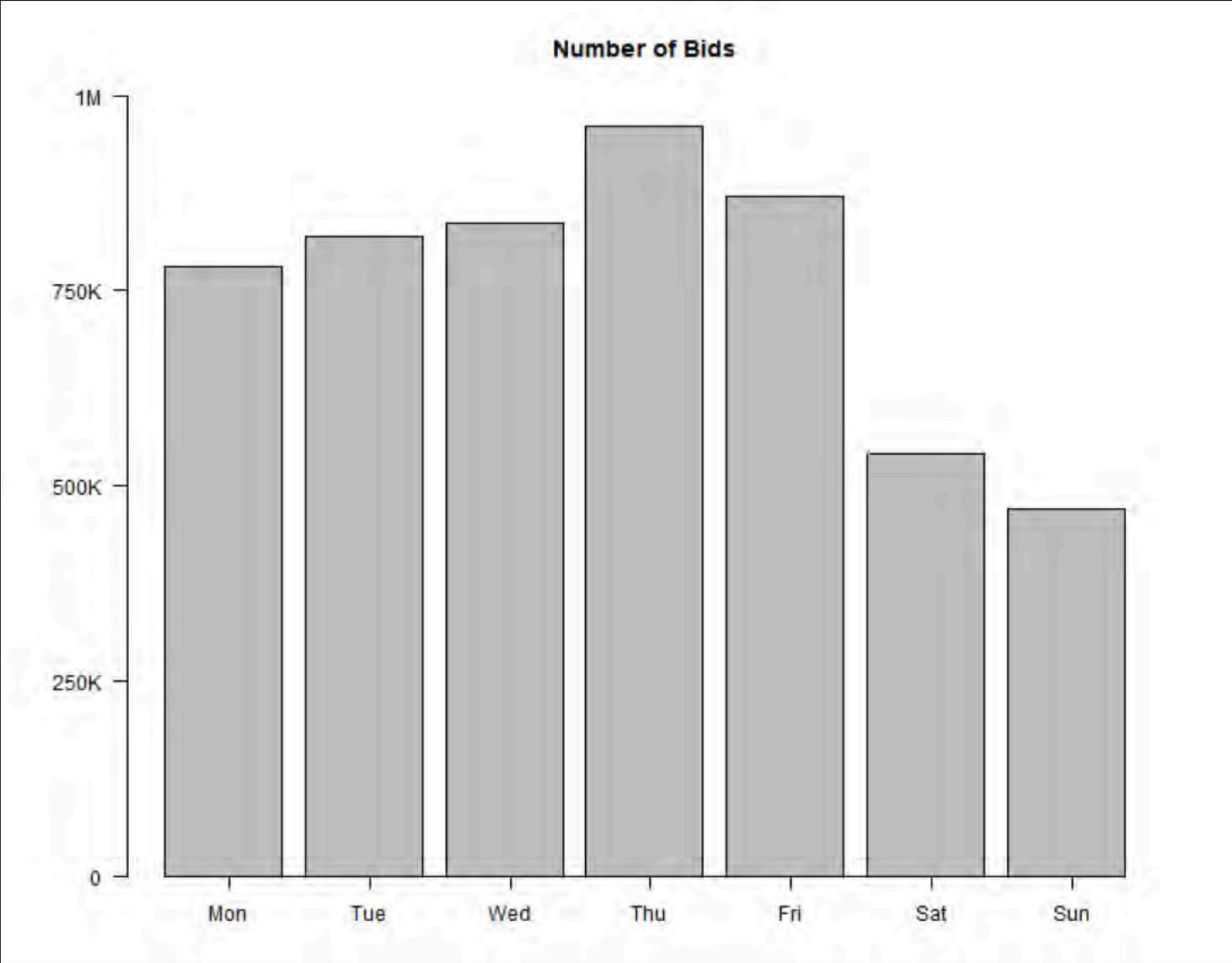
Weekends are weird, does that end of the work week (i.e., Friday) increase risky bidding?

Even when using lender, loan, and time shock controls, Fridays riskier investment choice ($p < .001$)

Alternative definitions of end of week?
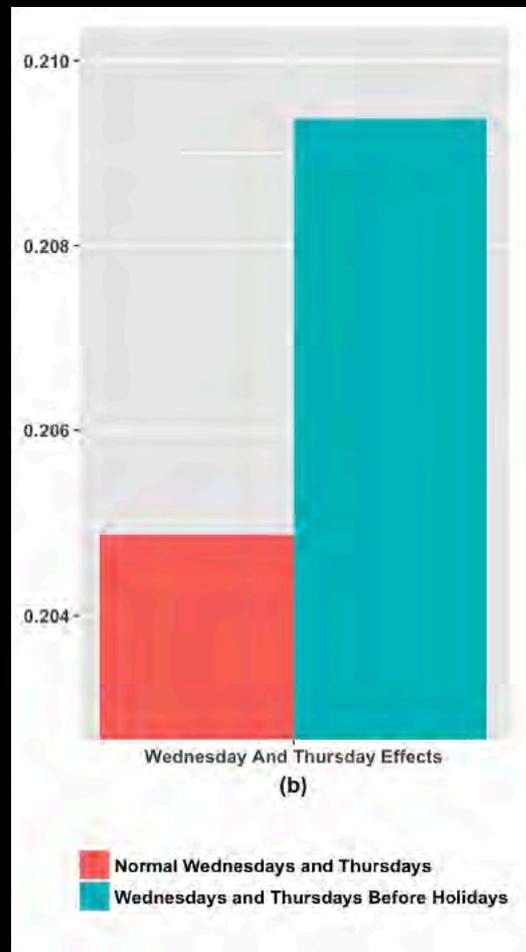

FRIDAY
SATURDAY
SUNDAY
= WEEKEND

3-day weekend =
Thursday is the end-of-period

4-day weekend =
Wednesday is the end-of-period

HAPPY
THANKSGIVING

Alternative definitions of end of week?

Even when including lender, loan, and time shock controls, alternative definitions of end of week predicts riskier investment choice (p<.001)

# Do other other end-of-periods, like the end-of-month influence risky choices?

Do other other end-of-periods, like the end-of-month influence risky choices?
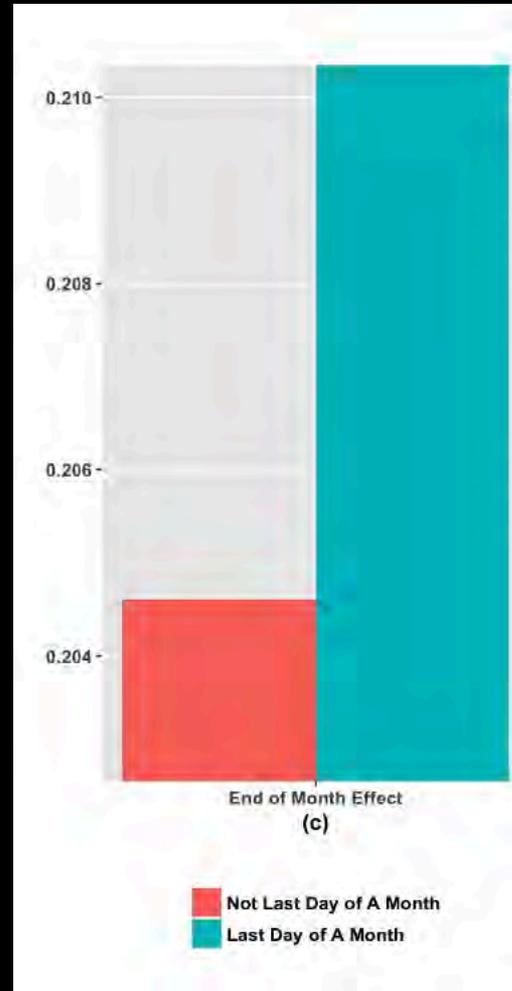
Even when including lender, loan, and time shock controls, the last day of the month also predicts riskier investment choice (p<.001(p < .001)

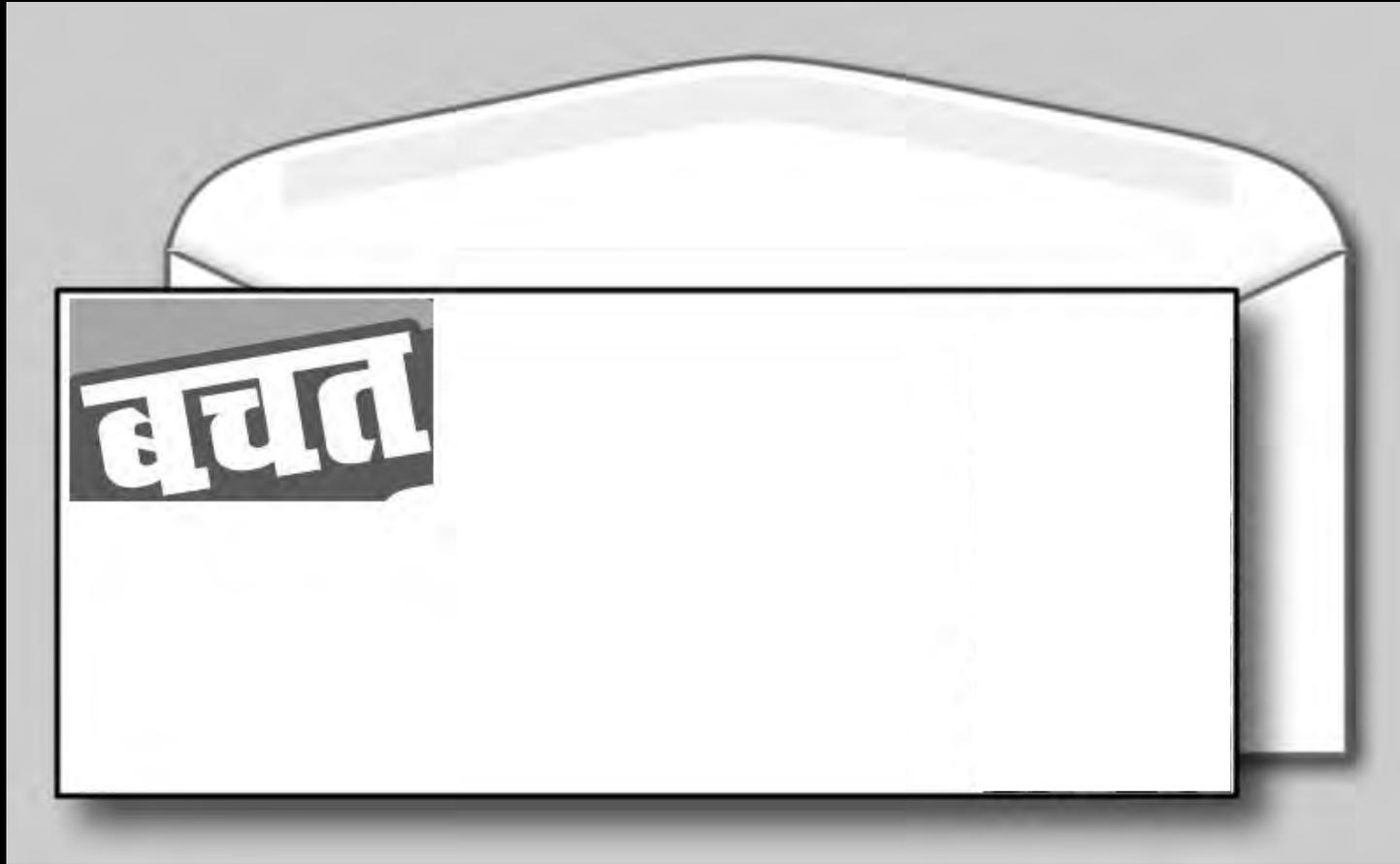But higher risk can lead to greater rewards!

But higher risk can lead to greater rewards!
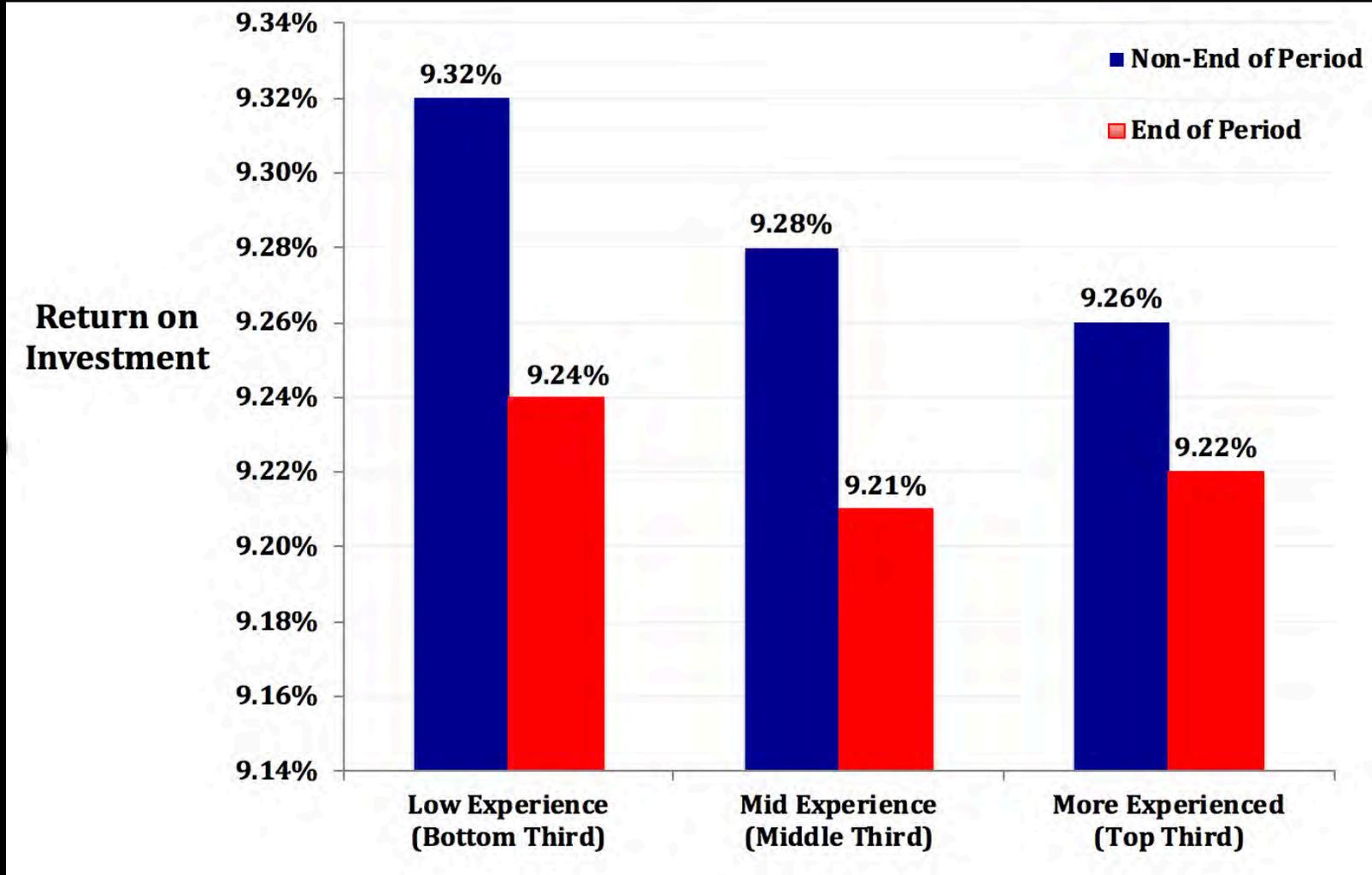
Even for those who have invest more frequently, so have more performance feedback!
($p < .001$ for Low/Mid Experience, $p=.005$ for More experienced)

Using Emotions To Help Save Money

Using Emotions To Help Save Money

Using Emotions To Help Save Money

Using Emotions To Help Save Money...
Help Connect Those Emotional Dots!

Virtual Ageing Simulation

A: Actual photo of First Author

B: Non-aged Digital Avatar

C: Aged Digital Avatar

Using Emotions To Help Save Money...
Help Connect Those Emotional Dots!

MERRILL
EDGE®
Bank of America Corporation

Face | Retirement®
Preparing for retirement is easier when it's staring you in the face

☐ I agree to the Terms & Conditions

Meet the future you™ »

Using Visual Cues to Signal Info Easily

Using Visual Cues to Signal Info Easily

Using Visual Cues to Signal Info Easily

Use Cues To Communicate More Effectively

Math is Hard, Losses Work:
Use Cues To Communicate More Effectively

Here's what it looks like:

$1 + $1 = $6
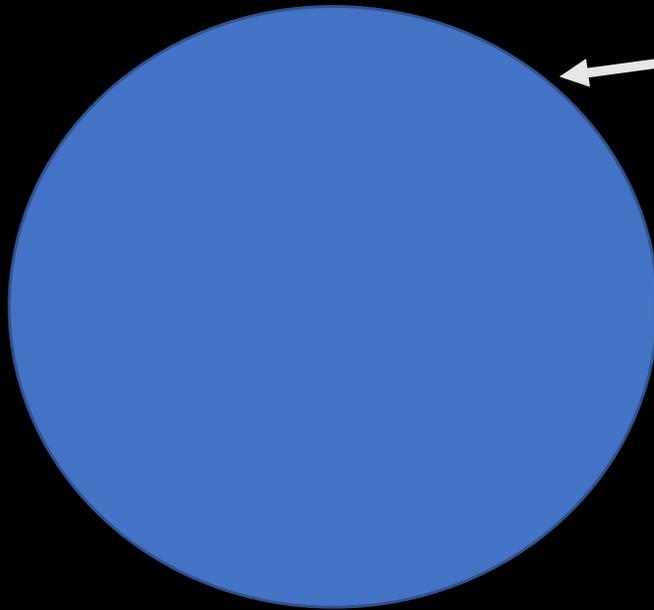
You Contribute — Company Match — With compound interest it really adds up

Availability Bias

the availability heuristic is a mental shortcut that relies on immediate examples that come to a given person's mind when evaluating a specific, topic, concept, method, or decision.

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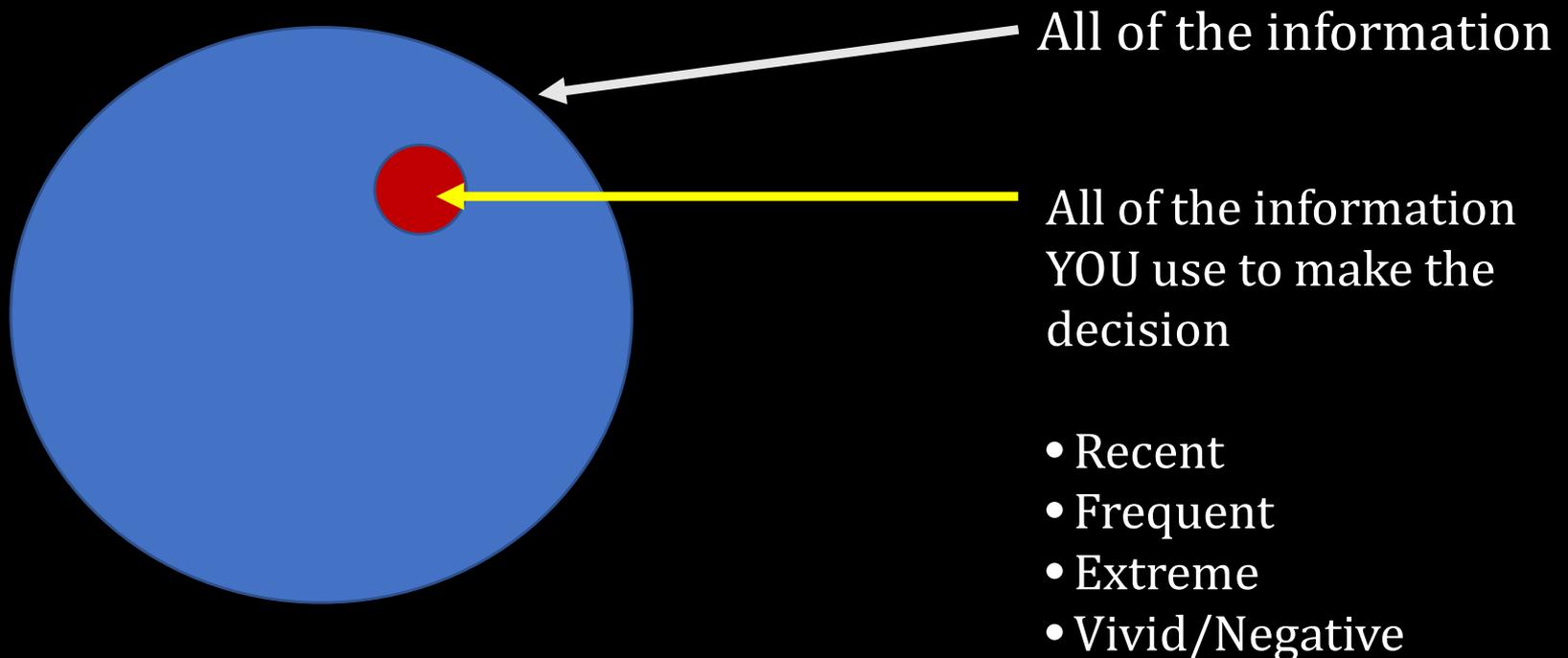
All of the information

Availability Bias

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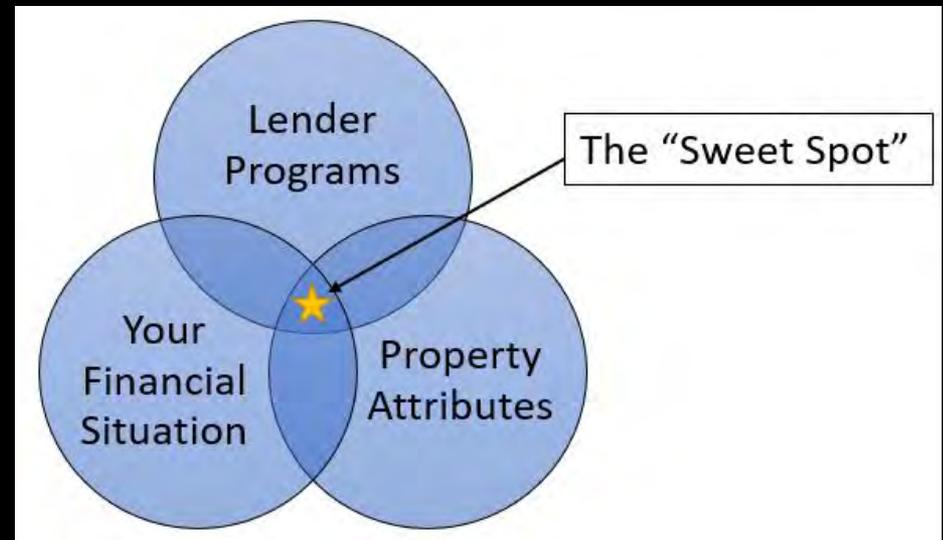
All of the information

All of the information YOU use to make the decision

- Recent
- Frequent
- Extreme
- Vivid/Negative

Who do we turn to for info?

Who do we turn to for info?

Property

Lender Programs

The "Sweet Spot"

Your Financial Situation

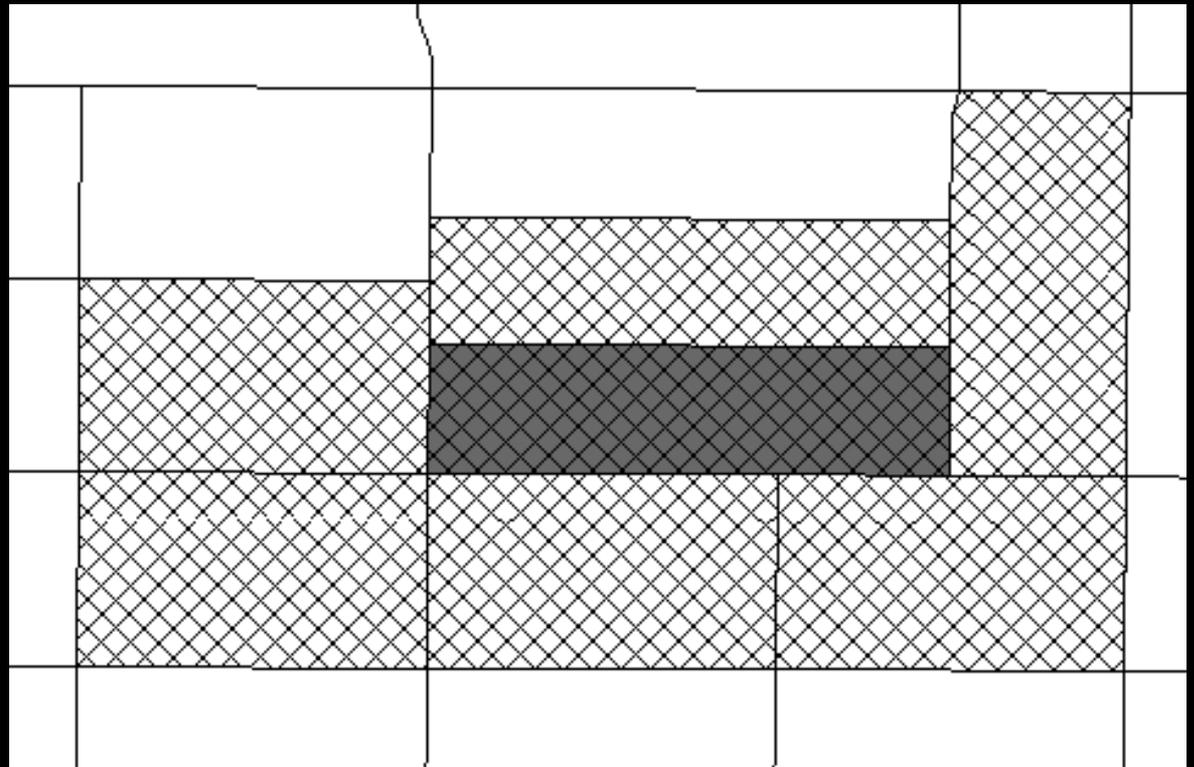Property Attributes
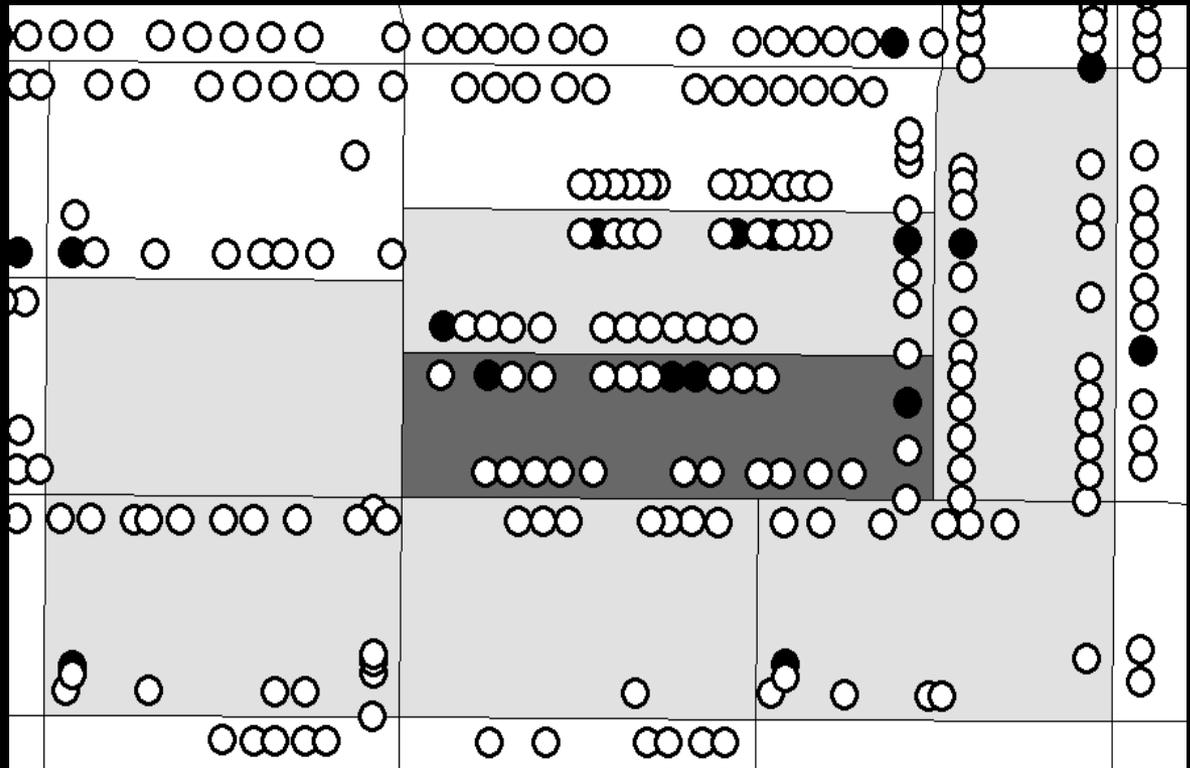
Social Influence Effects & Herding

Social Influence Effects & Herding

Legend

• Wells Fargo Loans
○ Non Wells Fargo Loans
☐ Census Blocks
▓ A Particular Census Block
░ The Block's Neighborhood

0   0.1 Miles

Social Influence Effects & Herding

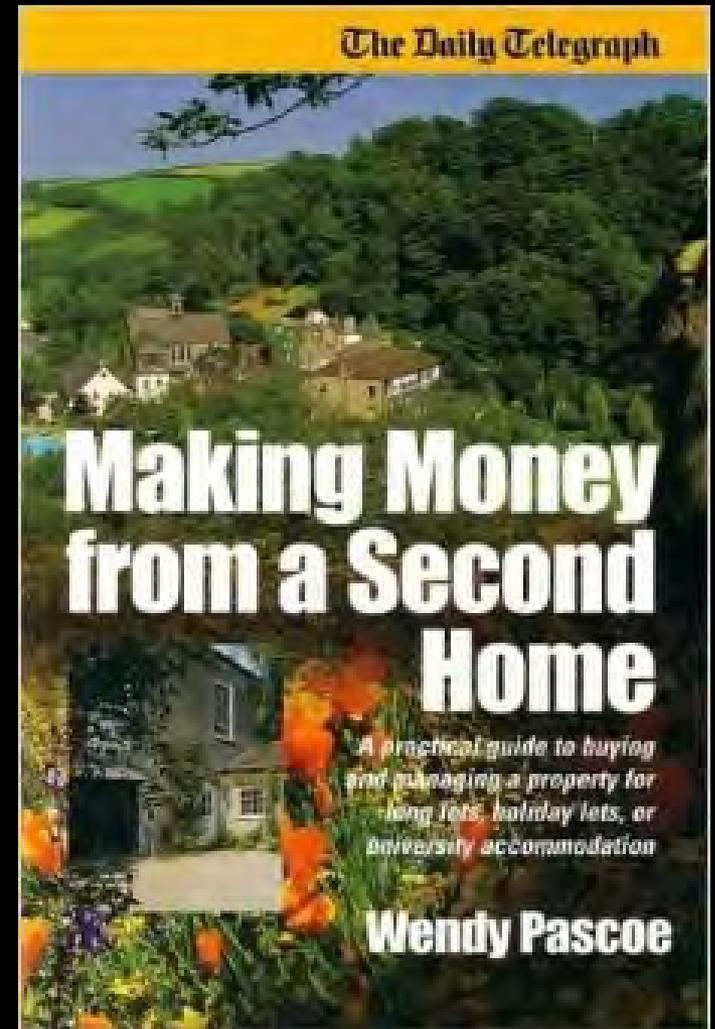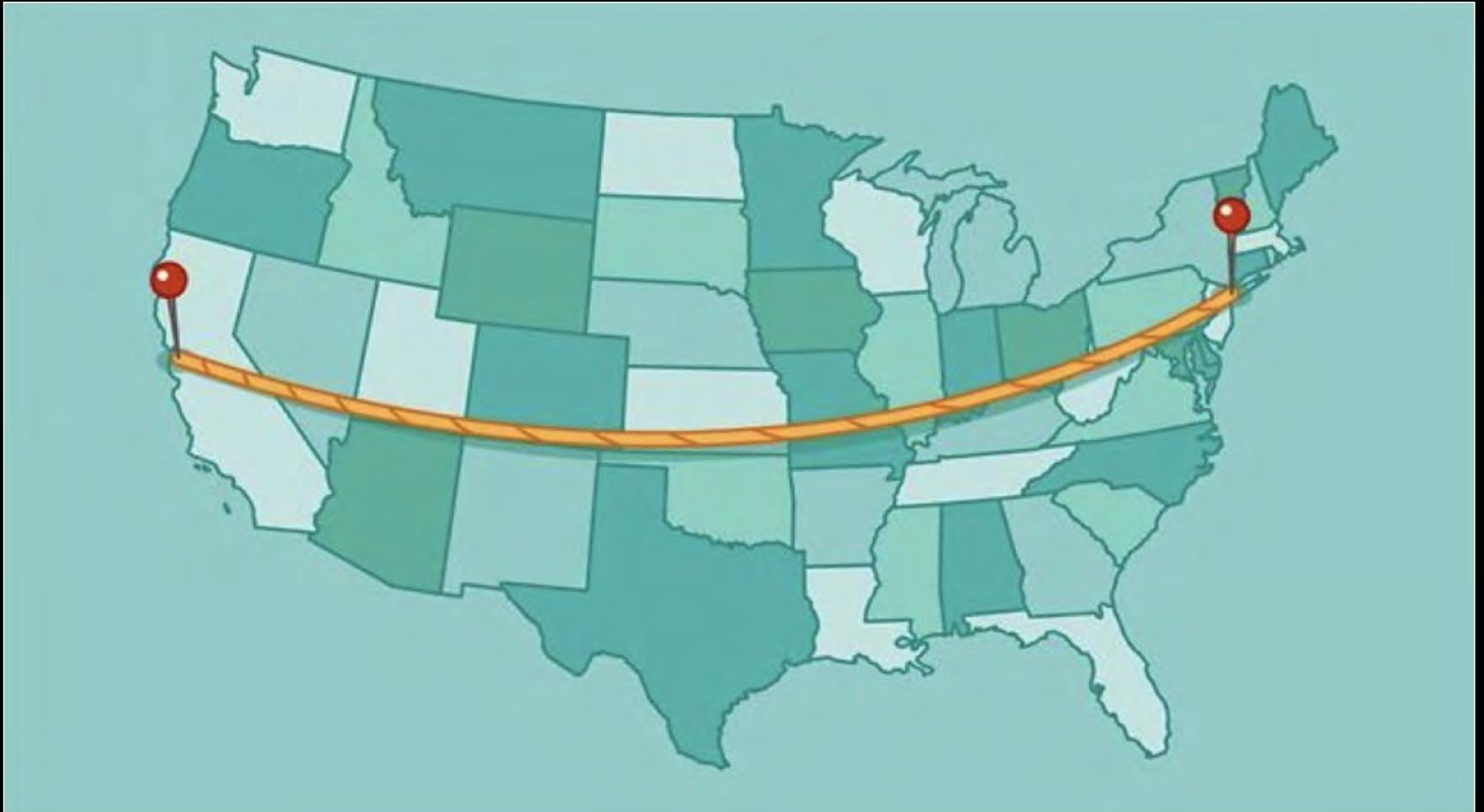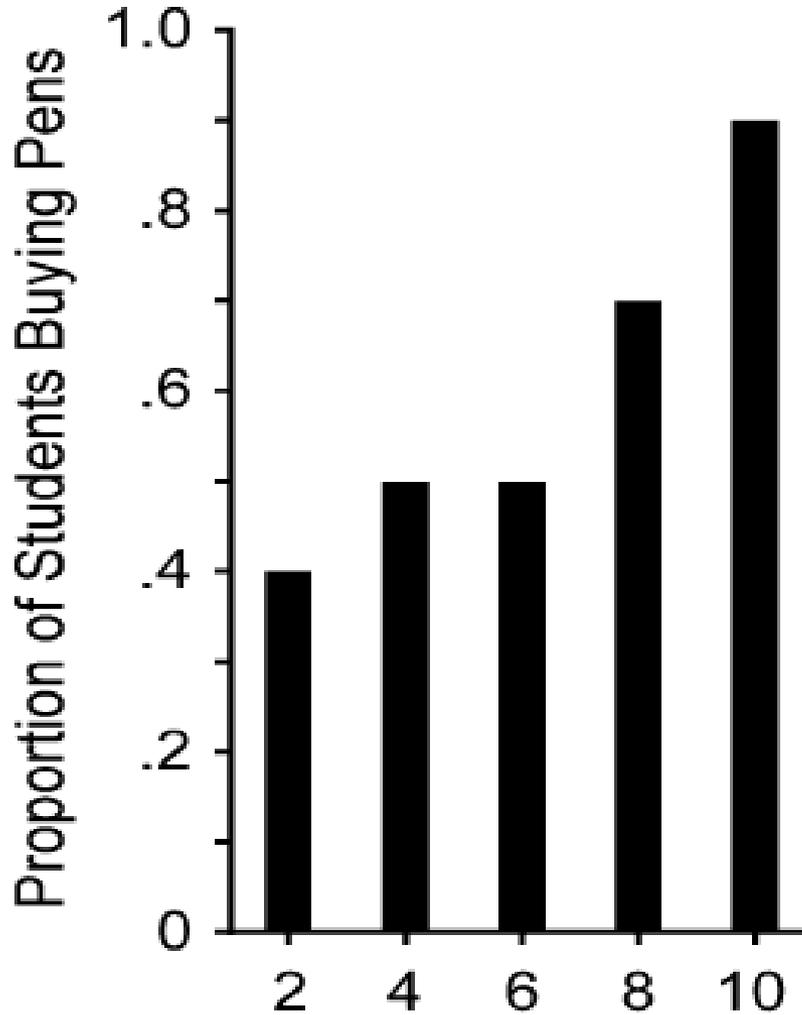# But how about if you do not live there?

How about those who move?

More Options Increases Buying

# More Options Increases Buying

- Preference-matching
  (Baumol & Idol 1954; Kahn, Moore, & Glazer 1987)

- Caters to different consumers (Anderson 2006)

- Perceived freedom = Greater satisfaction!
  (Reibstein, Youngblood, Fromkin 1975)

Shah & Wolford, 2007, *Psych Science*

...Only to an Optimal Point

- Cognitive costs of comparison (e.g., Timmermans 1993; Fasolo et al. 2009; Kahn and Lehmann 1991)

- More than one meets preferences (Schwarz 2004; Sela, Berger, and Liu 2009)

- Affective costs (e.g., Schwartz 2000; Iyengar, Wells, and Schwartz 2006; Diehl and Poynor 2007)

Shah & Wolford, 2007, *Psych Science*
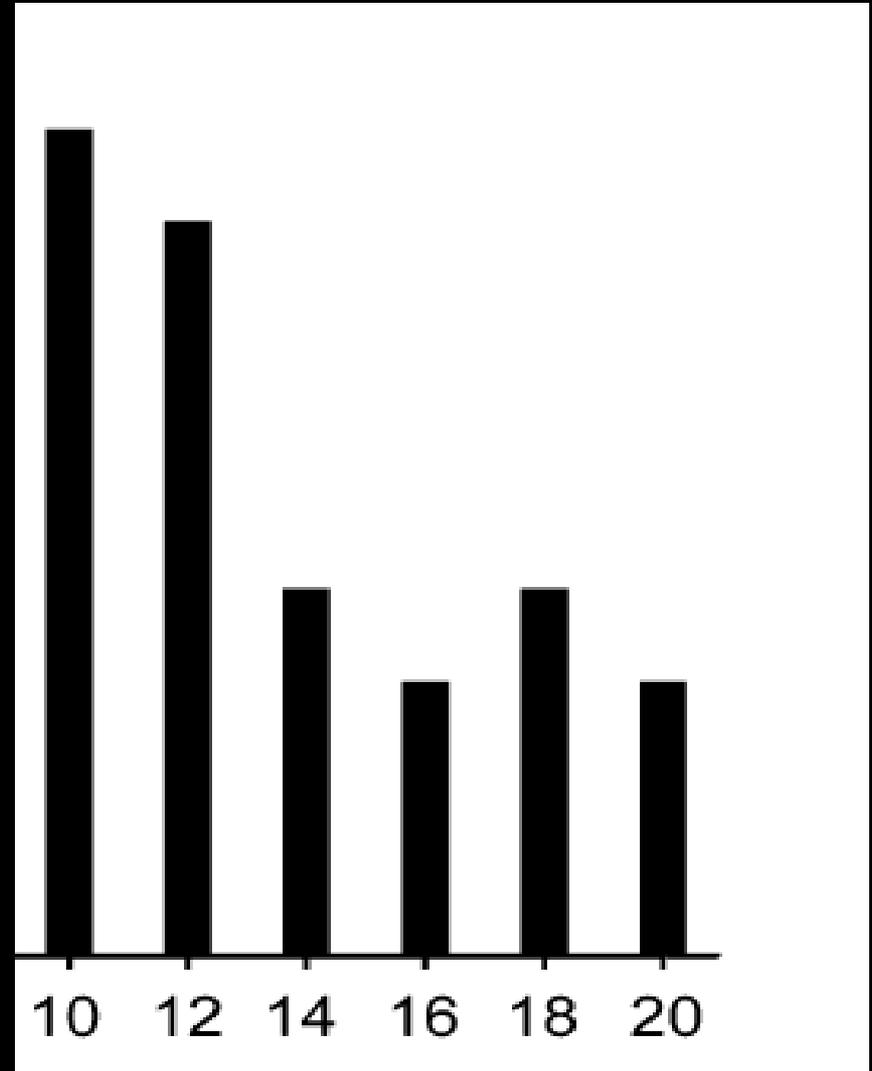
Buying Behavior is a Curvilinear Function of the Number of Alternatives
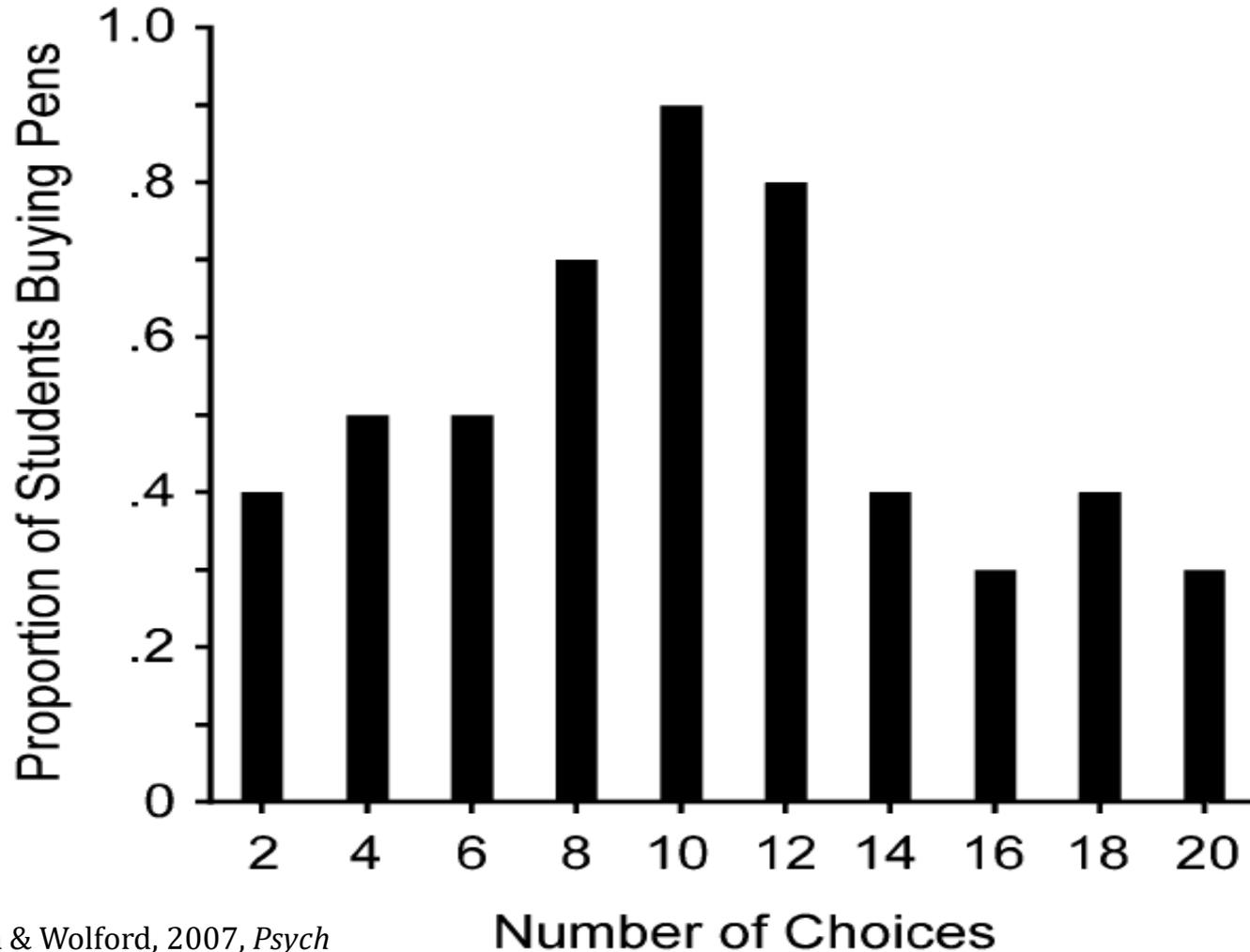
Shah & Wolford, 2007, *Psych*

However not all decisions are the same
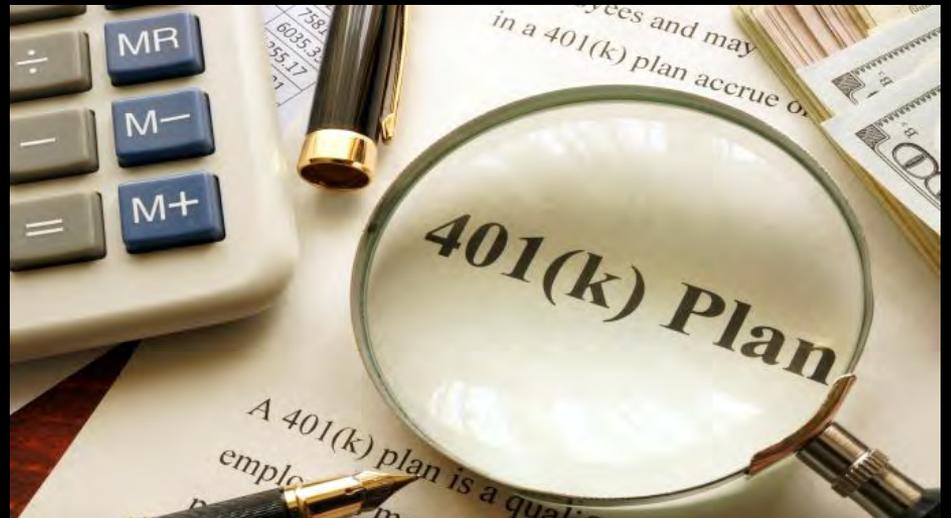
Choice Overload kicks in at different points

Choice Overload shown in 401K participation
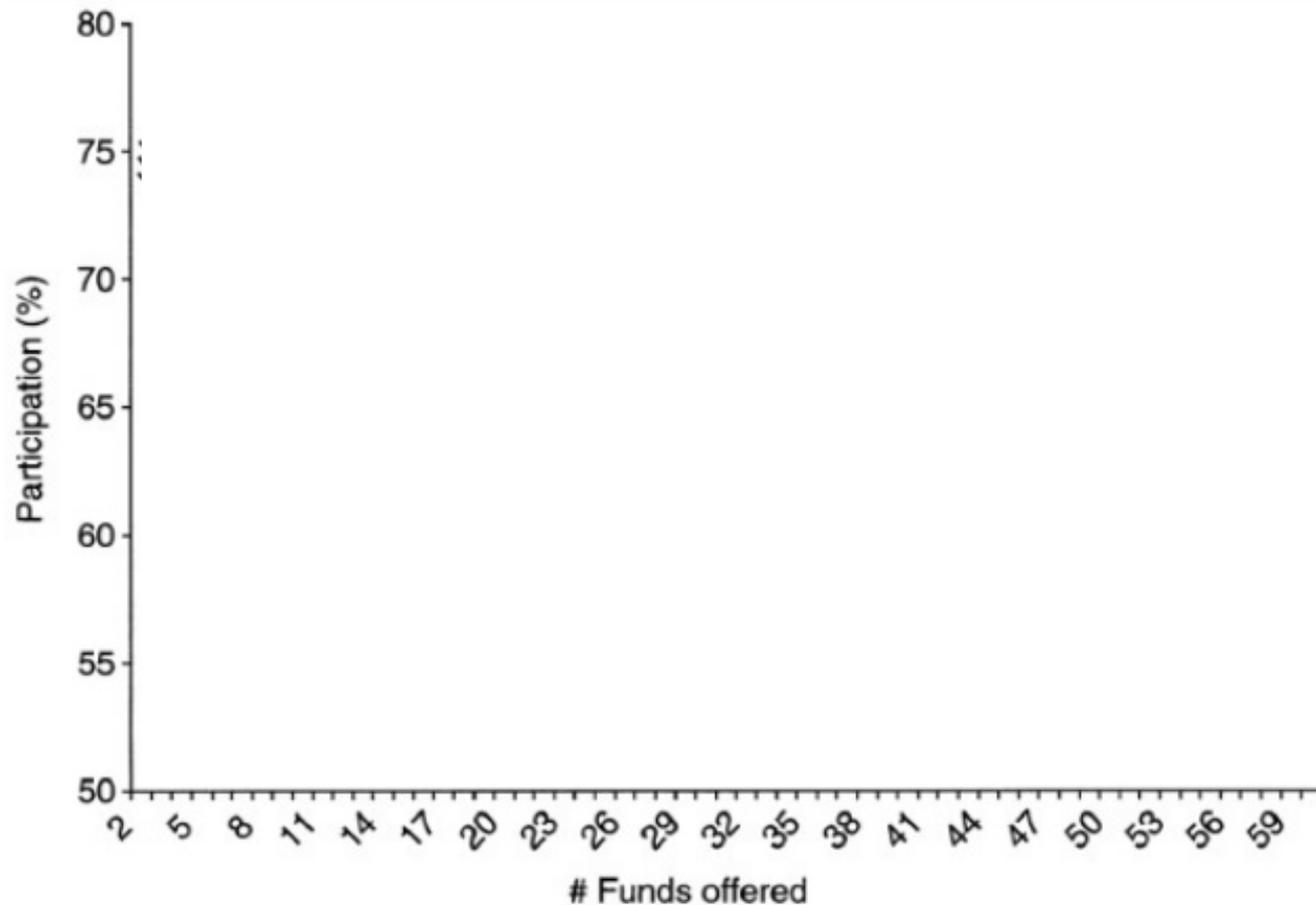
Choice Overload kicks in at different points

Choice Overload shown in 401K participation
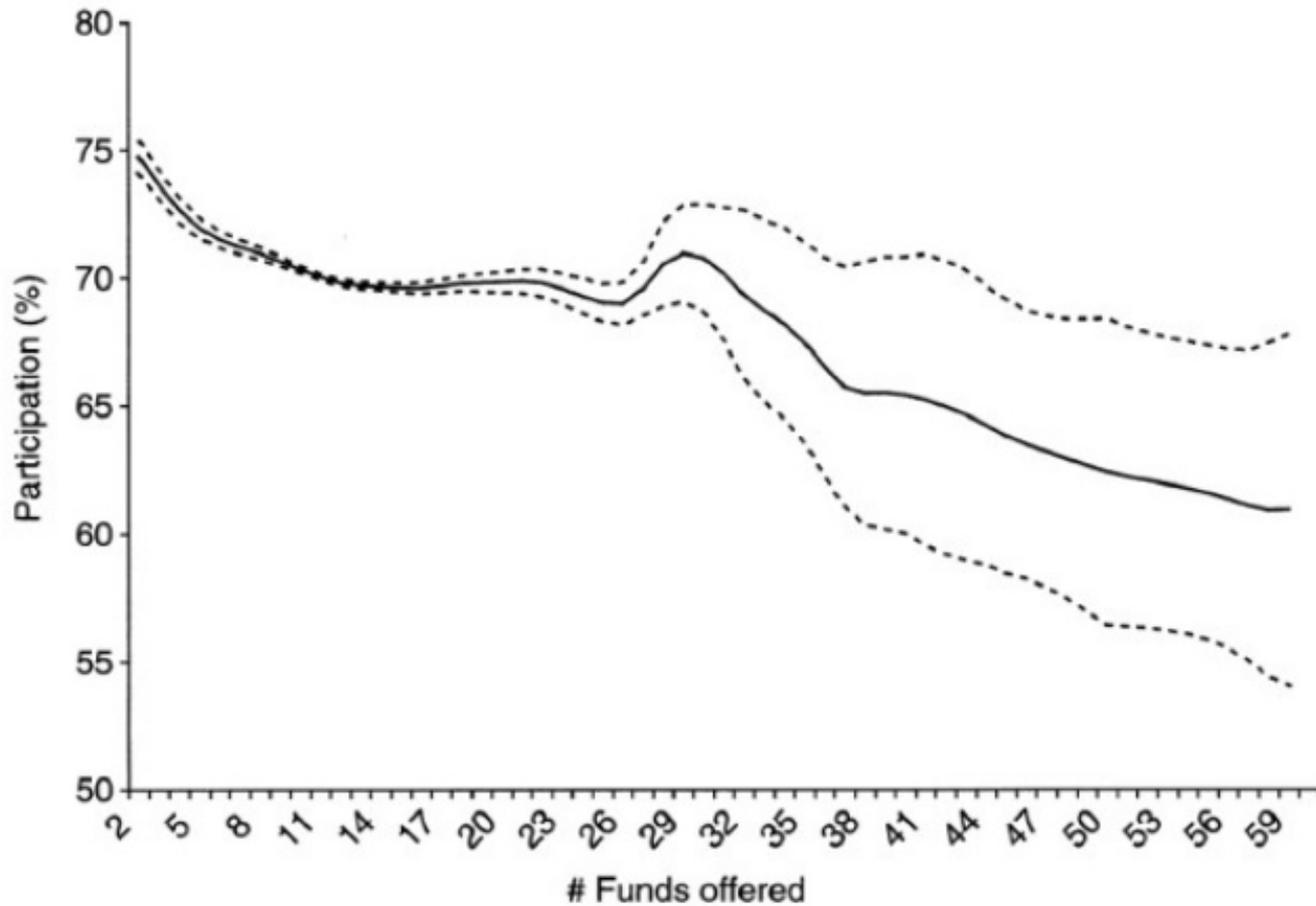
How to Overcome this...

How to Overcome this…Use Defaults

Share of 401(k) Plans Featuring Automatic Enrollment
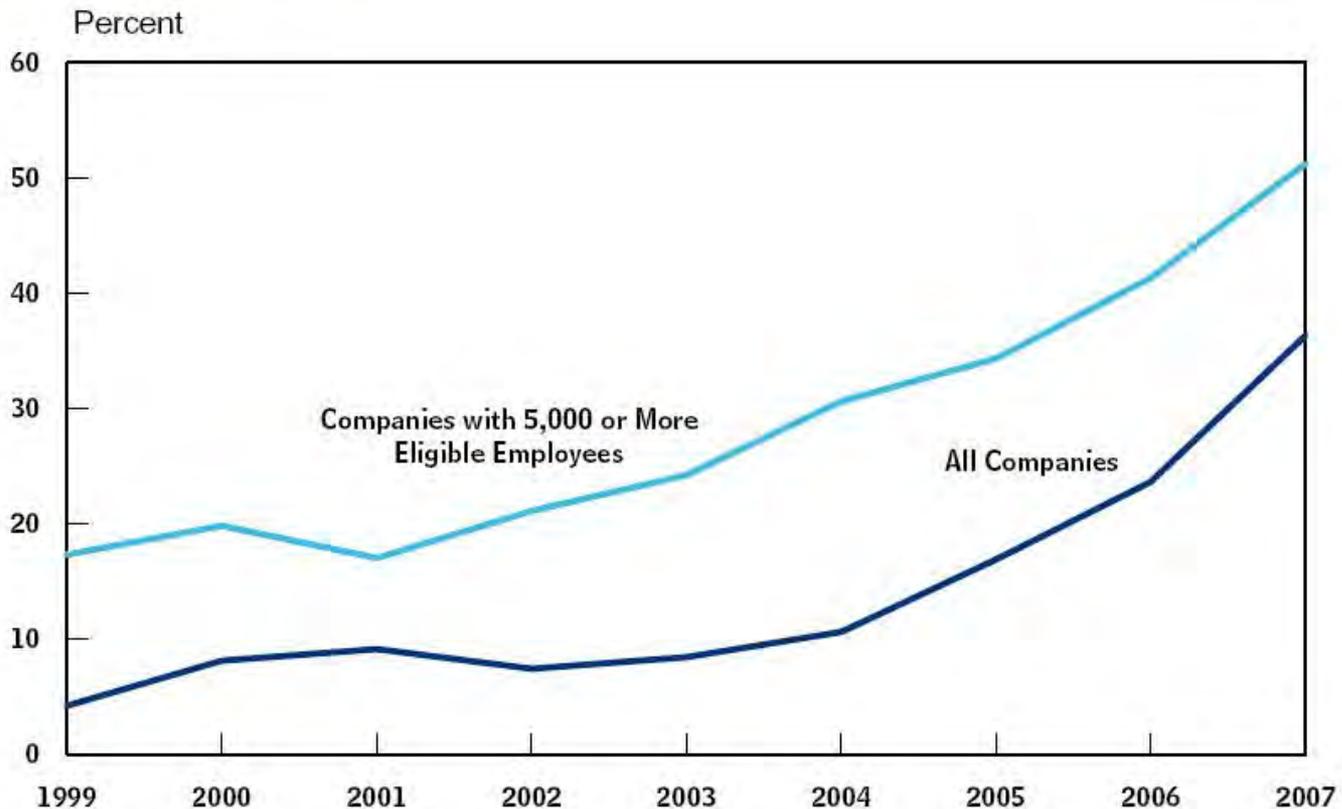
Source: Data from Profit Sharing/401k Council of America.

Why Do Defaults Work?

- Active choices are hard for individuals
  - Using laziness to our advantage!

- Status Quo Bias:
  - a preference for whatever we currently are doing
  - **inference that it is the best/popular option

Additional Evidence of Defaults in Other Settings

- SMRT plan for savings (Thaler and Benartzi, 2004)
- Health-club contracts (DellaVigna and Malmendier, 2006)
- Organ donation (Johnson and Goldstein, Science 2003)

Using Status Quo Effectively
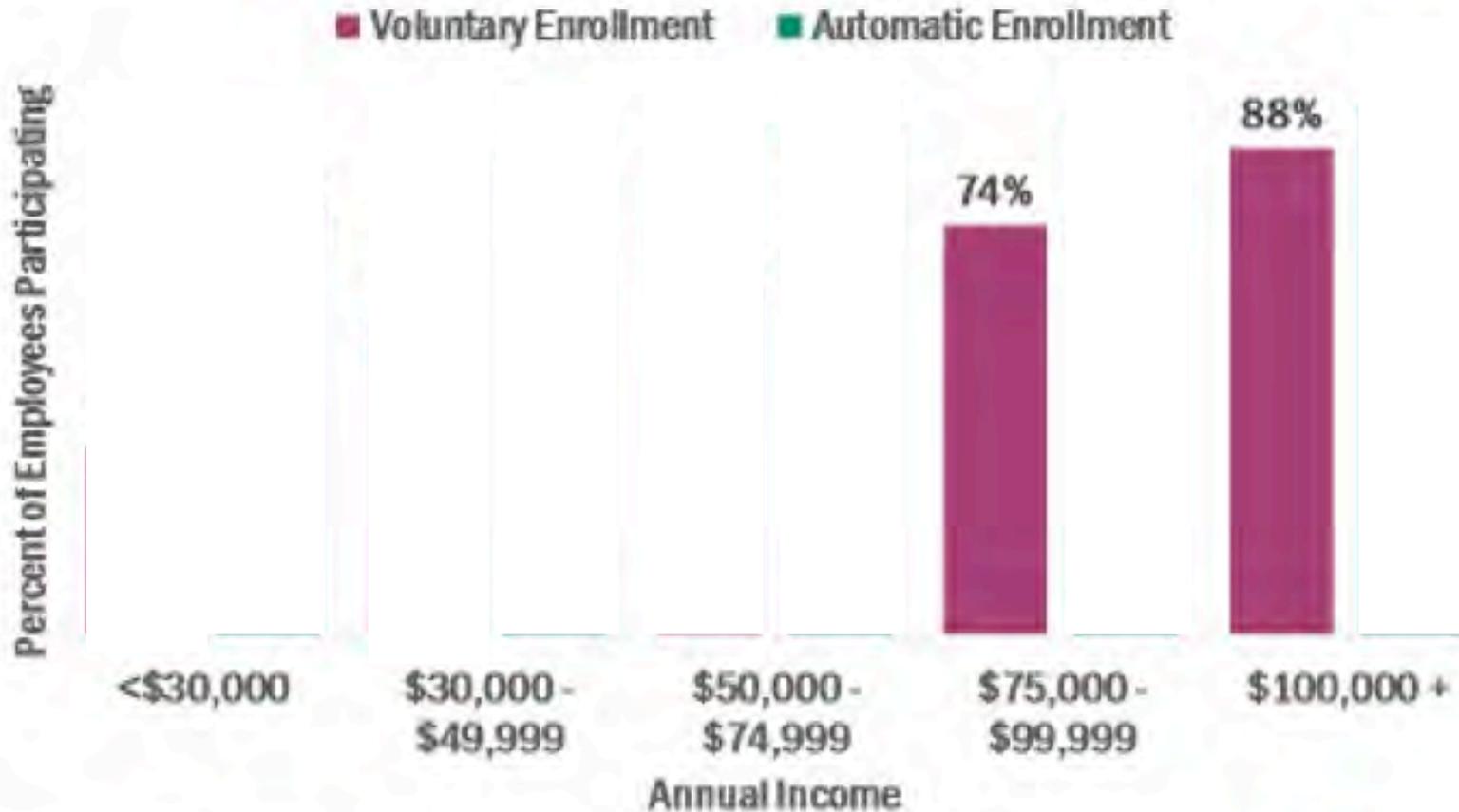
Source: Vanguard, How America Saves, 2014

WWW.BIPARTISANPOLICY.ORG

BIPARTISAN POLICY CENTER

Using Status Quo Effectively

Using Status Quo Effectively

Lower-income Workers More Likely to Participate with Automatic Enrollment

The Power of Habits

The Power of Habits

Is this because we want this much soda?

Is this because we want this much soda?

Is this because we want this much soda?

The Power of Habits

Is this because we want this much soda?

Is this because we want this much soda?

Nudge Habits to Curb Consumption

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    - Using the combined powers of BE, Big Data, and AI/ML for a (more) optimal tomorrow

What Lies Ahead?
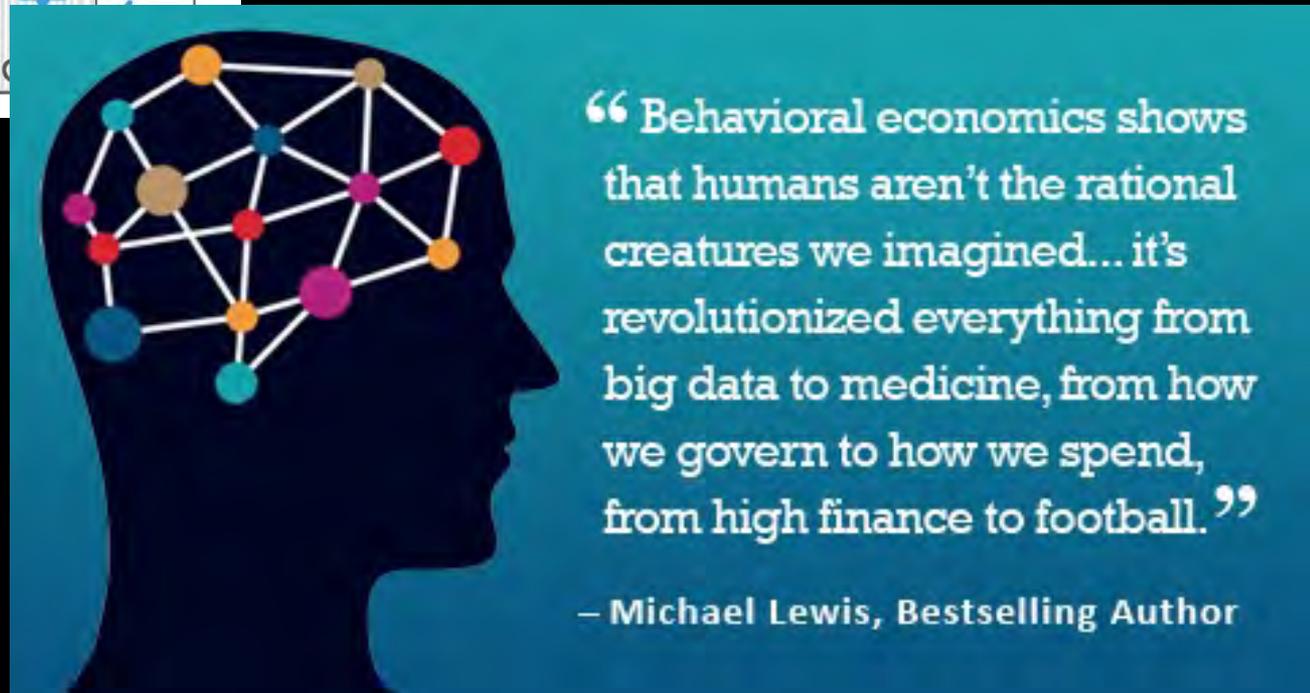
BIG DATA

"Behavioral economics shows that humans aren't the rational creatures we imagined.... it's revolutionized everything from big data to medicine, from how we govern to how we spend, from high finance to football."

– Michael Lewis, Bestselling Author

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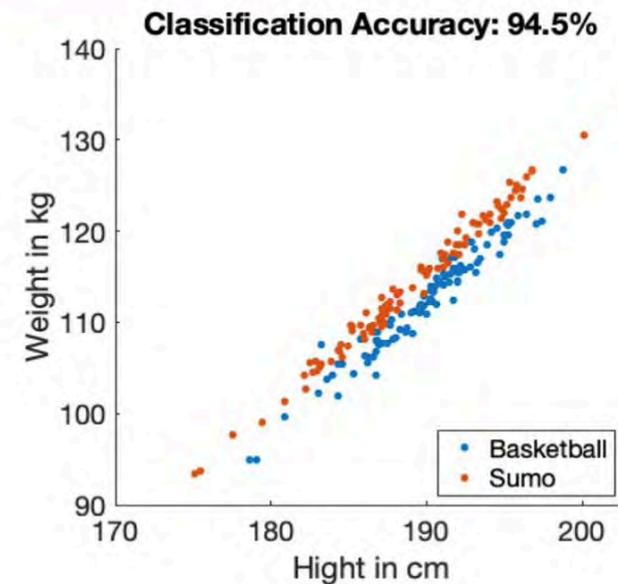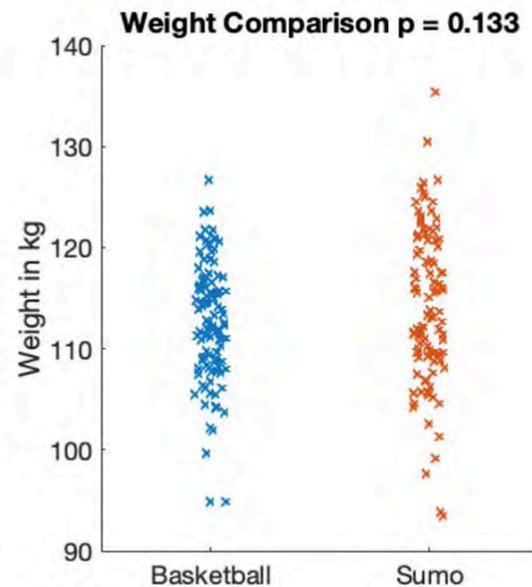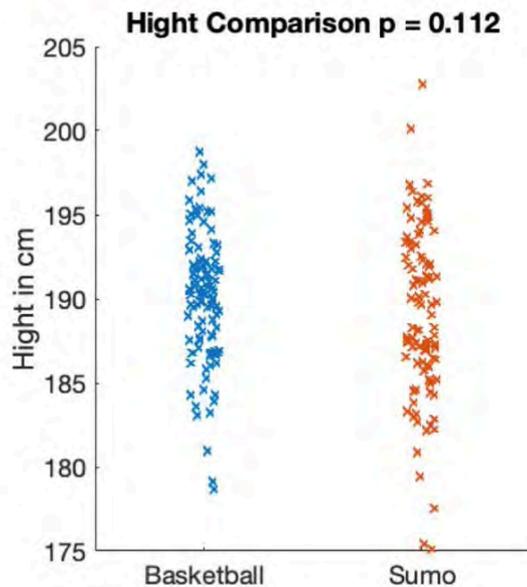
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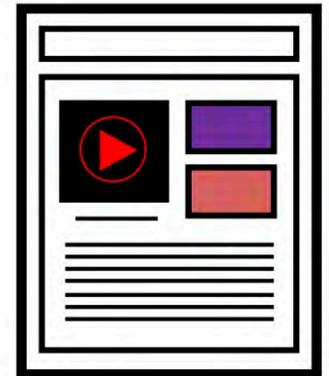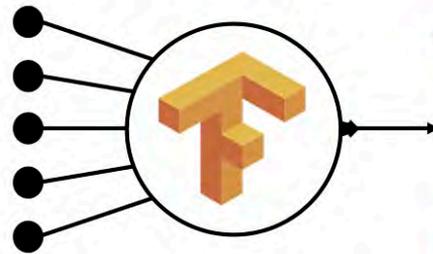
Case Study: Mexico Retirement System

Rendimiento Neto de las SB2 (46 a 59 años)	
Siefore Básica 2	**Rendimiento Neto**
SURA	9.46%
PensionISSSTE	9.36%
Banamex	8.79%
Profuturo GNP	8.62%
XXI-Banorte	8.33%
MetLife	8.09%
Invercap	8.04%
Principal	7.64%
Azteca	7.03%
Coppel	6.91%
Inbursa	4.98%
Promedio Simple	**7.93%**
Promedio Ponderado *	**8.35%**

Citizens choose a retirement company and then make a mandatory contribution equivalent to 6.5% of their salary

Retirement savings is a huge issue in Mexico

- Under this system, workers expect to receive less than 40% of their salary when they do retire
  - Note: 3rd highest rate of 65+ men, 4th highest rate of 65+ women working (World Bank, 2015)

- Thus there is a need for individuals to make substantial voluntary contributions to their retirement

- *Less than 0.3% of the 19 million active pension account holders contribute to their retirement in any given year (~112,000 people)*

Lack of Voluntary Contributions and Retirement Savings Generally has Huge Welfare Implications

Where are pensioners most at risk of poverty?

Percentage of the population aged 65+ living in relative income poverty.

WORLD ECONOMIC FORUM
COMMITTED TO IMPROVING THE STATE OF THE WORLD

Country	Percentage
South Korea	49.6
Australia	35.5
Mexico	31.2
Israel	24.1
Switzerland	23.4
United States	21.5
Japan	19.4
Chile	18.4
Turkey	18.4
Slovenia	15.9
United Kingdom	13.4

Source: OECD, 2015

31.2% elderly poverty rate, third worst in the world... and the number is only increasing every year

How do we get people to save for their future (e.g., retirement)?

What are the Key Barriers?
(Qualitative Interviews with over 100 citizens across the country)

Consumer Side:
What are the Key Barriers?
(Qualitative Interview with over 100 citizens across the country)

- A small contribution amount won't make a difference over the traditional savings (note: hard to calculate rate of return).

- A deposit doesn't feel like money gained but rather money lost

- I don't know how to go through the process

- I want to have money easily accessible for my family now

Using SMS Text Reminders To Encourage Savings

Kaju & Maglio 2018; Karlan et al 2017

Do reminders improve improve retirement contribution rates?

Can increasing the salience of family improve rates?

Do reminders improve improve retirement contribution rates?

Can increasing the salience of family improve rates?

How does this compare relative to past nudges/interventions? Are they more/less effective?

RCT: Using Nudges to Improve Contribution Rates

- Partnered with a retirement company in Mexico(N=97,149)
- Study ran from October-December 2016 (follow-up from Jan-March 2017)

- IV
  - Control (n=13,902)
  - New Statement Alone (n= 13,875)
  - New Statement + SMS Treatments (n=69,372)
    - Basic Alert, Pennies-a-day, Fresh Start, **Individual Goals/Security, Family Security**

Text Message Interventions

Condition	First Message	Reminder Message (October 27)
Individual Security	Hi [[Name]], check out the tips in your Afore account statement. Set your goals TODAY. Plan for your future. Improve your future and reach your goals TODAY with Voluntary Savings: Contribute to your Afore Account at a 7Eleven or Telecomm with your CURP or call 018005222367 option 3	Hi [[Name]], setting a goal is the first step to change! Contribute to your Afore Account at a 7Eleven or Telecomm with your CURP or call 018005222367 option 3
Family Security	Hi [[Name]], check out the tips in your Afore account statement. Act TODAY to improve your future and that of your family. Save for the expenses that will come. Secure your future and that of your family TODAY with Voluntary Savings: Contribute to your Afore Account at a 7Eleven or Telecomm with your CURP or call 018005222367 option 3	Hi [[Name]], it's never to late to secure a better future for you and your family: Contribute to your Afore Account at a 7Eleven or Telecomm with your CURP or call 018005222367 option 3

Text Message Interventions

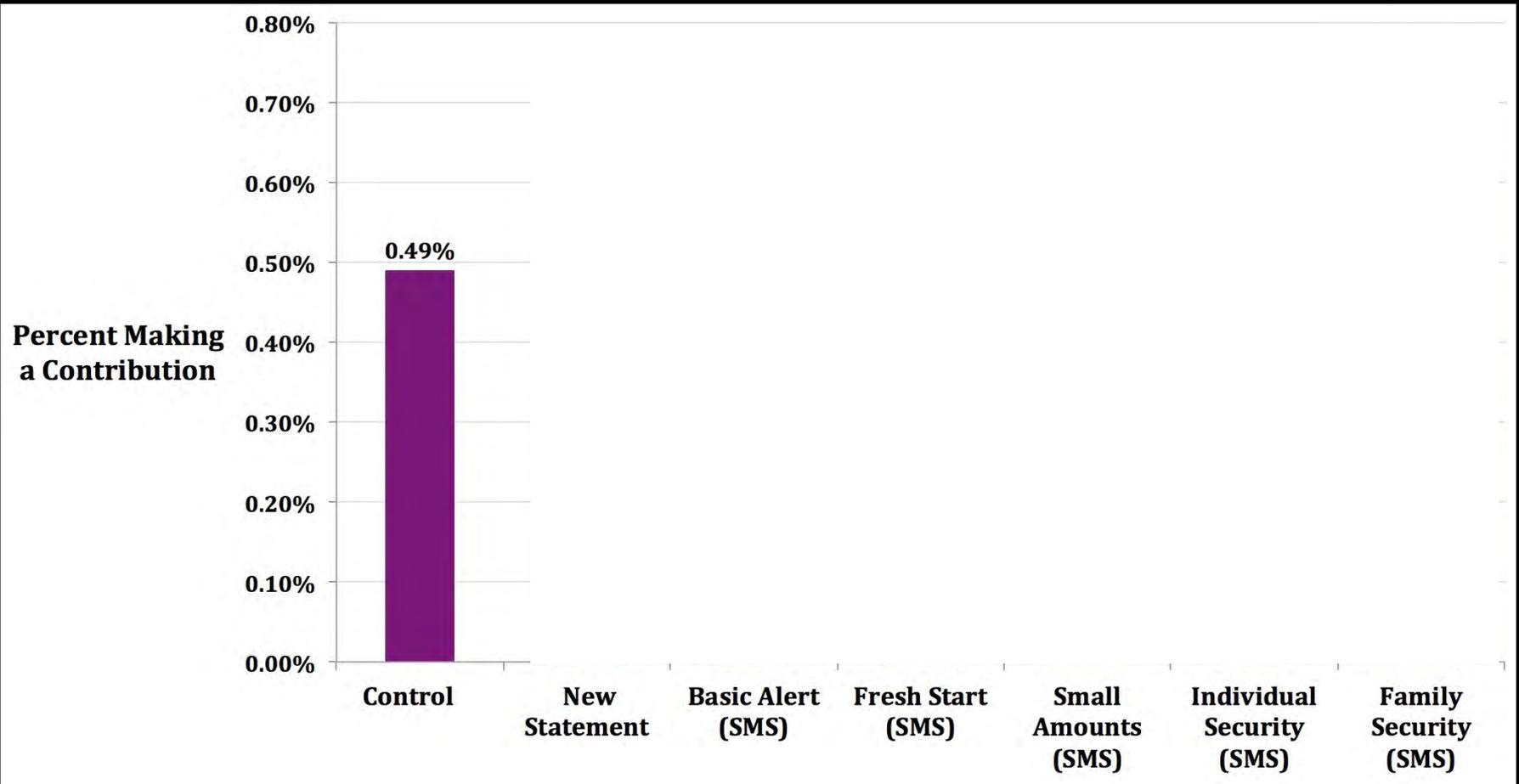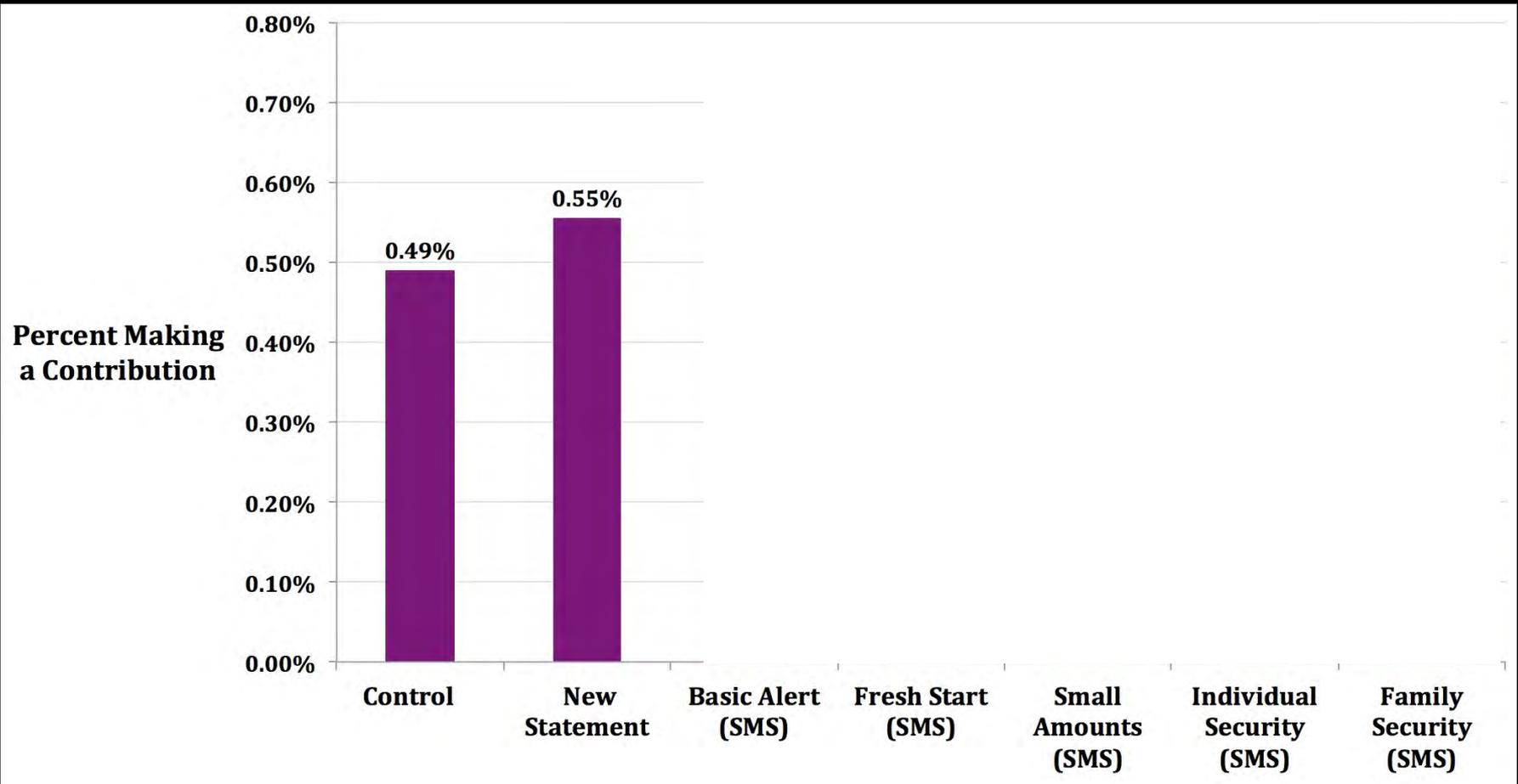| Condition	First Message	Reminder Message (October 27)
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- DV
  - Contribution likelihood, Amount, Number times contributed

RCT: Using Nudges to Improve Contribution Rates

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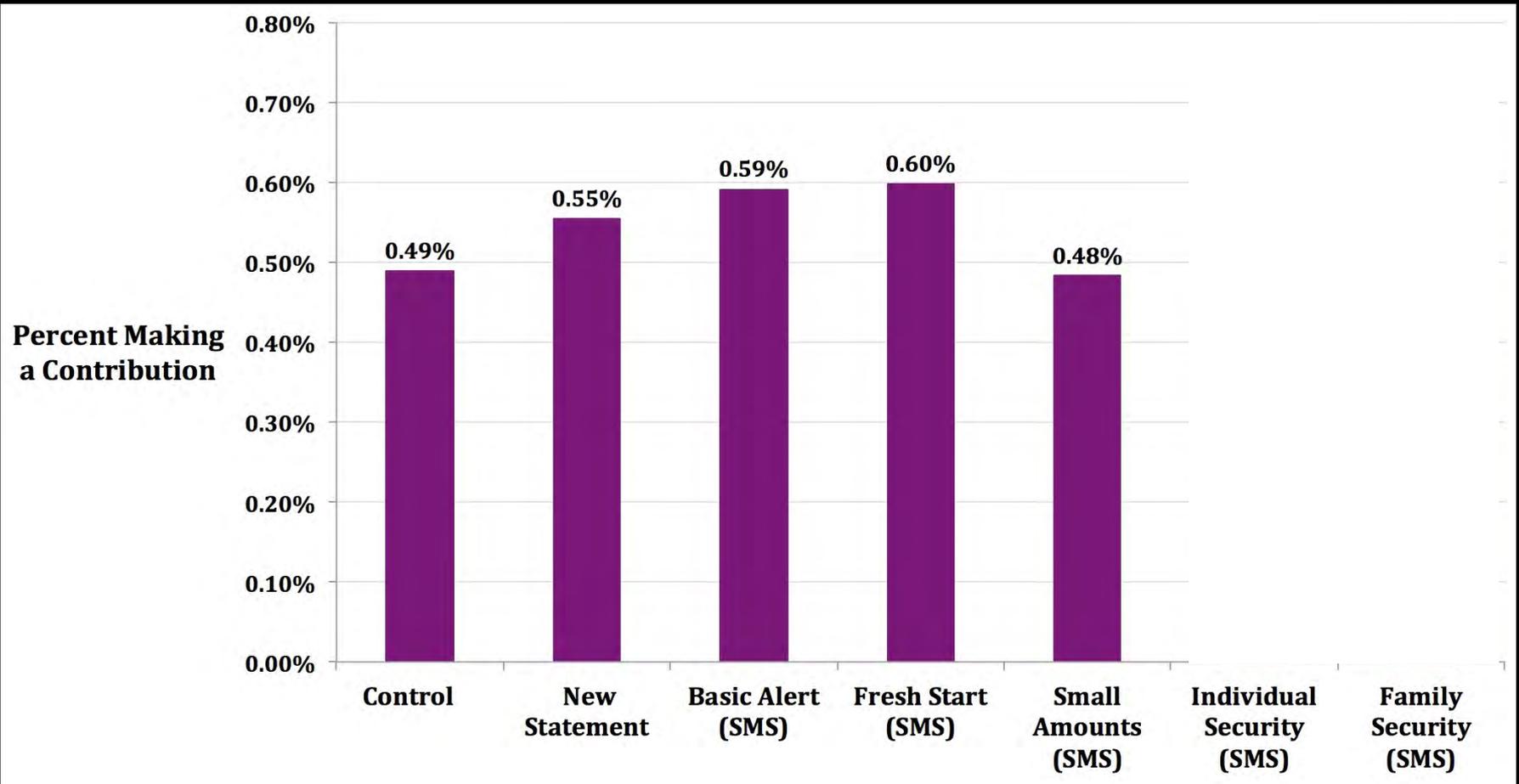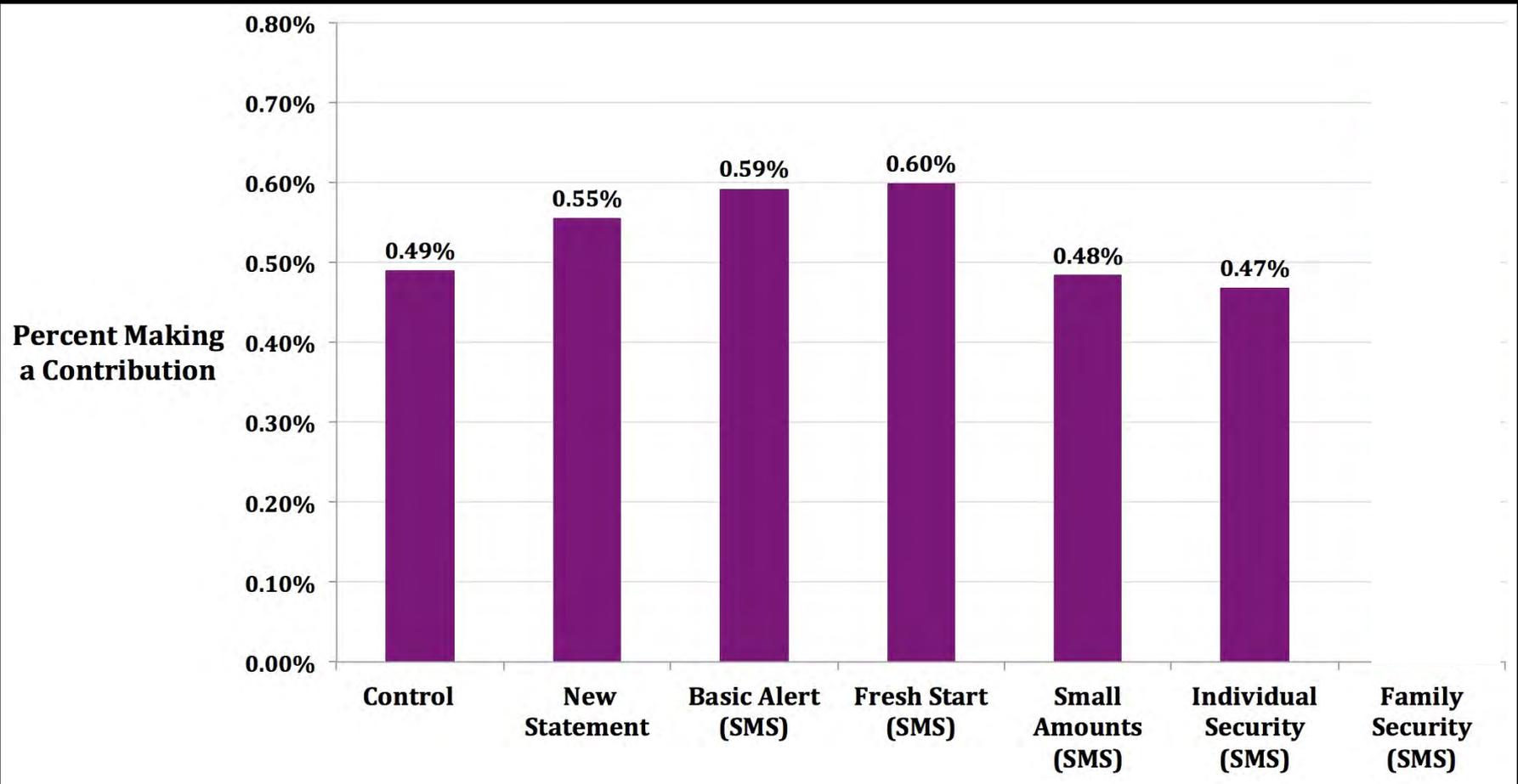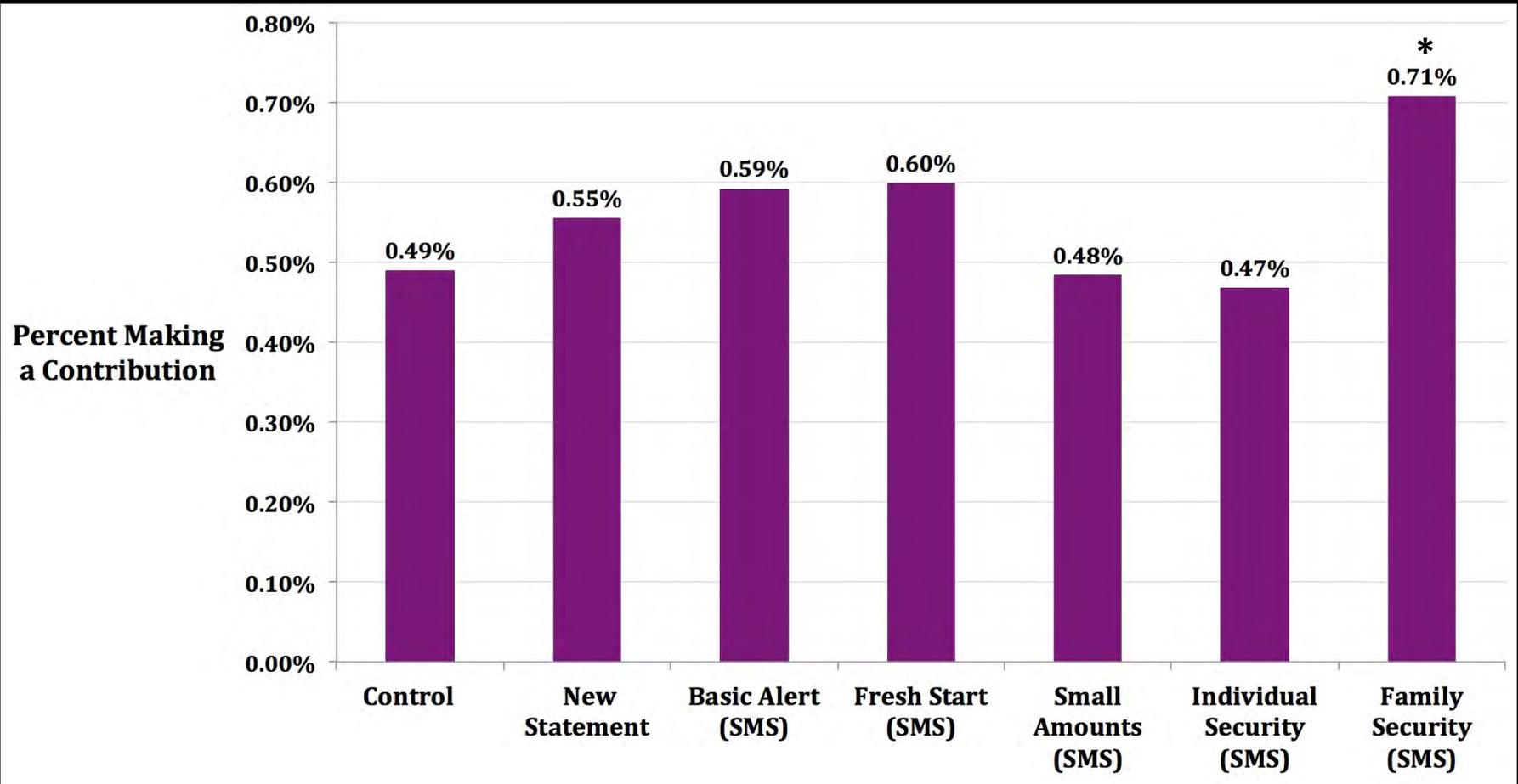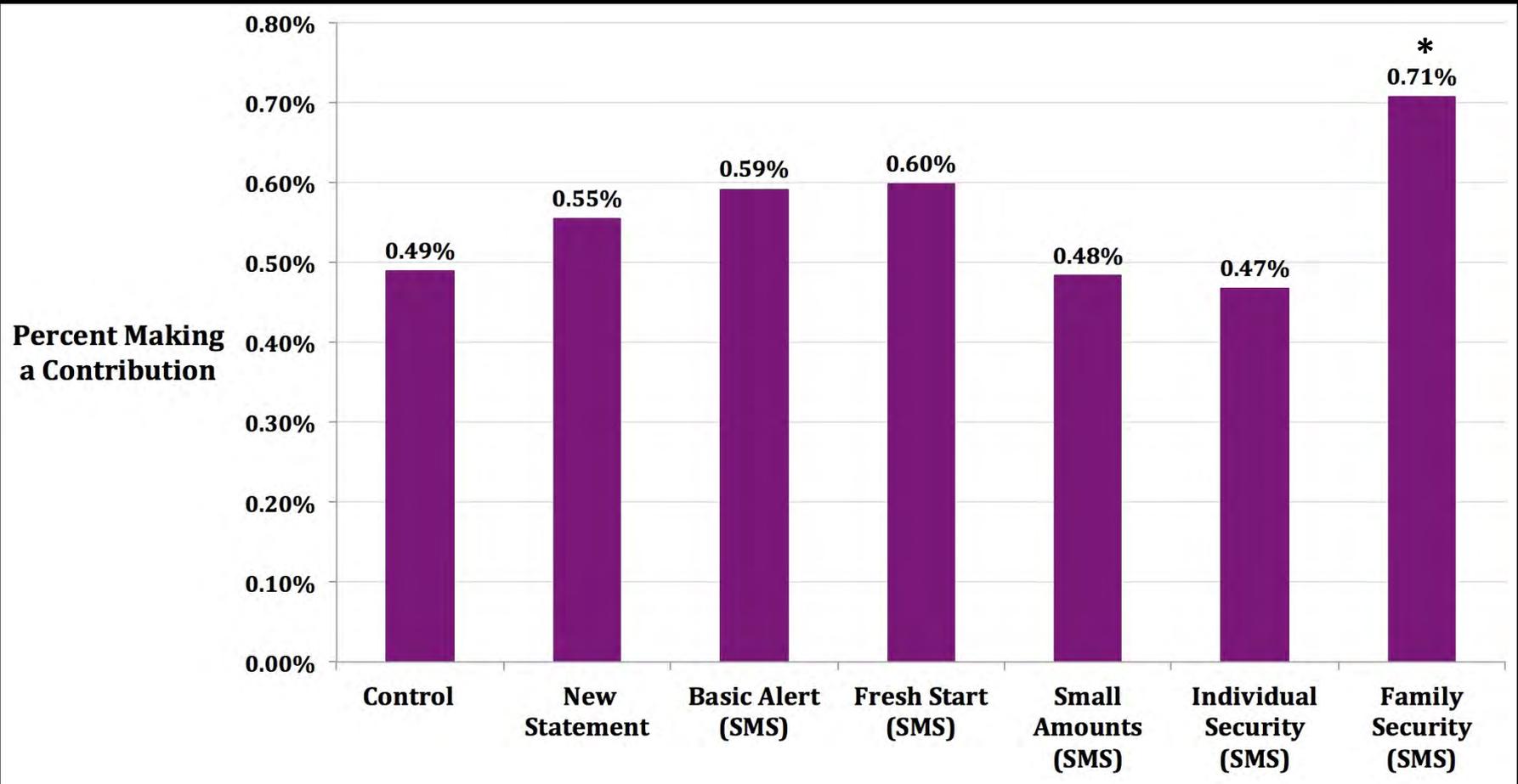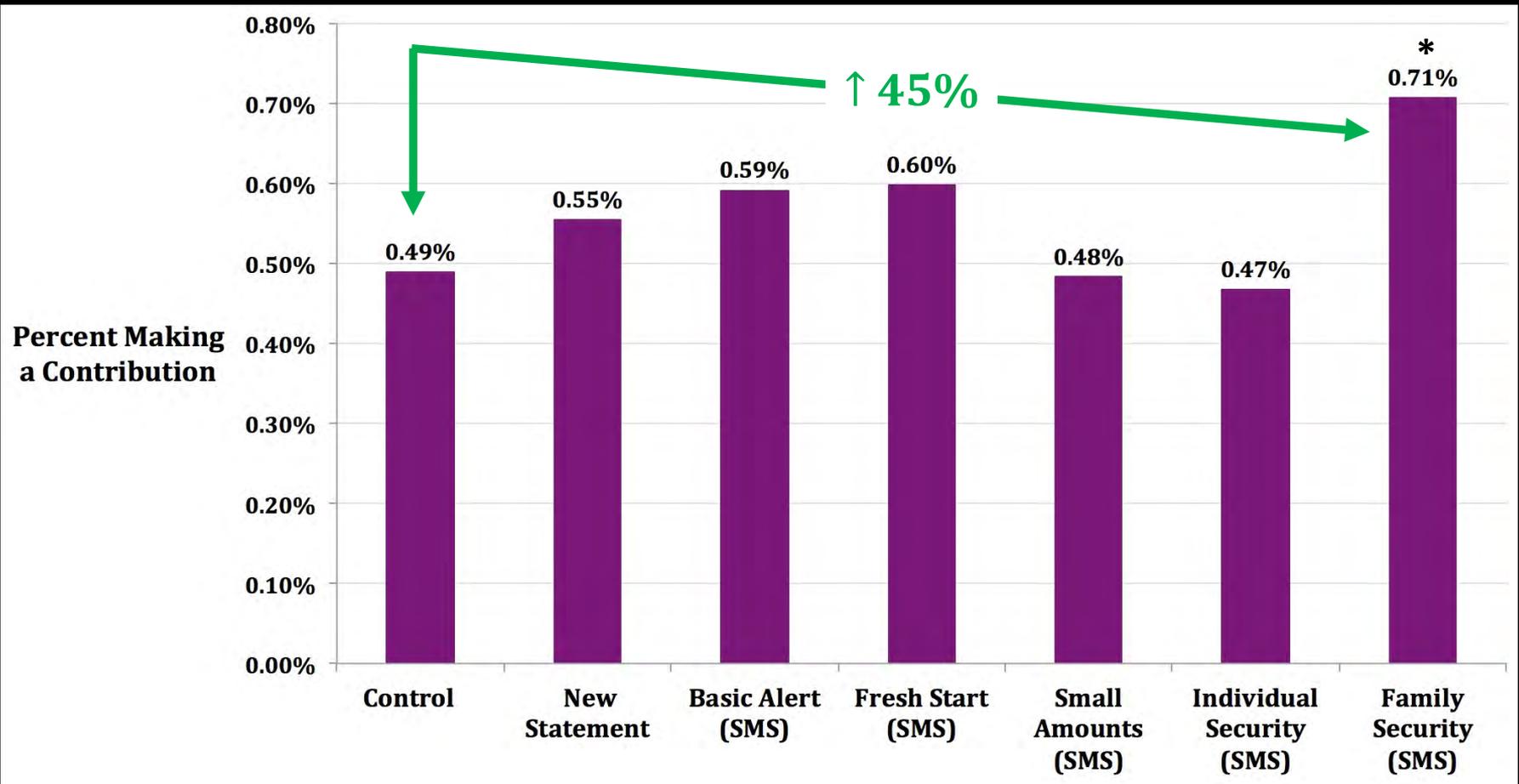# RCT: Using Nudges to Improve Contribution Rates

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	Made A Contribution (Oct. 3 - Dec 31, 2016)	Made A Contribution (After Jan. 1, 2017)	Total Contribution Amount	Average Contribution Amount	Number of Contributions
Constant	0.0049***				
	(0.001)				
New Statement	0.0007				
	(0.001)				
New + Reminder	0.0010				
	(0.001)				
New + Fresh Start	0.0011				
	(0.001)				
New + Small Amounts	-0.0001				
	(0.001)				
New + Future Security	-0.0002				
	(0.001)				
New + Family Security	0.0022**				
	(0.001)				
Dep. Var. Mean	0.0056				
N	97149				

Notes: Standard errors are shown in parentheses. Robust standard errors are used. *, **, and *** indicate significance at 10%, 5%, and 1% for a two-tailed test. In columns 1 through 3, the regression is done only for individuals who made a contribution after the experiment.

RCT: Using Nudges to Improve Contribution Rates

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Constant	0.0049***		3329.993***	2656.819***	2.515***
	(0.001)		(494.534)	(302.484)	(0.323)
New Statement	0.0007		187.411	593.235	-0.476
	(0.001)		(647.370)	(529.345)	(0.423)
New + Reminder	0.0010		-17.728	19.125	-0.356
	(0.001)		(629.054)	(377.383)	(0.420)
New + Fresh Start	0.0011		-236.166	267.428	-0.840**
	(0.001)		(554.571)	(401.222)	(0.362)
New + Small Amounts	-0.0001		99.241	445.636	0.023
	(0.001)		(897.807)	(817.992)	(0.468)
New + Future Security	-0.0002		-724.415	-260.133	-0.192
	(0.001)		(577.485)	(436.959)	(0.447)
New + Family Security	0.0022**		668.458	896.200	-0.351
	(0.001)		(732.353)	(621.923)	(0.417)
Dep. Var. Mean	0.0056		3364.153	2972.042	2.180
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Are All People Motivated by Family in the Same Way?

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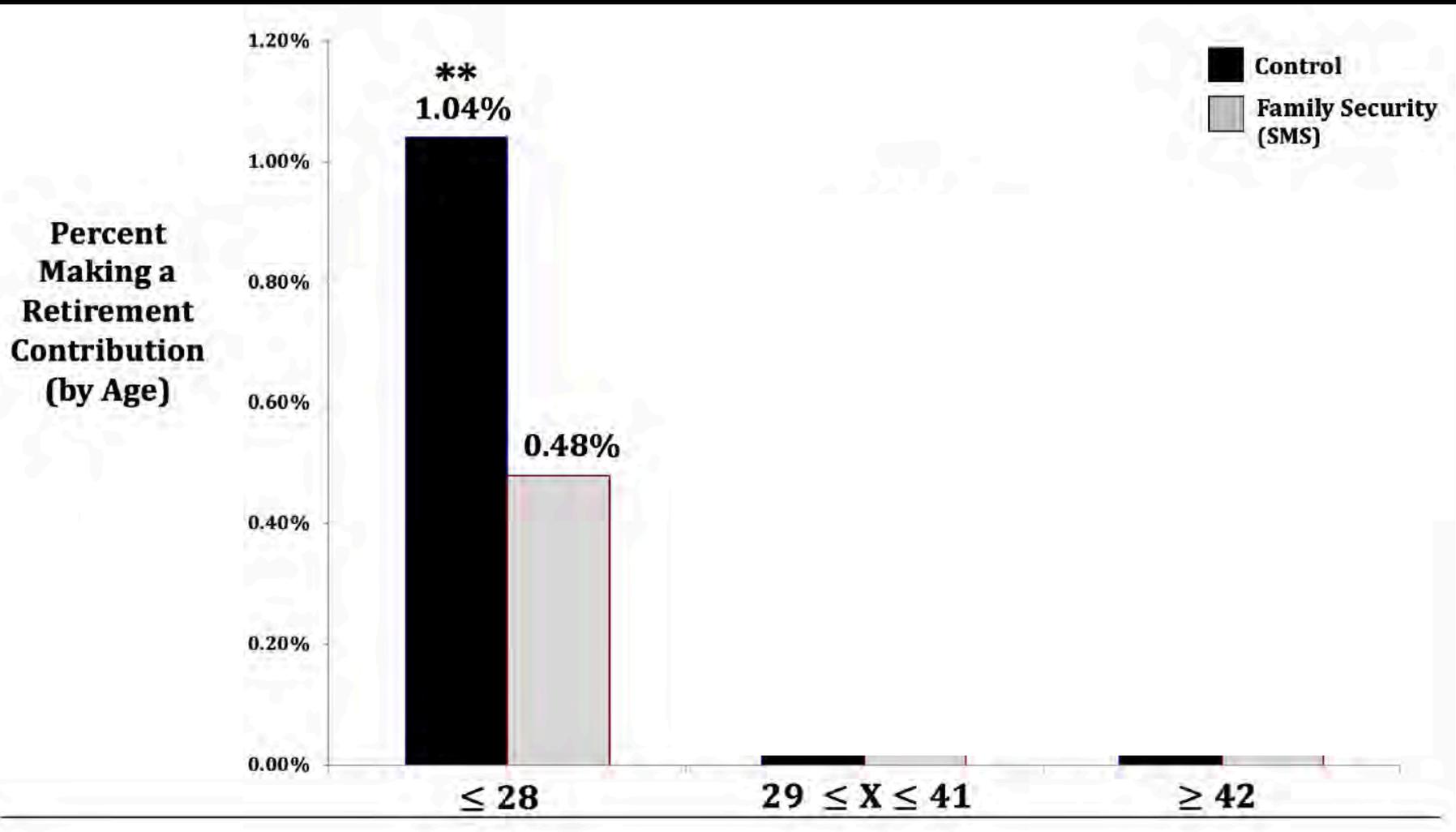
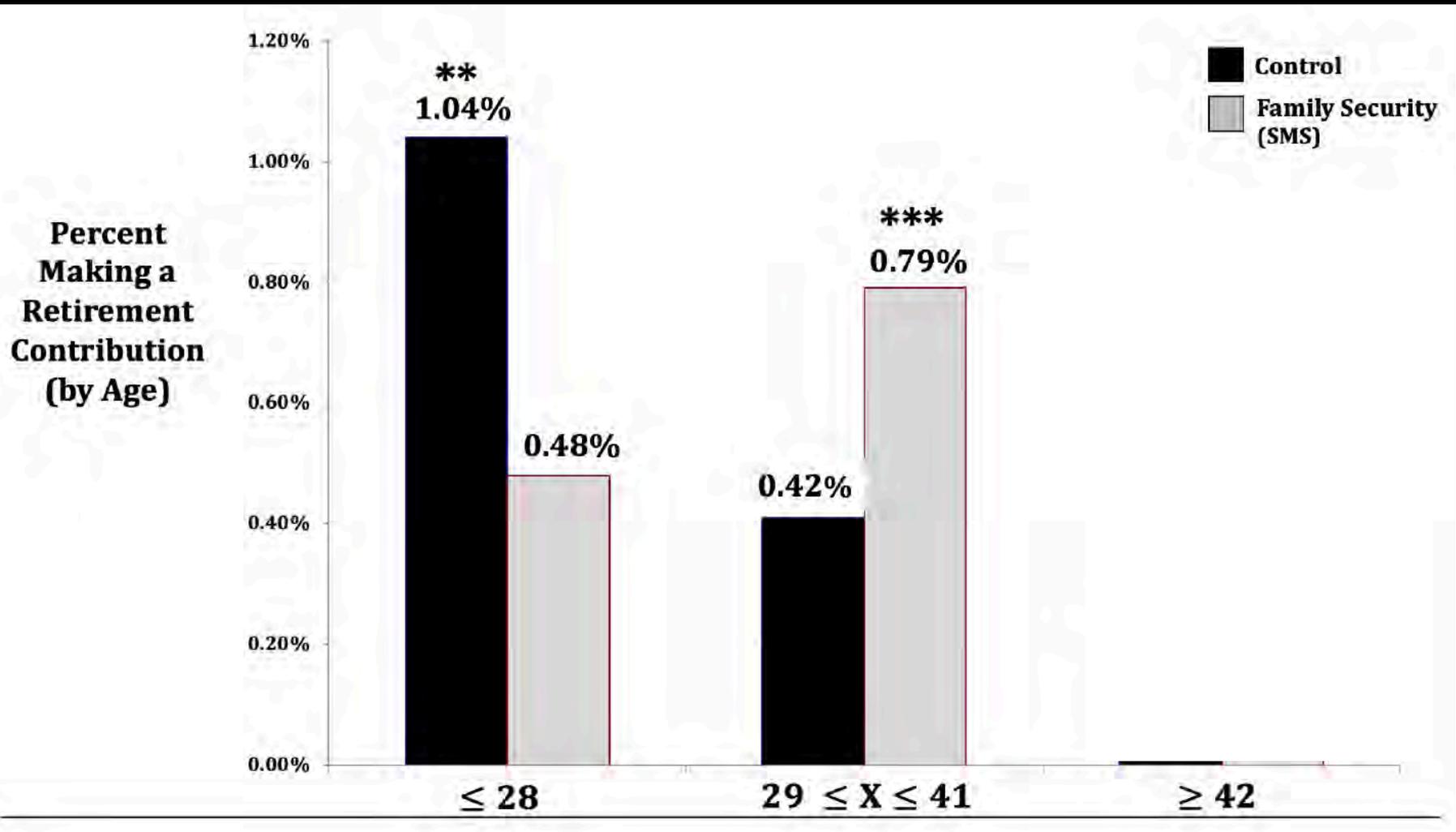# Are All People Motivated by Family in the Same Way?

Most Powerful Interactions: Machine Learning (CausalTree, Wager and Athey, 2017)
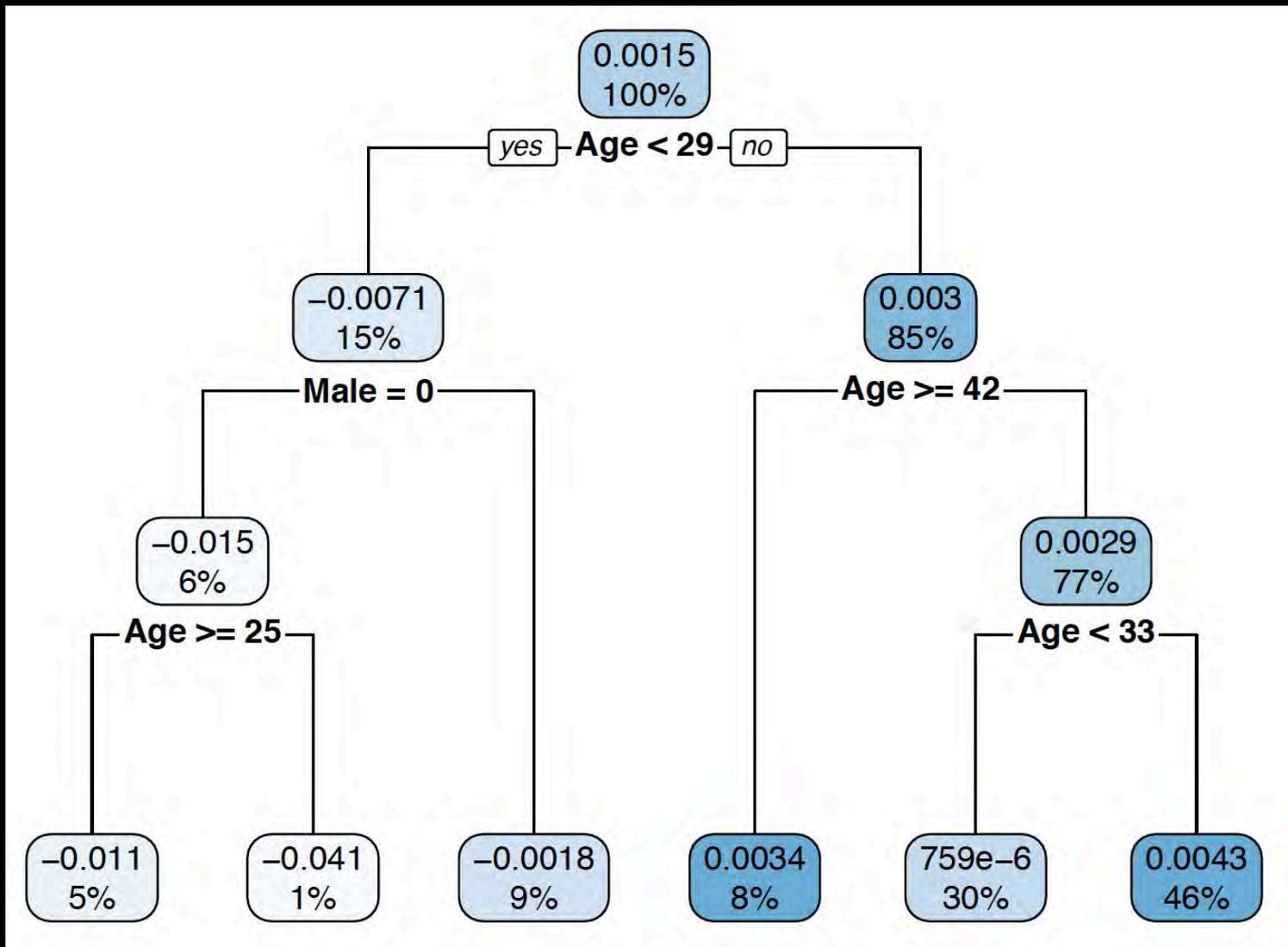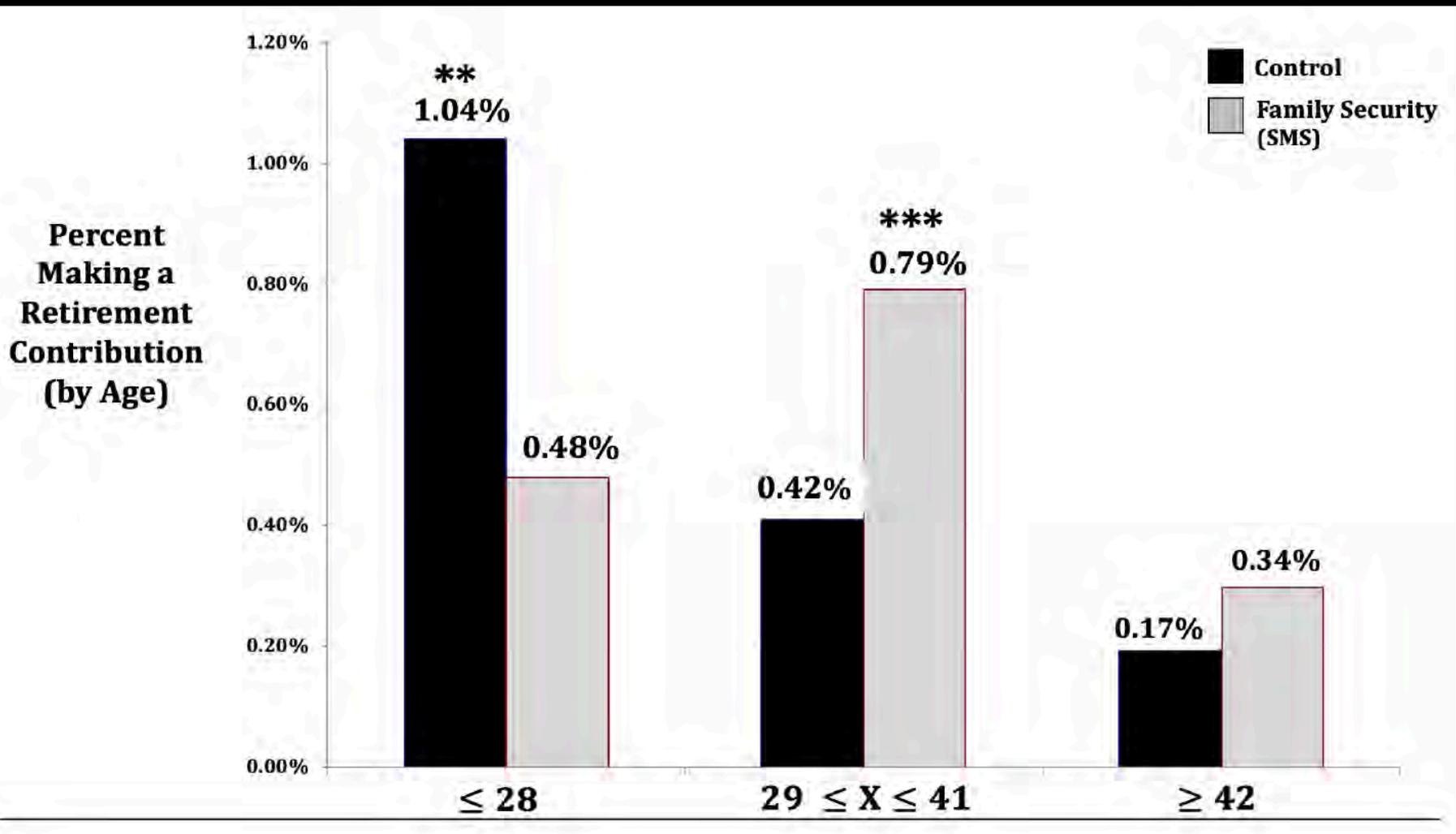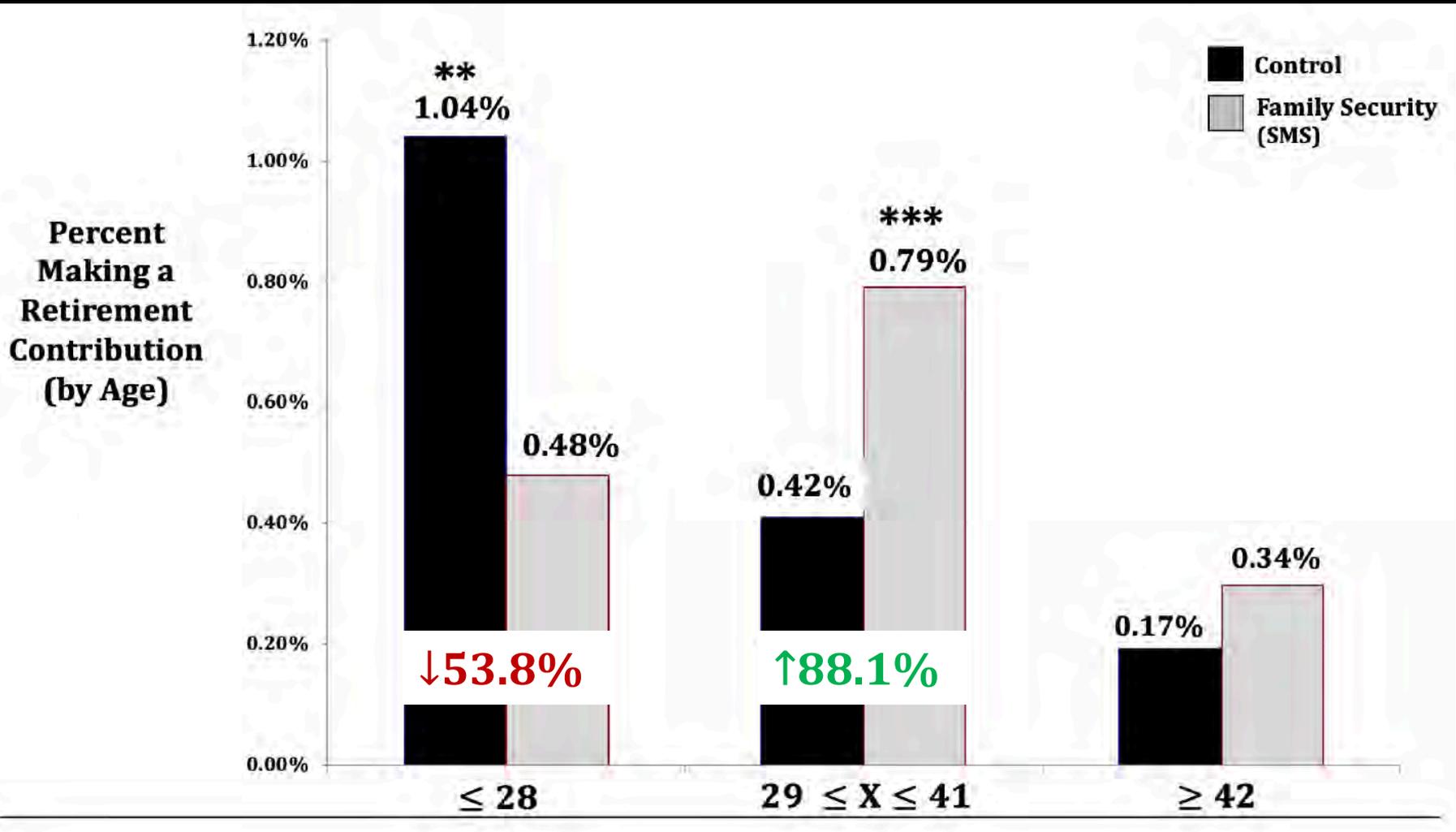
Behavioural Drivers and Age Effects in Retirement

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Takeaways

- **Building a More Behaviourally Informed Future**
  - Limited Attention
  - Present Bias/Myopia
  - Mental Accounting
  - Emotions
  - Availability Bias & Herding
  - Choice Overload

Takeaways

- Building a More Behaviourally Informed Future
  - Limited Attention
  - Present Bias/Myopia
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  - Choice Overload

- Everyone is in the game of behavior change!
  - Today more than ever, it's easier to combat bias to help consumers and decision-makers at every level improve efficiency!

Thank You!

Contact Info: avni.shah@utoronto.ca