

Introduction to Bounded Rationality and Limited Information

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Behavioral Economics G6943
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- In the first few lectures we are going to be focusing on the topics of bounded rationality
- And, in particular, limited attention
- Here I am going to offer an introduction to (how I understand) both topics

What is Bounded Rationality?

- Start with a 'standard' economic model
 - e.g. utility maximization

$$C(A) = \max_{x \in A} u(x)$$

- If the model is wrong how can we adjust it?
- Two 'minimal' adjustments we could make
 - ① Modify objective
 - ② Modify constraints
- Most of behavioral economics concerned with approach 1
 - Loss aversion
 - Ambiguity aversion
 - etc
- Bounded rationality concerned with approach 2
 - Optimal behavior within some additional costs/constraints

What is Bounded Rationality?

- Costs to acquiring or processing information
 - E.g. Simon [1955], Stigler [1961], Sims [2003]
- Limits on reasoning
 - E.g. Camerer [2004], Crawford [2005]
- Thinking Aversion
 - E.g. Ergin and Sarver [2010], Ortoleva [2013]
- Bounded memory
 - E.g. Wilson [2014]
- Automata
 - E.g. Piccione and Rubinstein [1993]
- Semi-Rational Models
 - E.g. Gabaix et al. [2008], Esponda [2008], Rabin and Vayanos [2010], Gabaix [2013],
- Heuristics
 - Tversky and Kahneman [1974], Gigerenzer [2000]

Advantages and Disadvantages of Bounded Rationality

- Advantage:
 - Intuitive plausibility
 - Evolution equipped us to optimize within constraints
 - Can 'microfound' behavioral models
 - Leads to new predictions: how behavioral phenomena can change with the environment
- Disadvantages:
 - May be wrong!
 - What is correct constraint?
 - Regress issue







- For this course I am going to focus on one particular constraint on decision making:
 - Understanding the world is hard!
- More specifically, there is an enormous amount of information out there that may be relevant for our choices
- It can be hard/impossible to process all of it
 - Even if it is 'freely' available
- This means there is likely to be a gap between the 'true' state of the world and that perceived by the decision maker

- This is
 - Fairly obvious through introspection

Am I fully Informed?

Not enough data to make a forecast

Stops	XMN	NYC	Dec 15 depart	Dec 15 arrive	Economy	1 cabin	Change
nonstop							
1 stop							
2+ stops							
Prices							
Take-off Eastern Mon 6:30a - 3:00p							
Take-off New York Mon 2:30p - 11:30p							
Show landing times							
Airports							
Depart/return same							
Xiamen							
XMN Xiamen							
New York							
EWR Newark	\$2434						
JFK John F. Kenn.	\$1483						
LGA LaGuardia							
Airlines							
Carrier Alliance							
Air China	\$1483						
China Eastern Air	\$2082						
United	\$2434						
Multiple airlines							
More filters							

Sort by: price (low to high)	176 of 218 flights	show all	Round-trip Segment		
\$1483 Expedia	 Air China	8:00a XMN 3:50p JFK	1:30p JFK 18h 30m 11:00p XMN 18h 10m	1 stop (PEK) 1 stop (PEK)	Economy
Select	Show details	Only 3 seats left at this price			
\$1483 Expedia	 Air China	7:40a XMN 3:50p JFK	1:30p JFK 18h 50m 11:00p XMN 18h 10m	1 stop (PEK) 1 stop (PEK)	Economy
Select	Show details				
\$1483 Expedia	 Air China	8:00a XMN 3:50p JFK	1:30p JFK 18h 30m 12:25a XMN 18h 35m	1 stop (PEK) 1 stop (PEK)	Economy <small>Shanghai Airlines operates flight 1151.</small>
Select	Show details				
\$1483 Expedia	 Air China	6:30a XMN 3:50p JFK	1:30p JFK 20h 00m 11:00p XMN 18h 10m	2 stops (TNA, PEK) 1 stop (PEK)	Economy <small>Shanghai Airlines operates flight 1151, 1151.</small>
Select	Show details				
\$1483 Expedia	 Air China	7:40a XMN 3:50p JFK	1:30p JFK 18h 50m 12:25a XMN 18h 35m	1 stop (PEK) 1 stop (PEK)	Economy <small>Shanghai Airlines operates flight 1151, 1151.</small>
Select	Show details				
\$1483 Expedia	 Air China	6:30a XMN 3:50p JFK	1:30p JFK 20h 00m 12:25a XMN 18h 35m	2 stops (TNA, PEK) 1 stop (PEK)	Economy <small>Shanghai Airlines operates flight 1151, 1151, 1151.</small>
Select	Show details				

Am I fully informed?

BROWN

Users Candidates Interviews Flyouts Offers Settings Help Logout

Candidate Functions

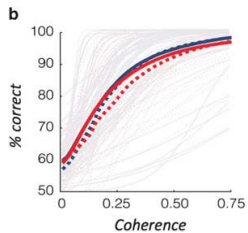
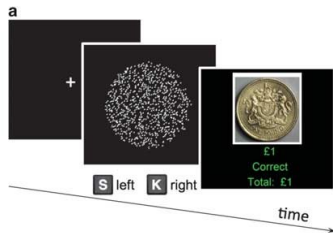
List Candidates Candidates by Field Review Assignments Search Candidates Search Recommendations Add Candidate My Favorite Candidates Make a Comment My Comments All Comments My Grades All Grades Placement Recommendations

List of Candidates by Primary Field (from EconJobMarket.org)

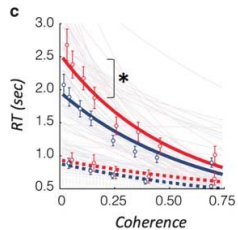
Click on the blue hyperlink to the number of candidates in each field to list all candidates in that field.
Click on the link to the number of assigned reviewers to assign (or modify the assignment) of reviewers for all candidates in the specified field.

#	Field	Assigned Committee Members	# Candidates	# Reviewers
1	Accounting		0	0
2	Any Field		9	0
3	Behavioral Economics		14	0
4	Business Economics		6	0
5	Computational Economics		0	0
6	Decision Sciences		1	0
7	Development		60	0
8	Econometrics		52	0
9	Economic History		9	0
10	Environmental Economics		23	0
11	Experimental Economics		6	0
12	Finance		67	0
13	Health, Education, Welfare Economics		37	0
14	Industrial Organization		45	0
15	Insurance		1	0
16	International Finance		19	0
17	International Trade		35	0
18	Labor		67	0
19	Law and Economics		0	0
20	Macroeconomics		118	0
21	Management, General		1	0
22	Management, Health Care		1	0
23	Management, Information Technology		1	0
24	Marketing		0	0
25	Microeconomics		84	0
26	Public Policy Research		0	0
27	Organizational Behavior		0	0
28	Other		4	0
29	Political Economy		7	0
30	Public Economics		32	0
31	Real Estate		1	0
32	Theory		25	0
33	Urban, Rural, Regional Economics		6	0
34	No primary field entered	Eggertson	0	0
35	All Candidates		731	0

- This is
 - Fairly obvious through introspection
 - Well documented in psychology experiments



■ HV
■ OCD
— No Cost
--- Cost



- This is
 - Fairly obvious through introspection
 - Well documented in psychology experiments
 - Documented in economics experiments

4
3
20
15
8

2
13
11
8
10

4+6+10-11-23+9

3+9-17-99+102-6+15

20-27+7-19+2+3-5

15-5-5+6+16+17-20-9

8+8+9-13-9-6+7

2+3+6-11-14+9+10

6+18-19-55+70

11+2-5+7-8-9+10

8+9+10-11+8+2+6-32

10-9+17-23+10+2+15

- Subjects choose between 'sums'

four plus eight minus four

- Value of option is the value of the sum
- 'Full information' ranking obvious, but uncovering value takes effort
- 6 treatments
 - 2 x complexity (3 and 7 operations)
 - 3 x choice set size (10, 20 and 40 options)
- No time limit

Size 20, Complexity 7

- zero
- seven minus four minus two minus four minus two plus eleven minus four
- six plus five minus eight plus two minus nine plus one plus four
- seven minus two minus four plus three plus four minus three minus three
- seven plus five minus two minus two minus three plus zero minus two
- six plus seven plus six minus two minus six minus eight plus four
- six plus two plus five minus four minus two minus seven plus three
- six minus four minus one minus one plus five plus three minus six
- two plus six plus seven minus two minus four minus two plus zero
- two minus three minus five plus nine minus one plus five minus three
- three plus zero plus two plus zero plus one minus three minus one
- four plus three plus zero minus two plus three plus four minus ten
- seven plus two plus seven minus seven plus three minus two minus two
- three plus three minus two plus zero plus zero minus four plus five
- two minus two plus zero plus nine minus two minus one minus one
- three plus four minus three plus three minus four plus three minus four
- three plus five plus seven plus five minus two minus seven minus ten
- three plus six minus eight plus one plus two minus two plus zero
- three plus five plus zero plus four plus three minus four minus two
- eight minus one plus one minus four minus four minus five plus six
- four minus five plus four minus one minus four plus zero plus four

Finished

Results

Failure rates (%) (22 subjects, 657 choices)

Failure rate		
Set size	Complexity	
	3	7
10	7%	24%
20	22%	56%
40	29%	65%

Results

Average Loss (\$)

Average Loss (\$)		
Set size	Complexity	
	3	7
10	0.41	1.69
20	1.10	4.00
40	2.30	7.12

- This is
 - Fairly obvious through introspection
 - Well documented in psychology experiments
 - Documented in economics experiments
 - The most straightforward explanation for many important economic behaviors

- Abaluck and Gruber: "Choice inconsistencies among the elderly: evidence from plan choice in the Medicare Part D program" [2011]

"Our findings are striking: along three dimensions, elders are making choices which are inconsistent with optimization under full information. First, elders place much more weight on plan premiums than they do on the expected out of pocket costs that they will incur under the plan. Second, they substantially under-value variance reducing aspects of alternative plans. Finally, consumers appear to value plan financial characteristics far beyond any impacts on their own financial expenses or risk. These findings are robust to a variety of specifications and econometric approaches."

- Chetty et al: "Salience and Taxation" [2009]
 - Prices are usually posted net of sales tax
 - Price is added at register
 - Adding a tag that includes the post tax price should be an 'inconsequential' change in the product
 - Does it affect choice?
- Experiment
 - Take 1 large supermarket
 - 30% of products have sales tax of 7.375% added at register
 - Take three 'impulse purchase' product categories
 - Cosmetics, hair care accessories, deodorants
 - 750 products in total
 - Add tags which displayed post tax price (as well as pre tax price)
 - Experiment lasted 3 weeks

TABLE 3
Effect of Posting Tax-Inclusive Prices: DDD Analysis of Mean Quantity Sold

<u>TREATMENT STORE</u>			
<u>Period</u>	<u>Control Categories</u>	<u>Treated Categories</u>	<u>Difference</u>
Baseline (2005:1- 2006:6)	26.48 (0.22) [5,510]	25.17 (0.37) [754]	-1.31 (0.43) [6,264]
Experiment (2006: 8- 2006:10)	27.32 (0.87) [285]	23.87 (1.02) [39]	-3.45 (0.64) [324]
Difference over time	0.84 (0.75) [5,795]	-1.30 (0.92) [793]	DD_{TS} = -2.14 (0.68) [6,588]
<u>CONTROL STORES</u>			
<u>Period</u>	<u>Control Categories</u>	<u>Treated Categories</u>	<u>Difference</u>
Baseline (2005:1- 2006:6)	30.57 (0.24) [11,020]	27.94 (0.30) [1,508]	-2.63 (0.32) [12,528]
Experiment (2006: 8- 2006:10)	30.76 (0.72) [570]	28.19 (1.06) [78]	-2.57 (1.09) [648]
Difference over time	0.19 (0.64) [11,590]	0.25 (0.92) [1,586]	DD_{CS} = 0.06 (0.95) [13,176]
		DDD Estimate	-2.20 (0.59) [19,764]

Notes: Each cell shows mean quantity sold per category per week, for various subsets of the

- Basic message of these first two papers is that 'people screw up'
- Other examples include:
 - Bhargava, Saurabh, and Dayanand Manoli. 2015. "Psychological Frictions and the Incomplete Take-Up of Social Benefits: Evidence from an IRS Field Experiment." *American Economic Review*, 105 (11): 3489-3529.
 - Saurabh Bhargava, George Loewenstein, and Justin Sydnor. Choose to lose: Health plan choices from a menu with dominated option. *The Quarterly Journal of Economics*, 132(3):1319|1372, 2017.
 - Benjamin R Handel and Jonathan T Kolstad. Health insurance for "humans": Information frictions, plan choice, and consumer welfare. *American Economic Review*, 105(8):2449{2500, 2015.
 - Kling, Jeffrey R., Sendhil Mullainathan, Eldar Shafir, Lee C. Vermeulen, and Marian V. Wrobel. 2012. "Comparison friction: Experimental evidence from Medicare drug plans." *The Quarterly Journal of Economics* 127, no. 1: 199-235.

Sluggish Price Responses (Boivin et al. 2009)

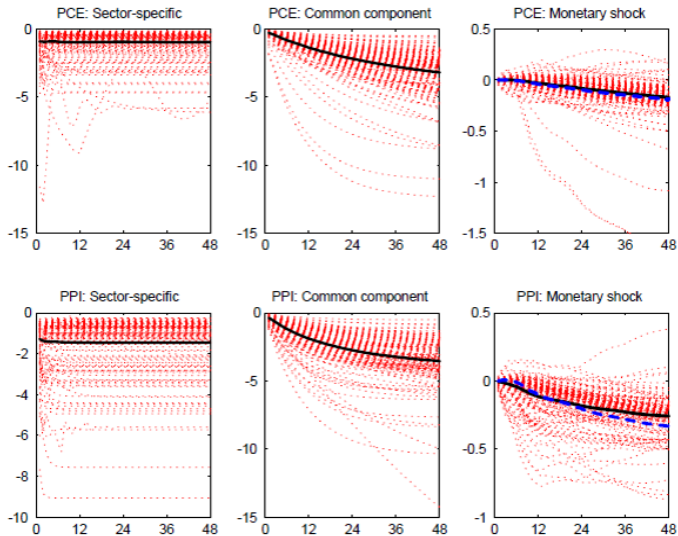


Figure 2. Sectoral price responses to various shocks

- This is
 - Fairly obvious through introspection
 - Well documented in psychology experiments
 - Documented in economics experiments
 - The most straightforward explanation for many important economic behaviors
 - Potentially an explanation for many behavioral economic phenomena

Behavioral Economics as Limited Attention

- As you will see from this week's reading, if you squint you can use inattention to explain
 - Existence of shrouded attributes
 - Inattention to taxes
 - Nominal Illusion
 - Hyperbolic discounting
 - Prospect theory
 - Projection bias
 - Base rate neglect
 - Correlation neglect
 - Overconfidence
 - Left digit bias.....

- Limited attention is absolutely ubiquitous
- It is always the case that there is more potentially relevant information than we can (or should) process
- We are always making decisions based on a restricted data set
- The data set a decision maker uses is not (easily) observable to the outside researcher

- This leads to a number of first order important questions
- ① How is the information that people use determined?
 - Do they selected it rationally?
 - Is it determined by features of the environment such as salience?
 - Do they use simplifying heuristics?
 - ② How should we adjust our economic models to take limited attention into account?
 - This question could be asked in pretty much an field you care to imagine
 - Currently mainly done in macro and a bit in IO
 - ③ What are the normative implications?
 - Choice no longer equals preference
 - If attention is costly this should be taken into account
 - Are more options always better?