Psychology and Economics

14.13 Lecture 14: Attention

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Some housekeeping

- Don't expect too much from yourself (and others)
- Be kind and forgiving to yourself and others
- Remember: class is pass/fail
- Mid-term on Monday (will send details by email)
- Pset due at 6 pm today.

Overview of this class

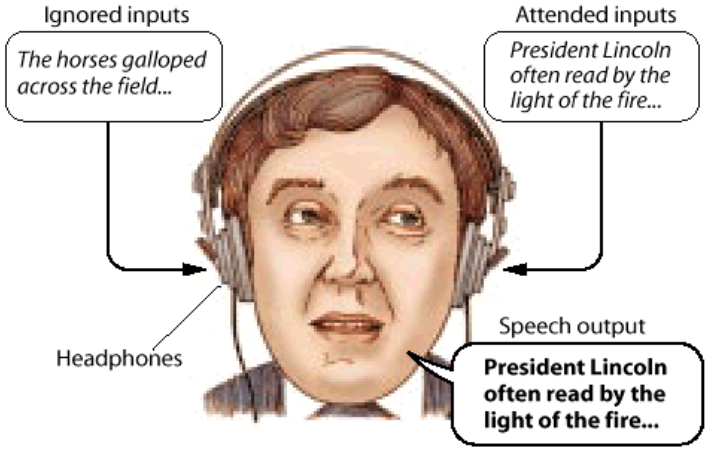
- Time, risk, and social preferences
- Beliefs
  - Attention
  - Beliefs and learning
- Decision-making
  - Mental accounting
  - Defaults, frames, nudges
- Policy and welfare
  - Malleability and inaccessibility of preferences
  - Gender and racial discrimination
  - Happiness and mental health
  - Policy and paternalism
  - Poverty through the lens of psychology

Overview: limited attention

- Introduction and motivating evidence
- Chetty et al. (2009): inattention to taxes
- Hanna et al. (2014): learning by noticing

Due to copyright restrictions, we aren't able to include the video "Movie Perception Test." You can view it on YouTube.

Dichotic listening (Broadbent, 1958)



Attention is limited.

- Plenty of examples of "inattention" or "change blindness" (Neisser 1979, Simons and Chabris 1999)
- Dichotic listening experiments (Broadbent, 1958)
  - Hear two messages:
    (1) in left ear
    (2) in right ear
  - Instructed to attend to message in one ear
  - When asked later about message in other ear, people cannot remember it.
  - More importantly: When asked to keep a number in their head, people remember the played message much less.

Attention is malleable.

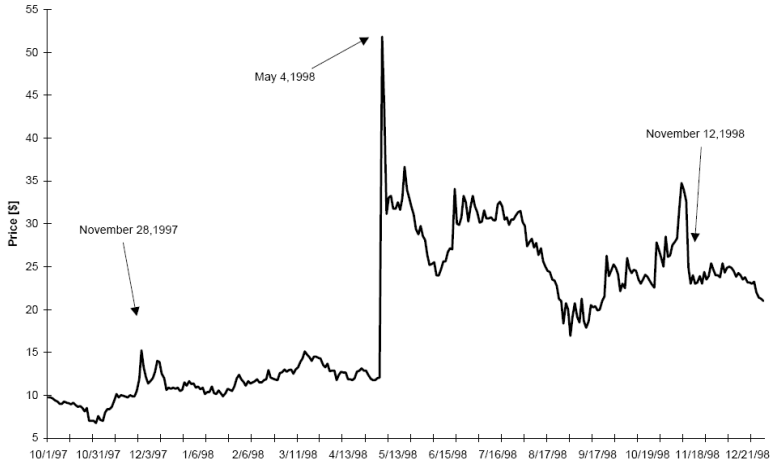
- What factors might affect attention?
  - Distractions (e.g. social media)
  - Worries (e.g. about own or others' well-being)
  - Sleep
  - Practice?
  - Other?

Is inattention limited to low-stakes situations?

- Event of economic importance: Huberman-Regev (2001)
- Timeline:
  - October-November 1997: Company EntreMed has very positive early results on a cure for cancer
  - Nov 28, 1997: *Nature* prominently features; *New York Times* reports on page A28
  - May 3, 1998: *New York Times* features essentially same article as on Nov 28, 1997 on front page
  - Nov 12, 1998: *Wall Street Journal* front page about failed replication
- What happened to EntreMed stock prices?
  - In a world of full attention with unlimited arbitrage?
  - And in reality?

EntreMed stock price over time

Figure 5: ENMD Closing Prices and Trading Volume 10/1/97-12/30/98



How do we measure the impact of attention?

- Impact of reminders on behavior
  - Plenty of evidence, e.g. on saving or medical adherence
- Impact of making some features (e.g. taxes) salient
  - Chetty et al. (2009)
- Impact of information when 'correct' response is known
  - Hanna et al. (2014)

Simple model (DellaVigna, 2009)

- Consider good with value V (inclusive of price), sum of two components: $V = v + o$
  - (1) Visible (salient) component v
  - (2) Opaque component o

- Inattention
  - Consumer perceives the value $\hat{V} = v + (1 - \theta)\, o$
  - Degree of inattention θ, with $\theta = 0$ standard case
  - Interpretation: each individual sees o, but processes it only partially, to the degree θ.

Inattention to taxes: Chetty et al. (2009)

- Taxes not featured in price are likely to be ignored.
  - Sales tax only added at the register
  - Compare demand response to sales taxes changes vs. to other prices changes
- Data on the demand for items in a grocery store
- Demand $D(\hat{V})$ is a function of perceived value $\hat{V}$.
  - Visible part of the value v, including the price p
  - Less visible part o (state tax: $-tp$)
  - $\hat{V} = v + (1-\theta)o = v - (1-\theta)\,tp$
  - Note that $\frac{dD}{d\hat{V}} > 0$ (and therefore $\frac{dD}{dp} < 0$).

Effect of making the tax fully salient

- Linearization: change in log demand when θ falls to 0

$$\begin{aligned}
\Delta \log D &= \log D\left[v - tp\right] - \log D\left[v - (1-\theta)\, tp\right] \\
&\approx -\theta tp \cdot \frac{d \log D[v-(1-\theta)tp]}{d\theta} \\
&= -\theta \underbrace{tp * D'\left[v - (1-\theta)\, tp\right] / D\left[v - (1-\theta)\, tp\right]}_{d \log D[v-(1-\theta)tp]/d\theta} \\
&= -\theta t * \eta_{D,p}
\end{aligned}$$

- $\eta_{D,p}$ is the price elasticity of demand $(-\frac{p}{D} \cdot \frac{dD}{dp})$
- This implies $\theta = -\Delta \log D/(t * \eta_{D,p})$, which Chetty et al. (2009) try to measure.

Field experiment to estimate inattention parameter θ

- Goal: Estimate the change in demand from making taxes fully salient
- Three-week period: modify price tags of certain items
- Make after-tax price salient (in addition to pre-tax price)

Triple-differences design

- Compare sales D during treatment period to:
  - previous-week sales for same items
  - sales for items for which tax was not made salient
  - sales in control stores

Triple-differences estimates

TABLE 3
DDD Analysis of Means: Weekly Quantity by Category

TREATMENT STORE

Period	Control Categories	Treated Categories	Difference
Baseline (2005:1-2006:6)	26.48 (0.22) [5510]	25.17 (0.37) [754]	-1.31 (0.43) [6264]
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) [5795]	-1.30 (0.92) [793]	**DD_{TS} = -2.14** (0.64) [6588]

CONTROL STORES

Period	Control Categories	Treated Categories	Difference
Baseline (2005:1-2006:6)	30.57 (0.24) [11020]	27.94 (0.30) [1508]	-2.63 (0.32) [12528]
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) [11590]	0.25 (0.92) [1586]	**DD_{CS} = 0.06** (0.90) [13176]
		DDD Estimate	***-2.20*** (0.58) [19764]

Notes: Each cell shows mean number of units sold per category per week, for various subsets of the sample. Standard errors (clustered by week) in parentheses, number of observations in square

- Two difference-in-differences estimates:
  (1) Change in demand in treatment stores.
  (2) Change in demand in control stores.
- Triple-difference estimate: (1) - (2)

Results

- Average quantity sold decreases (significantly) by 2.20 units relative to a baseline level of 25, an 8.8 percent decline
- Compute inattention parameter $\theta = -\Delta \log D/(t * \eta_{D,p})$
  - Estimates of price elasticity $\eta_{D,p}$: 1.59
  - Tax is $t = .07375$
  - $\theta = -(-.088)/(1.59 * .07375) \approx .75$
- Interpretation: Consumers react to price changes due to sales tax changes only a quarter as much as to other price changes.

Non-experimental panel-data variation

- Compare demand responses to more and less salient taxes on beer consumption
  - Excise tax is included in the price (highly salient during choice process)
  - Sales tax is added at the register (opaque during choice process)
- Panel identification: consider variation across states and over time
- Indeed, elasticity to excise taxes substantially larger.
  - Estimate of the inattention parameter of $\theta = .94$
  - Substantial consumer inattention to non-transparent taxes

Results from panel variation

TABLE 7
Effect of Excise and Sales Taxes on Beer Consumption

Dependent Variable: Change in Log(per capita beer consumption)

	Baseline (1)	Bus Cycle (2)	Bus Cycle Lags (3)	Alc Regulations (4)
ΔLog(1+Excise Tax Rate)	**-0.87** (0.17)***	**-0.91** (0.17)***	**-0.86** (0.17)***	**-0.89** (0.17)***
ΔLog(1+Sales Tax Rate)	**-0.20** (0.30)	**-0.00** (0.30)	**0.03** (0.30)	**-0.02** (0.30)
ΔLog(Population)	0.03 (0.06)	-0.07 (0.07)	0.05 (0.19)	-0.07 (0.07)
ΔLog(Income per Capita)		0.22 (0.05)***	0.18 (0.05)***	0.22 (0.05)***
ΔLog(Unemployment Rate)		-0.01 (0.01)**	-0.01 (0.01)	-0.01 (0.01)**
Lag Bus. Cycle Controls			x	
Alcohol Regulation Controls				x
Year Fixed Effects	x	x	x	x
F-Test for Equality of Tax Variables (Prob>F)	0.05	0.01	0.01	0.01
Sample Size	1607	1487	1440	1487

- Relatively high elasticity of demand wrt. salient excise taxes
- Low (zero) elasticity of demand wrt. non-salient excise taxes
- Ratio of the two elasticities (and some algebra) yields $\theta = 0.94$

Inattention to taxes: (why) should we care?

- Reduced distortions from taxation?
  - Government levies sales tax to generate revenue.
  - But taxes (can) distort consumer choices.
  - Distortion much lower if people don't (fully) react to taxes
  - Want higher taxes on goods for which people don't attend to prices.
- But government *wants* consumers to react to some taxes.
  - Excise taxes levied to reduce externalities and internalities
  - Want to make such taxes particularly salient
- Interesting issues when consumers are heterogeneous

Can attention have large effects?

- People's choices (e.g. consumption patterns) distorted due to limited attention
- Open questions
  - What is salient to people?
  - (How) do people decide what to focus on?
  - Won't people pay attention to important things anyway (rational inattention)?
  - Is it possible for inattention to have large effects?

Learning by noticing: intuitive example

- Consider the following situation:
  - You have been getting headaches.
  - Doctor asks whether it gets worse after eating certain foods.
- What do you answer?

Why "I don't know"?

- We can only learn from encoded information.
  - We didn't suspect food allergies to be a likely cause.
  - We didn't attend to and encode how we felt after eating.
  - Relationship between attention and memory
- Selective attention may have persistent effects on what we learn (Schwartzstein 2014).

Another example

- Problem: Many women died from childbed fever at hospitals in the mid-19th century.
- Popular theories: Bad smells at the hospital; presence of male doctors wounded the modesty of mothers (Nuland 2003)
- True explanation: Germs. Doctors didn't wash their hands.
- Took a long time to discover. Why?

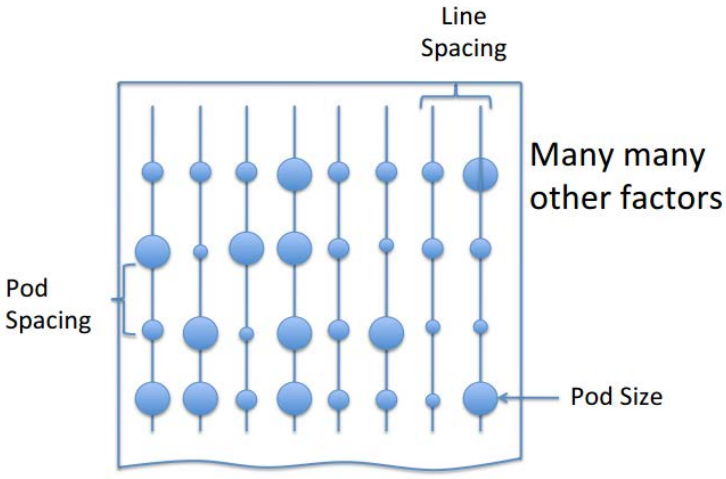
Basic insights from Schwartzstein (2014)

- Beliefs today $\rightarrow$ what is attended to today $\rightarrow$ beliefs tomorrow
- May fail to learn to attend to important aspects of the world
- Forecasts and beliefs may be persistently biased, but in a *systematic* fashion.
- May persistently mis-react and misattribute cause to unimportant variables

Seaweed farming

Image by Derek Keats. CC BY

Many factors are important.



Experimental Setting

- Project conducted with seaweed farmers in Indonesia
- Farmers use the "bottom method":
  - Drive wooden stakes in shallow bottom near shore; attach lines through stakes
  - Take raw seaweed from last harvest and cut into pods
  - Pods are planted by attaching them at a given interval on the lines in the sea.
  - At low tide, farmers tend the plots.
  - Seaweed is harvested after about 35 to 40 days.
- Tons of dimensions could matter: pod size, distance between lines, distance between pods, timing, ...
  - An advantage of seaweed: many pods, so can try to estimate importance of these factors

Farmers are experienced and educated.

- Baseline questionnaire (at beginning of study): demographics, income, and farming methods
- On average, farmers have 18 years of experience farming seaweed; 83% are literate.
- Enumerators then visited one of the farmer's plots to measure and document farming methods.

Most farmers don't know their current pod size.

	Percent Unable to Provide Answer (1)	Mean (2)
	Panel A: Self-Reported Current Production Methods	
Current Pod Size	86%	118.11
Length of Typical Line	2%	5.05
Distance Between Lines	1%	16.49
	Panel B: Beliefs on Optimal Production Methods	
Optimal Pod Size	87%	148.26
Optimal Distance Between Knots	2%	15.97
Optimal Distance Between Lines	2%	16.39
Optimal Cycle Length	1%	37.43

- Majority of farmers:
  - (i) do not know their current pod size;
  - (ii) do not even have a guess regarding the optimal pod size.

- Farmers seem to neglect pod-size dimension entirely!

Experimental trial

- Enumerators varied the seaweed production methods across 10 lines of a plot with the farmer's assistance and tracked returns.
  - *Sort subtreatment* ($N = 65$): farmers asked to cut pods as they normally would for plot in question; sorted pods by size.
  - *Weight condition* ($N = 52$): pods of different sizes were exogenously created; randomly distributed across the 10 lines.
  - Distance between pods was also randomized.

- Will farmers learn on their own from this experiment?
  - Should have all the info needed to learn that pod size matters
  - But might not learn if don't attend to pod size at all

Follow-up surveys

- First follow-up survey was designed to learn whether farmers changed any of their methods after participating in the trial.
- After the first follow-up survey, enumerators provided the experimental results to each farmer.
- After that, a second follow-up survey was conducted to determine the effect of having received the trial results.

Information provision

Example of Presented Trial Results

A. Weight Example

Pod Size	Distance	#Pods per line	Initial investment	Return per line
40	15	33	1650	4510
40	20	26	1300	3553
60	15	33	2310	1517
60	20	26	1820	1195
80	15	33	2970	1871
80	20	26	2340	1474
100	15	33	3630	1904
100	20	26	2860	1500
120	15	33	4290	597
120	20	26	3380	470
140	15	33	4950	1574
140	20	26	3900	1240

Currently

Pod Weight: 152.5 **Distance: 15**

Recommendation:

Pod Weight: 40 **Distance: 15**

- Recommendations regarding pod weight and distance
- No info given that farmers didn't already have access to

Courtesy of Rema Hanna, Sendhil Mullainathan, and Joshua Schwartzstein. Used with permission.

Results

- Large estimated gains from changing farming methodology
- Trial participation only has small (insignificant) effect.
- Summarizing data (in addition) has much larger effect.
- No impact of participating in trial on its own
  - Large impact of trial *if* data from trial is presented to farmers
  - No impact of trial on dimensions farmers already noticed.

Lessons and interpretation

- Systematic learning failures even though all info was available.
- Farmers simply did not pay attention because they did not think that pod size was relevant.
- Potential explanation why people might not pay attention even to important information
- Lack of attention might generate arbitrarily large welfare losses

What's next?

- Monday (April 6): mid-term exam
- Wednesday (April 8) and Monday (April 13): beliefs and learning

References used in this lecture I

Chetty, Raj, Adam Looney, and Kory Kroft, "Salience and Taxation: Theory and Evidence," *American Economic Review*, 2009, *99* (4), 1145–1177.

DellaVigna, Stefano, "Psychology and Economics: Evidence from the Field," *Journal of Economic Literature*, 2009, *47(2)*, 315–372.

Hanna, Rema, Sendhil Mullainathan, and J. Schwartzstein, "Learning Through Noticing: Theory and Evidence from a Field Experiment," *Quarterly Journal of Economics*, 2014, *129* (3), 1311–1353.

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