# The Role of Information in Behavioral and Environmental Health Economics: An Experimental Approach

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# Motivation

Rational Choice Theory

Policy relevance

How do people deviate from rational choice theory?

# Key Research Questions

- How do households process and respond to information on long-term latent cancer risks?
  - Perception of risk
  - Improved understanding of risks
- Does framing of risk information matter?
  - Health gains versus health losses
- Do bright lines matter?
- How does relative risk information affect risk perception?

# Relevant Literatures

## Information Disclosure

- Government mandated disclosures: Khanna et al. 1998, Hamilton 2005
- Firm/facility response: King and Lenox 2001, Bennear 2008
- Household response: Jalan and Somanathan 2004, Shimshack at al. 2007, Balasubramanya et al. 2010

## Behavioral Economics

- Framing Effects: Kahneman and Tversky 1979, Künberger 1998

## Health and Risk Communication

# Behavioral Economics and Risk Communication: Health

- Sunscreen
  - Detweiler et al 1999
- Prevention vs Detection Behaviors
  - Rothman and Salovey 1997, Detweiler et al. 1999, Rothman et al. 1999, Schneider et al. 2001, Salovey and Williams-Piehota 2004, Rivers et al. 2005

# Experimental Design

Hypothetical setup

Repeated Questions

- How concerned are you about the level of arsenic in the water from your new private well?
- How likely do you think it is that you will get sick from drinking water from your new private well?
- How likely do you think it is that you will get cancer from drinking water from your new private well?
- Overall, to what extent do you believe it is important that you take action to address the levels of arsenic in water from your new private well?

# Experimental Manipulations and Hypotheses

Framing of health risk information

Arsenic level

Bright lines

- EPA standard for arsenic in public drinking water: 10 ppb
- NC State health-based recommendation: 0.02 ppb

Relative risk information

# Examples of Frames

| Gains Frame | Loss Frame |
| --- | --- |
| Reducing your exposure to arsenic decreases your risk of developing cancer. | Continuing your exposure to arsenic increases your risk of developing cancer. |
| If you currently have or choose to adopt one of these systems, your water will no longer contain a significant amount of arsenic, which reduces your family's risk of cancer. | If you do not currently have or do not choose to adopt one of these systems, your water will continue to contain a significant amount of arsenic, which increases your family's risk of cancer. |

# Participant Recruitment

Focus on Wake, Chatham, and Durham Counties

Identified that meet all criteria

- Large number of private wells, though not required
- Socio-economic characteristics representative of county as a whole

Direct mail recruitment

- Sent letters to ~8000 households
- Recruitment goal of 500

# Sample Characteristics: Demographics

Generally new housing
- Only 32% built before 1980

Moderate duration in home
- Average is 10 years

A minority of homes have children present
- 41% have children under 18 years
- 25% have children under 11 years

Responders are affluent, well-educated, and white
- 87% white
- 61% earn more than 75K
- 75% have Bachelor's degree or higher

# Sample Characteristics: Water Testing and Treatment

- Water sources
  - Private wells: 56%
  - Public water: 40%
  - Community wells: 4%
- Among well owners, only 57% have ever had their well water tested
  - Vast majority tested only for bacteria
- 56% of all households have treatment systems
  - Carbon Filter 45%, Water Softener 15%

# Sample Characteristics: Knowledge Retention

| Text of Question | Correct Answer | Percent Correct* |
|---|---|---|
| Arsenic in water can cause cancer. | True | 94 |
| If I am going to get sick from arsenic in my water, it will usually happen quickly (within a few hours or days of drinking the water). | False | 83 |
| I can reduce my risk from arsenic in water by boiling the water. | False | 88 |
| I can reduce my risk from arsenic in water by using a reverse osmosis system. | True | 88 |
| Runoff from agricultural or meat production can cause arsenic contamination. | True | 77 |
| Naturally occurring substances in the ground can cause arsenic contamination. | True | 94 |
| Human errors such as leaking underground tanks, industrial spills, etc. can cause arsenic contamination. | True | 76 |

* Participants could respond true, false or unsure

# Results of Randomization

- Minimal differences in predetermined variables among gains/loss groups.
  - Loss frame well owners were more likely to have well tested for bacteria and radioactive materials
  - Federal treatment more likely to live in town house
  - Federal and State more likely to have a reverse osmosis filter (than those assigned to see both)
  - Those who see both the federal and state standard are more likely to have an ultraviolet filter
  - These variables are included in regression analysis.

# Outcome Variables

- Risk Perception
  - Arsenic, cancer
  - Importance of action
  - Likert Scale
- Behavioral Changes
  - Drink bottled water, drink filtered water
  - Spending on bottled water, filtration

# Ordered Probit Model: Framing and Risk Perception

| | Dependent Variables | | | |
|---|---|---|---|---|
| **Independent Variables** | Concern about Arsenic | Likelihood of getting sick | Likelihood of getting cancer | Importance of taking action |
| Loss Frame | 0.076 | 0.159 | 0.138 | 0.175* |
| | (0.106) | (0.104) | (0.104) | (0.104) |
| Arsenic Level: Med | 0.275** | 0.095 | 0.200 | 0.334*** |
| | (0.132) | (0.128) | (0.129) | (0.126) |
| Arsenic Level: High | 1.114*** | 0.763*** | 0.750*** | 0.980*** |
| | (0.136) | (0.130) | (0.131) | (0.132) |
| Prior measure of DV | 0.411*** | 0.539*** | 0.597*** | 0.273*** |
| | (0.052) | (0.058) | (0.065) | (0.038) |
| n | 434 | 434 | 432 | 433 |
| Quasi R-squared | 0.104 | 0.104 | 0.103 | 0.077 |

*** Statistically significant at 1% level
** Statistically significant at 5% level
* Statistically significant at 10% level

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A blue ribbon panel of experts* has estimated that the cancer risk from drinking 2 liters of water per day containing 10 ppb arsenic for 70 years is 1 in 150. This means that if 150 people drink water with 10 ppb, over their lifetime one additional person out of that 150 would get cancer.

Scientists' best estimate is that the cancer risk is directly proportional to the amount of arsenic in the water and the amount of water consumed. The table below provides estimates of cancer risk increases for different levels of arsenic and different amounts of water consumed per day.

Estimated Increase in Cancer Risk From Arsenic Exposure

| | 2 liters of Water Per Day (Eight 8- ounce glasses) | 1 liter of Water Per Day (Four 8- ounce glasses) |
|---|---|---|
| 20 ppb | 1 in 75 | 1 in 150 |
| 10 ppb | 1 in 150 | 1 in 300 |
| 5 ppb | 1 in 300 | 1 in 600 |
| 1 ppb | 1 in 1500 | 1 in 3000 |

These risks are estimated for the average person. Your individual cancer risk from arsenic exposure also depends on your personal health history.

*National Research Council (2001) Arsenic in Drinking Water: 2001 Update (Washington, DC: National Academies Press).

# Issues going forward

Repeated measures of concern

Effect of NC and Federal standards

Effect of relative risk information

# Ordered Probit: Relative Risk Perception

**Dependent Variable:** Concern about arsenic

| Independent Variables | | | | |
|---|---|---|---|---|
| Relative risk | Significantly higher | 0.71*** (0.17) | 1.03*** (0.18) | 1.07*** (0.19) |
| (compared to same) | Slightly higher | 0.13 (0.17) | 0.34* (0.18) | 0.34* (0.19) |
| | Slightly lower | -0.08 (0.17) | -0.01 (0.18) | -0.12 (0.19) |
| | Significantly lower | -0.02 (0.17) | -0.13 (0.18) | -0.33 (0.19) |
| Standard | Federal | 0.28** (0.13) | 0.31** (0.14) | |
| (compared to both) | State | 0.03 (0.13) | 0.23 (0.14) | |
| Arsenic Level | Medium | 0.36*** (0.13) | | |
| (compared to low) | High | 1.06*** (0.14) | | |
| Prior concern | | 0.45*** (0.05) | | |
| Concern after arsenic | | | 1.14*** (0.07) | |
| Concern after standard | | | | 1.51**** (0.08) |
| n | | 431 | 430 | 434 |
| Quasi R-squared | | 0.13 | 0.31 | 0.43 |

*** Statistically significant at 1% level
** Statistically significant at 5% level
* Statistically significant at 10% level