Psychology and Economics
14.13 Lecture 14: Attention

Frank Schilbach

MIT

April 1, 2020
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)

Ignored inputs

*The horses galloped across the field...*

Attended inputs

*President Lincoln often read by the light of the fire...*

Speech output

*President Lincoln often read by the light of the fire...*
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

- What happened to EntreMed stock prices?
  - In a world of full attention with unlimited arbitrage?
  - And in reality?
Motivating evidence

Inattention to taxes

Learning by noticing

References

EntreMed stock price over time

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

© John Wiley & Sons, Inc. All rights reserved. This content is excluded from our Creative Commons license. For more information, see https://ocw.mit.edu/help/faq-fair-use/
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 $\theta$, with $\theta = 0$ standard case
  
  - Interpretation: each individual sees $o$, but processes it only partially, to the degree $\theta$. 
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 $\theta$ falls to 0

\[
\Delta \log D = \log D[v - tp] - \log D[v - (1 - \theta) tp] \\
\approx -\theta tp \cdot \frac{d \log D[v - (1 - \theta) tp]}{d \theta} \\
= -\theta tp \cdot D' [v - (1 - \theta) tp] / D [v - (1 - \theta) tp] \\
= -\theta t \cdot \eta_{D,p}
\]

- $\eta_{D,p}$ is the price elasticity of demand ($-\frac{P}{D} \cdot \frac{dD}{dp}$)

- This implies $\theta = -\Delta \log D / (t \cdot \eta_{D,p})$, which Chetty et al. (2009) try to measure.
Field experiment to estimate inattention parameter $\theta$

- **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)**

© American Economic Association. All rights reserved. This content is excluded from our Creative Commons license. For more information, see https://ocw.mit.edu/help/faq-fair-use/
Motivating evidence

Inattention to taxes

Learning by noticing

References

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
Motivating evidence

Inattention to taxes

Learning by noticing

References

Triple-differences estimates

<table>
<thead>
<tr>
<th>Period</th>
<th>Control Categories</th>
<th>Treated Categories</th>
<th>Difference</th>
<th>Difference over time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>26.48</td>
<td>25.17</td>
<td>-1.31</td>
<td></td>
</tr>
<tr>
<td>(2005:1-2006:6)</td>
<td>(0.22)</td>
<td>(0.37)</td>
<td>(0.43)</td>
<td></td>
</tr>
<tr>
<td>Experiment</td>
<td>27.32</td>
<td>23.87</td>
<td>-3.45</td>
<td></td>
</tr>
<tr>
<td>(2006:8-2006:10)</td>
<td>(0.87)</td>
<td>(1.02)</td>
<td>(0.64)</td>
<td></td>
</tr>
<tr>
<td>Difference over time</td>
<td>0.84</td>
<td>-1.30</td>
<td>DD_{12} = -2.14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.75)</td>
<td>(0.92)</td>
<td>(0.64)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[5796]</td>
<td>[703]</td>
<td>[6586]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Period</th>
<th>Control Categories</th>
<th>Treated Categories</th>
<th>Difference</th>
<th>Difference over time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>30.57</td>
<td>27.94</td>
<td>-2.63</td>
<td></td>
</tr>
<tr>
<td>(2005:1-2006:6)</td>
<td>(0.24)</td>
<td>(0.30)</td>
<td>(0.32)</td>
<td></td>
</tr>
<tr>
<td>Experiment</td>
<td>30.76</td>
<td>28.19</td>
<td>-2.57</td>
<td></td>
</tr>
<tr>
<td>(2006:8-2006:10)</td>
<td>(0.72)</td>
<td>(1.06)</td>
<td>(1.09)</td>
<td></td>
</tr>
<tr>
<td>Difference over time</td>
<td>0.19</td>
<td>0.25</td>
<td>DD_{12} = 0.06</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.64)</td>
<td>(0.92)</td>
<td>(0.90)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[11590]</td>
<td>[1586]</td>
<td>[13176]</td>
<td></td>
</tr>
</tbody>
</table>

**References**

© American Economic Association. All rights reserved. This content is excluded from our Creative Commons license. For more information, see https://ocw.mit.edu/help/faq-fair-use/
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 $\theta = -\Delta \log D / (t \times \eta_{D,p})$
  - Estimates of price elasticity $\eta_{D,p}$: 1.59
  - Tax is $t = .07375$
  - $\theta = -(\.088) / (1.59 \times .07375) \approx .75$

- 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>
<thead>
<tr>
<th>TABLE 7</th>
<th>Effect of Excise and Sales Taxes on Beer Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable: Change in Log(per capita beer consumption)</td>
<td>Baseline</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td><strong>ΔLog(1+Excise Tax Rate)</strong></td>
<td>-0.87 (0.17)**</td>
</tr>
<tr>
<td><strong>ΔLog(1+Sales Tax Rate)</strong></td>
<td>-0.20 (0.30)</td>
</tr>
<tr>
<td>ΔLog(Population)</td>
<td>0.03 (0.06)</td>
</tr>
<tr>
<td>ΔLog(Income per Capita)</td>
<td>0.22 (0.05)**</td>
</tr>
<tr>
<td>ΔLog(Unemployment Rate)</td>
<td>-0.01 (0.01)**</td>
</tr>
<tr>
<td>Lag Bus. Cycle Controls</td>
<td>x</td>
</tr>
<tr>
<td>Alcohol Regulation Controls</td>
<td>x</td>
</tr>
<tr>
<td>Year Fixed Effects</td>
<td>x</td>
</tr>
<tr>
<td>F-Test for Equality of Tax Variables (Prob&gt;F)</td>
<td>0.05</td>
</tr>
<tr>
<td>Sample Size</td>
<td>1607</td>
</tr>
</tbody>
</table>

- 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.

- 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!

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

- Enumerators varied the seaweed production methods across 10 lines of a plot with the farmer’s assistance and tracked returns.
  - *Sort subtrement* ($N = 65$): 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.
Motivating evidence

Inattention to taxes

Learning by noticing

References

Information provision

<table>
<thead>
<tr>
<th>Example of Presented Trial Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Weight Example</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Pod Size</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>120</td>
</tr>
<tr>
<td>120</td>
</tr>
<tr>
<td>140</td>
</tr>
<tr>
<td>140</td>
</tr>
</tbody>
</table>

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

