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Engineering &
Public Policy

Privacy economics, attitudes, and behavior

Lorrie Faith Cranor
& Rebecca Balebako

September 9, 2014

8-533 / 8-733 / 19-608 / 95-818:
Privacy Policy, Law, and Technology



Today's Agenda

- Quiz
- IRB and Human Subjects Research
- Economics of Privacy
- Privacy Attitudes
- Privacy Survey and Behavioral Studies

By the end of class, you should be able to:

- Understand the review process of doing privacy research on human subjects
- Understand the difficulties in measuring privacy preferences and behavior
- Critically evaluate studies on privacy preferences or behavior

Human subjects research

Institutional Review Board

- Reviews human subjects research to make sure it is ethical and human subjects are protected
- Takes time and lots of paperwork
- Before submitting paperwork to IRB, you must complete human subjects training
- <http://www.cmu.edu/research-compliance/human-subject-research/>

IRB approval

- Research involving human subjects requires IRB approval
- Surveys are exempt, but you must ask IRB for exemption
- Exempt and low-risk IRB approval usually happens within 2 weeks
- High risk usually takes about a month, but may be longer
- Whenever possible, design study so participants sign informed consent form up front
 - You will have to convince IRB that there is a good reason not to
- Submit your IRB form as early as possible
 - You can submit an amendment later

Ethical considerations

- Sometimes tests can be distressing
 - users have left in tears
- You have a responsibility to alleviate
 - make voluntary with informed consent
 - avoid pressure to participate
 - let them know they can stop at any time
 - stress that you are testing the system, not them
 - make collected data as anonymous as possible

Economics of privacy

Financial Transactions

- Buyer and seller example [Varian 1996]
 - Buyers want sellers to know what they want so they can reduce their search costs
 - Buyers do not want sellers to know their maximum willingness to pay
 - Buyers don't want to be annoyed by sellers and don't want to spend time hearing about products they don't want (excess search costs)
 - Sellers don't want to waste time pitching products to people who don't want them

Externality

- The actions of a mailing list buyer impose costs on individuals on that list
- The seller of the list ignores those costs
- Varian says: Costs could be mitigated through choice

Incentives to reveal information

- Sometimes it is not to buyer's advantage to reveal personal characteristics
- Seller should structure incentives to

Contracts and markets for info

- What if we had property rights in information about ourselves?
 - We could contract to allow information to be used for only specified purposes
 - We could buy and sell these property rights
 - National Information Market [Laudon 1996]
 - What about transaction costs?

Public interest in personal information

- Public records
 - Court records
 - Tax assessments
 - Salaries of public officials
- What happens when information goes online and transaction costs approach zero?

Privacy attitudes

Consumer surveys to measure privacy attitudes

- Westin/Harris surveys
 - Privacy fundamentalist, pragmatist, unconcerned (marginally concerned)
- TRUSTe surveys
 - <http://www.truste.com/us-mobile-privacy-index-2013/>
- Academic research
- Does it matter what consumers think?

Privacy concerns seem inconsistent with behavior

- People say they want privacy, but don't always take steps to protect it
- Many possible explanations
 - They don't really care that much about privacy
 - They prefer immediate gratification to privacy protections that they won't benefit from until later
 - They don't understand the privacy implications of their behavior
 - The cost of privacy protection (including figuring out how to protect their privacy) is too high

How do we measure privacy behaviors?

- Self reported behaviors
- Web surveys
- Lab studies
- Field experiments
- Natural experiments

Ways to measure disclosure in a web survey

- Social Desirability Scale (SDS)
- Unethical Behaviors
- Sensitive Questions
- Gift Cards

Social Desirability Scale

- 33 items “No matter who I’m talking to I’m always a good listener”
- “There have been occasions when I feel like smashing things”
- High Social Desirability Score = Low disclosure

CROWNE, D. P., AND MARLOWE, D. A new scale of social desirability independent of psychopathology. *Journal of consulting psychology* 24, 4 (1960), 349.

Unethical behavior

- Types of behavior: Financial, Illegal, Sexual
- Answer choices
 - Yes
 - No
 - Prefer Not to Answer

JOHN, L.K., ACQUISTI, A., AND LOEWENSTEIN, G. Strangers on a plane: Context-dependent willingness to divulge sensitive information. *Journal of Consumer Research* (2011)

Sensitive Questions

- Essay questions
- Rated by independent judges 0-4

MOON, Y. Intimate exchanges: Using computers to elicit self- disclosure from consumers. *Journal of Consumer Research* (2000)

Gift Cards

- Willingness to pay for anonymous versus identified gift card



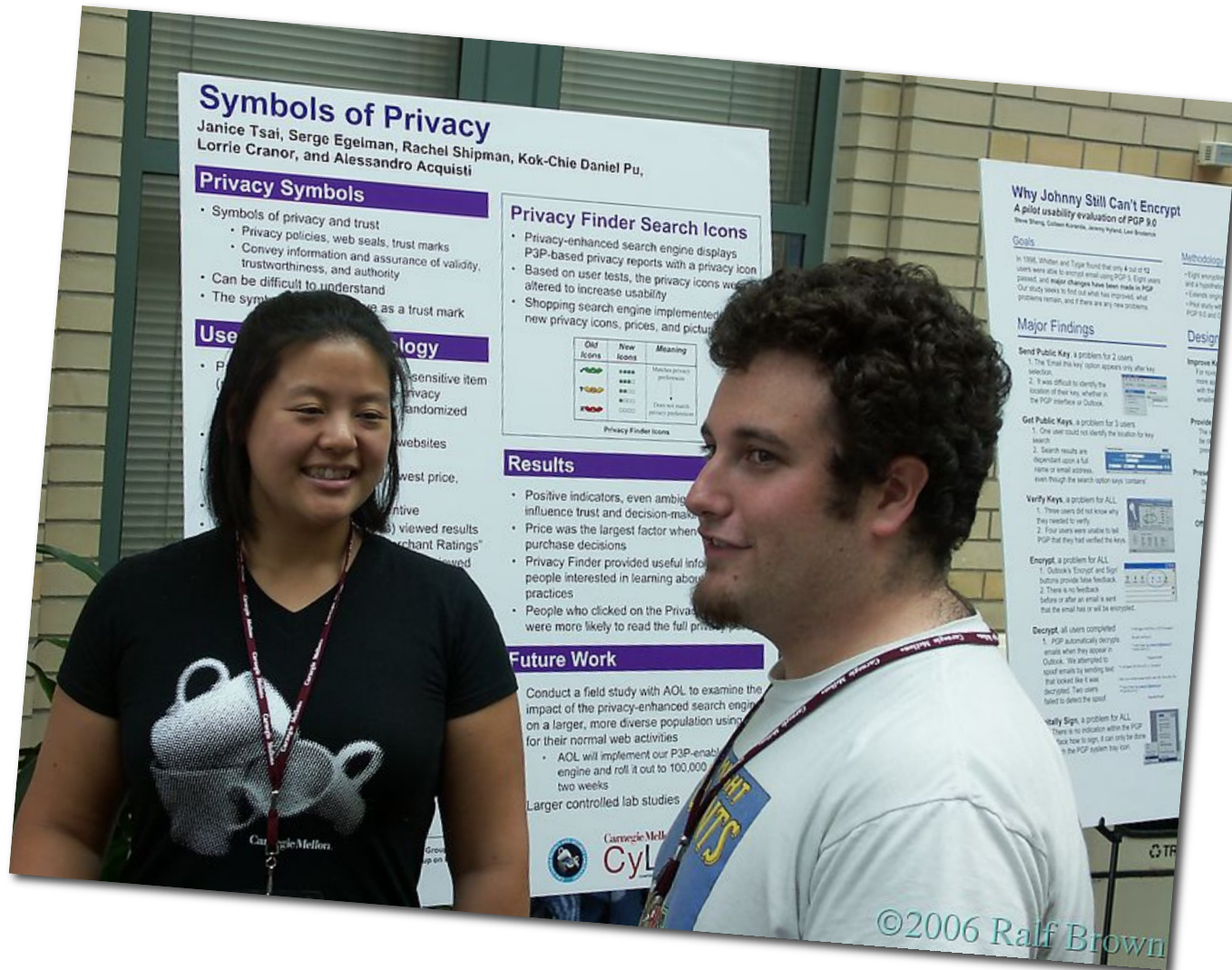
Acquisti, A., L. John, and G. Loewenstein. "What Is Privacy Worth?." The Journal of Legal Studies (2013):

Measuring Behavior in lab studies

Effect of privacy info on purchasing

Will the salient display of privacy information cause consumers to take privacy into account when making online purchasing decisions?

- J. Gideon, S. Egelman, L. Cranor, and A. Acquisti. **Power Strips, Prophylactics, and Privacy, Oh My!** SOUPS 2006. http://cups.cs.cmu.edu/soups/2006/proceedings/p133_gideon.pdf
- S. Egelman, J. Tsai, L. Cranor, and A. Acquisti. 2009. Timing is Everything? The Effects of Timing and Placement of Online Privacy Indicators. CHI2009.
- J. Tsai, S. Egelman, L. Cranor, and A. Acquisti. The Effect of Online Privacy Information on Purchasing Behavior: an Experimental Study. Information Systems Research. Published online 2010.



Symbols of Privacy

Janice Tsai, Serge Egeiman, Rachel Shipman, Lorrie Cranor, and Alessandro Acquisti

Privacy Symbols

- Symbols of privacy and trust
 - Privacy policies, web seals, trust marks
 - Convey information and assurance of validity, trustworthiness, and authority
- Can be difficult to understand
- The symbols serve as a trust mark

Use of Privacy Symbols

- Privacy symbols on sensitive item (e.g., credit cards) are more likely to be used
- Privacy symbols on randomized websites are more likely to be used
- Privacy symbols on websites with the lowest price, most positive reviews, and highest "Merchant Ratings" are more likely to be used

Privacy Finder Search Icons

- Privacy-enhanced search engine displays P3P-based privacy reports with a privacy icon
- Based on user tests, the privacy icons were altered to increase usability
- Shopping search engine implemented new privacy icons, prices, and pictures

Old Icons	New Icons	Meaning
		Matches privacy performance
		Does not match privacy performance

Privacy Finder Icons

Results

- Positive indicators, even ambiguous, influence trust and decision-making
- Price was the largest factor when making purchase decisions
- Privacy Finder provided useful information for people interested in learning about privacy practices
- People who clicked on the Privacy Finder were more likely to read the full privacy policy

Future Work

- Conduct a field study with AOL to examine the impact of the privacy-enhanced search engine on a larger, more diverse population using it for their normal web activities
- AOL will implement our P3P-enabled search engine and roll it out to 100,000 users in two weeks
- Larger controlled lab studies



Why Johnny Still Can't Encrypt

A pilot usability evaluation of PGP 9.0

Bruce Sherry, Colleen Koppelman, Jeremy Hayford, Lori Brinkman

Goals

- In 1996, Whitman and Taylor found that only 4 out of 12 users were able to encrypt email using PGP 5. Eight years passed, and major changes have been made in PGP. Our study seeks to find out what has improved, what problems remain, and if there are any new problems.

Methodology

- Eight experienced and 12 novice users
- Users were given a 15-minute tutorial on PGP 9.0 and 15 minutes to complete the tasks

Major Findings

- Send Public Key, a problem for 2 users
 1. The "Send" key option appears only after key selection.
 2. It was difficult to identify the location of the key, whether in the PGP interface or Outlook.

- Get Public Keys, a problem for 3 users
 1. One user could not identify the location for key search.
 2. Search results are dependent upon a full name or email address, even though the search option says "contact".

- Verify Keys, a problem for ALL
 1. Three users did not know why they needed to verify.
 2. Four users were unable to tell PGP that they had verified the keys.

- Encrypt, a problem for ALL
 1. Outlook's Encrypt and Sign buttons provide little feedback.
 2. There is no feedback before or after an email is sent that the email has or will be encrypted.

- Decrypt, all users completed
 1. PGP automatically decrypts emails when they appear in Outlook. No attempt to spoof emails by sending text that looked like it was encrypted. Two users failed to detect the spoof.

- Verify Signs, a problem for ALL
 1. There is no indication within the PGP how to sign. It can only be done in the PGP system key chain.

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PrivacyFinder

http://www.privacyfinder.org/ nutrition label

[Win prizes and help our research](#)
[Login here](#) if you already signed up



shoes Search

Search Engine: ☐ Google ☒ Yahoo! ☐ Shopping

Preference Level: Medium

Install the Privacy Finder [search bar](#)!
Compatible with Firefox 2 and Internet Explorer 7

[Frequently Asked Questions](#) | [Privacy Policy](#) | [Add A Site](#) | [Download Privacy Bird® Software](#) | [Privacy Finder 日本語版](#)

Privacy Finder is a public service provided by [CMU Usable Privacy and Security Laboratory](#)

Research questions

- Do privacy icons influence purchase decisions?
- Will people pay for privacy?

Laboratory study

- 24 students recruited for “online shopping study”
- Paid \$10 plus reimbursement for purchases made with their own credit cards
- Participants used “Shopping Finder” search engine
 - Control condition (no privacy icons)
 - Experimental condition (privacy icons)
- Asked to search for 6 outlet serge protector






But maybe we should have them search for something more privacy sensitive?

Power Strips, Prophylactics, and Privacy, Oh My!

Shopping Finder Search for: Trojan Shared Sensation 12 pack

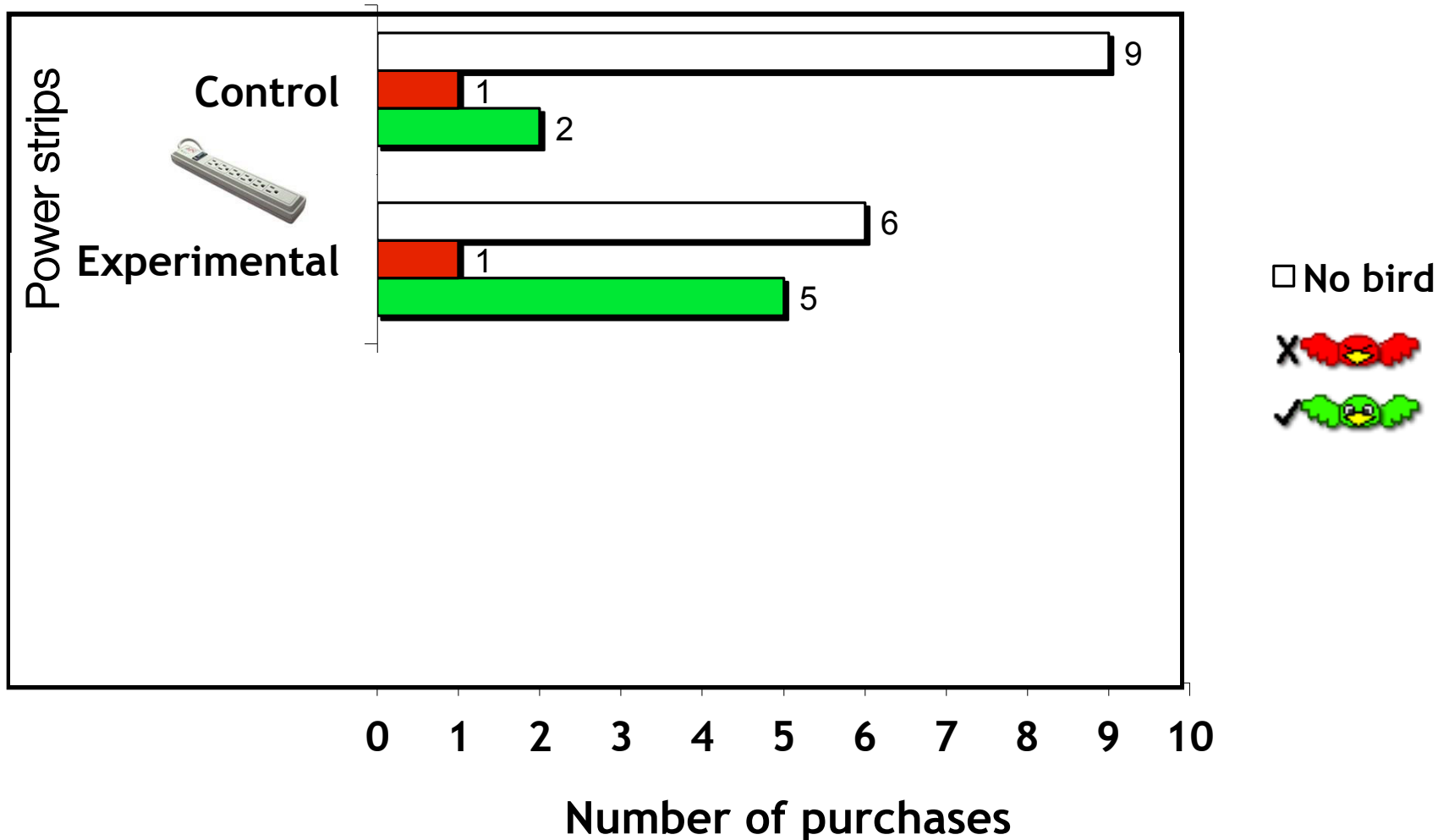
Shopping Finder

Trojan Shared Sensation 12 pack Search

-  [Trojan Shared Sensation Spermicidal Condoms - 12 Pack](#)
Trojan Shared Sensation Spermicidal Condoms - 12 Pack - Unique Shared Sensation Design for the Pleasure and Excitement of Both Partners: -Alternating rows of raised bumps and ridges for her -Flared ...
[store.yahoo.com/eprice/trojsharsens.html](#) - [Cached](#) - [Privacy Policy](#) - [Similar Pages](#)
- [Trojan Shared Sensation Condoms](#)
Purchase Trojan Shared Sensation condoms at QuikCondoms.com for discount prices and free shipping! ... Product Description. The Trojan Shared Sensation is part of the latest trend in condom design; with condoms companies ... QC Price. Qty. Trojan Shared Sensation Lubricated 12 Pack. 11.99 ...
<https://www.quikcondoms.com/product.jsp?id=151> - [Cached](#) - [Similar Pages](#)
-  [Trojan Shared Sensation Lubricated Latex Condoms - 12 Condoms | Vitacost](#)
Trojan Shared Sensation Lubricated Latex Condoms - 12 Condoms - Pleasure for Both Partners. Unique Shared Sensation Design for the Pleasure and Excitement of Both Partners: alternating ...
[www.vitacost.com/TrojanSharedSensationLubricatedLatexCondoms](#) - [No Cache](#) - [Privacy Policy](#) - [Similar Pages](#)
- [Trojan Shared Sensation Spermicide Condoms - 12 Pack](#)
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... Spermicidal Condoms > Trojan Shared Sensation Spermicidal Condoms. Trojan Shared Sensation Spermicidal Condoms ... Size: 12 Retail Pack. Trojan Shared Sensation Spermicidal Condoms ...
[www.condomave.com/trojan-shared-sensation-spermicidal-lubricated-condoms-condom.html](#) - [Cached](#) - [Privacy Policy](#) - [Similar Pages](#)
-  [Trojan Shared Sensation Condoms 12 PK](#)
... Trojan Shared Sensation Condoms 12 PK. Lubricated Unique Shared Sensation is design for the pleasure and excitement of ... Trojan Ultra Pleasure 12 pack ...
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-  [Trojan Shared Sensation Lubricated - 12 pack](#)
Shared Sensation Lubricated Trojan Condoms supplies pleasure and excitement of both partners. It has alternating rows of raised bumps and ridges for her, and a flared design that's roomy at the tip for him.
[store.yahoo.com/loveessentials/trojsharsenl.html](#) - [Cached](#) - [Privacy Policy](#) - [Similar Pages](#)



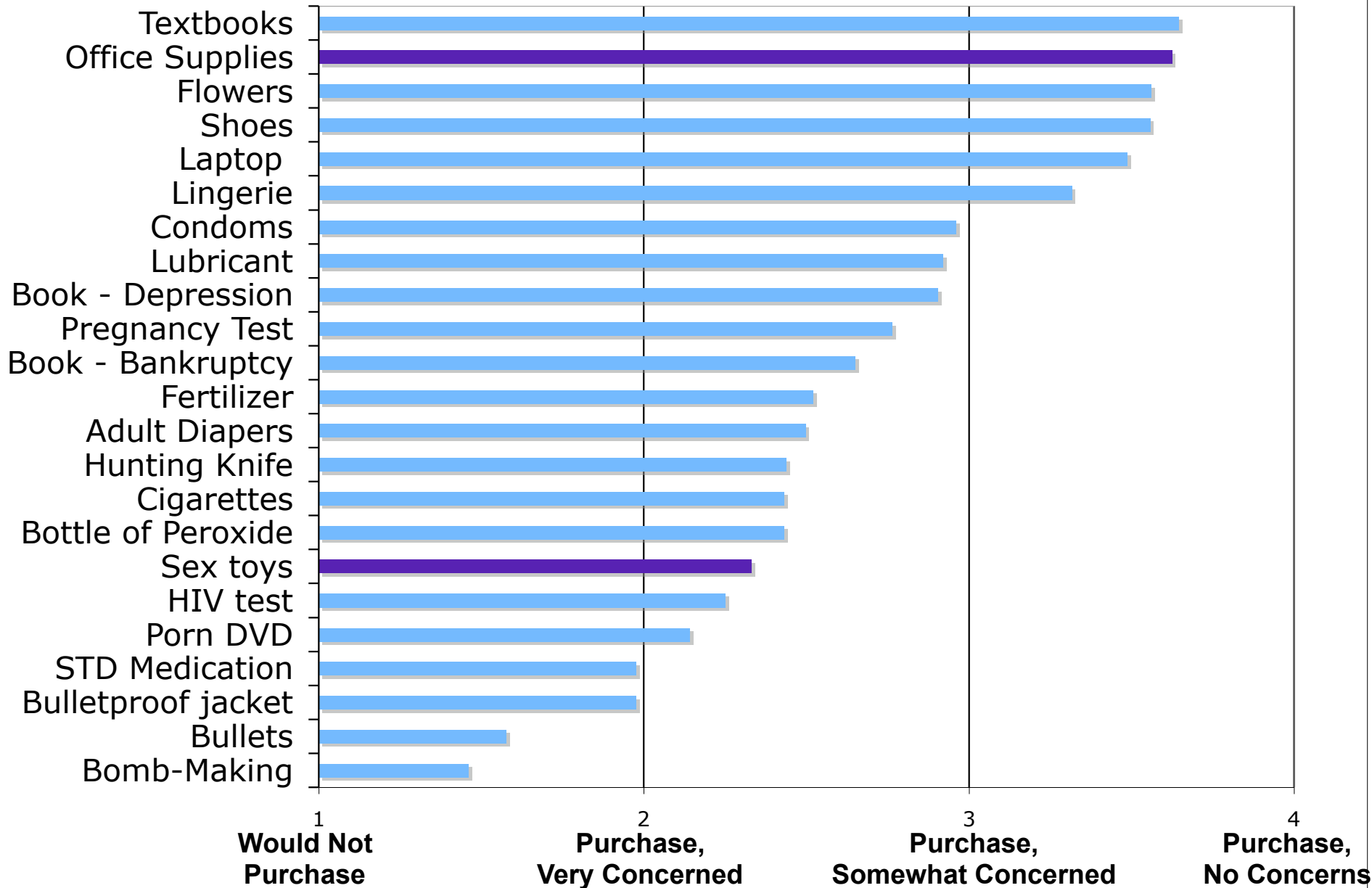
Sites selected for purchases



Good, but we can do better

- Provide fixed payment rather than reimbursement to create price incentive
- Make price/privacy tradeoff more clear
 - Display price in search results
 - Order results based on price and privacy
 - Eliminate confusion about blank indicator
- Test whether people are attracted to pretty indicators
- Find more privacy-sensitive items to purchase

User Study Items



Condition 1

No information



Duracell Alkaline Battery, AA, 8/PK

Duracell Coppertop Alkaline AA Batteries Long-life alkaline batteries provide the best, longest power source. Recommended for use in smoke alarms, flashlights, lanterns, calculators, pagers, cameras, recorders, radios, CD players

www.ccvsoftware.com/c/product.html?record@56119



\$14.45 (w/shipping)

Duracell AA8 DURACELL - Alkaline Batteries Value Packs

Duracell AA8 DURACELL Alkaline Battery Value Packs...

discountofficeitems.zoovy.com/product/DURMN15RT12Z



\$14.60 (w/shipping)

Duracell Alkaline Battery Value Packs

Duracell AA8 DURACELL Alkaline Battery Value Packs DURACELL AA ALKALINE BATTERY - 8 PACK Cardboard card for peg hook 8 pack Specifications Weight 0.45 lbs Length 4.5 inches Width 3.75 inches Height 1 inches Manufactures Web site www.duracell.com

www.instawares.com/Coppertop-Alkaline-Lithium-Bat...



\$14.80 (w/shipping)

Duracell Coppertop Alkaline AA Batteries

Long-life alkaline batteries provide the best, longest power source. Recommended for use in smoke alarms, flashlights, lanterns, calculators, pagers, cameras, recorders, radios, CD players, medical equipment, toys and electronic games. Dependable after seven years of storage.

www.officequarters.com/product.php/item/DUR-MN1500B8...



\$15.14 (w/shipping)

Condition 2

Irrelevant information



Duracell Alkaline Battery, AA, 8/PK

Duracell Coppertop Alkaline AA Batteries Long-life alkaline batteries provide the best, longest power source. Recommended for use in smoke alarms, flashlights, lanterns, calculators, pagers, cameras, recorders, radios, CD players

www.ccvsoftware.com/c/product.html?record@56119



\$14.45 (w/shipping)

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Handicap
Accessibility

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\$14.60 (w/shipping)

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Handicap
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www.instawares.com/Coppertop-Alkaline-Lithium-Bat...



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Duracell Coppertop Alkaline AA Batteries

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\$15.14 (w/shipping)

Condition 3

Privacy information



Privacy premium:
\$0.69 4.8%

□□□□
[Privacy Report](#)

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Cardboard card for peg hook 8 pack Specifications Weight 0.45 lbs Length 4.5 inches Width 3.75 inches Height 1 inches Manufactures Web site www.duracell...
www.instawares.com/Coppertop-Alkaline-Lithium-Bat... [Privacy Policy](#)


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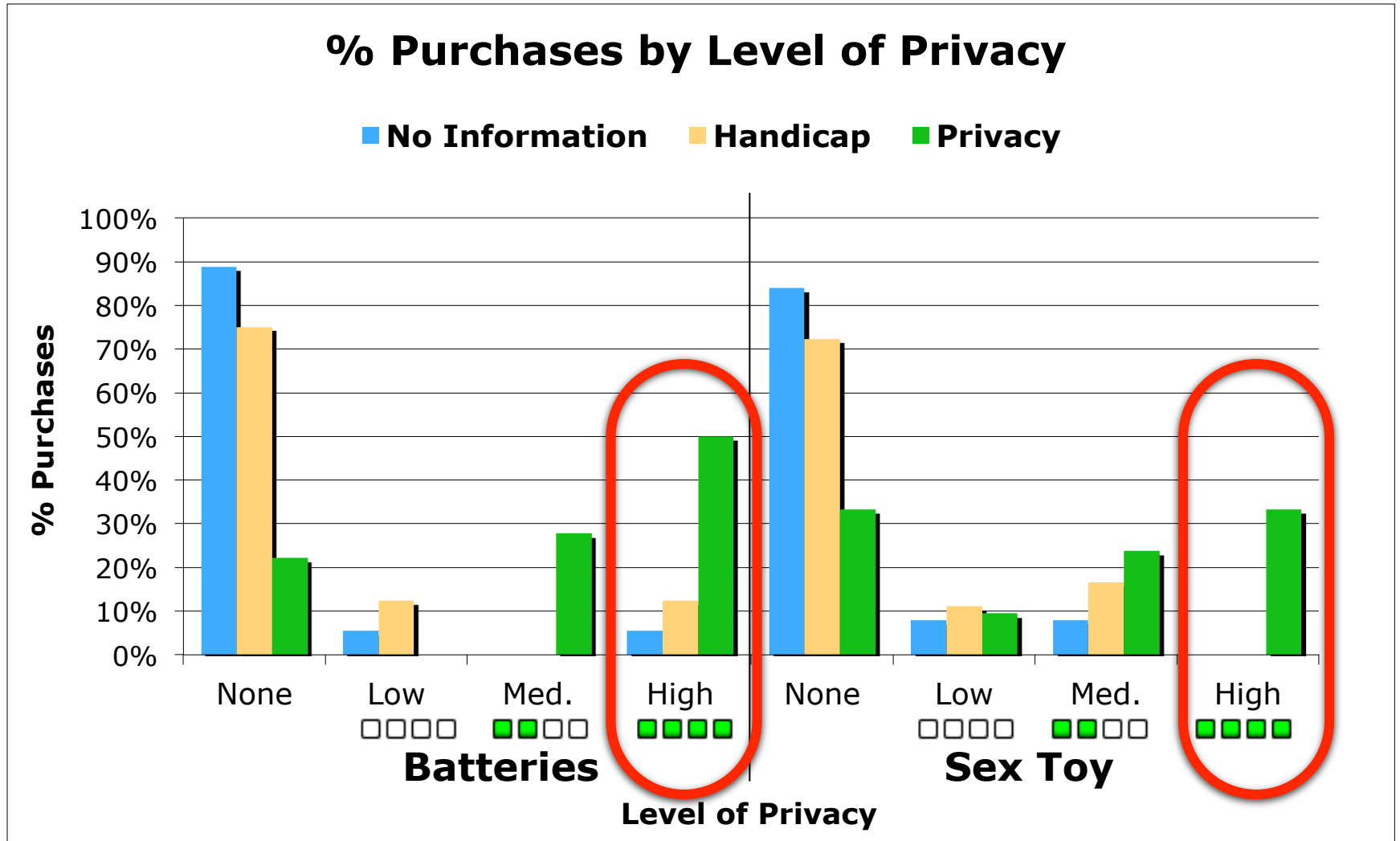
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Results



Results

- Demonstrated the following:
 - Privacy can be leveraged for profit
 - Prominent privacy information reduces information asymmetry gap
 - Indicators can provide people with an ability to choose a site based on privacy

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Good privacy pays for web stores

People will pay more for goods if a website does a good job of protecting their privacy, a study shows.

The Carnegie Mellon study looked at what shoppers do when they are told what sites do with personal data.

It suggests that shoppers will pay a premium equal to about \$0.60 (30p) on goods worth \$15 (£7) if they are reassured about privacy.

The study was used to evaluate a tool that aims to give web users clearer information about privacy policies.



Many web shoppers worry about what happens to personal data

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Problems remain

- No significant difference between battery and sex toy purchases
- But the privacy premium for sex toys was twice the premium for batteries
- We need better control over the prices
- Time to enlist the assistance of the online vendors

Contacting vendors

- Contacted 46 battery and sex toy vendors through postal mail, fax, and phone
- Convinced 8 vendors to adjust their prices for our study
- Most raised their prices but one had to lower prices
- Promised to pay difference to vendor who lowered prices
 - Sent \$140 check to The Dirty Bunny for “research project assistance”



Timing Study

- Research Question
 - Does the timing of privacy information have an impact on the value of prominent privacy information?
- Controlled for price
 - Same privacy premiums for both products

S. Egelman, J. Tsai, L. Cranor, A. Acquisti. Timing is Everything? The Effects of Timing and Placement of Online Privacy Indicators. CHI '09.



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Duracell AA 8-pack

Search

Duracell Alkaline Battery, AA, 8/PK

Duracell Coppertop Alkaline AA Batteries Long-life alkaline batteries provide the best, longest power source. Recommended for use in smoke alarms, flashlights, lanterns, calculators, pagers, cameras, recorders, radios, CD players

www.littleofficesupply.com/durmn1500b8z.html - [Privacy Policy](#)



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Trusted Everywhere, Delivers long-lasting, dependable quality in wide range of everyday devices. For general use; Battery Size: AA; For Use With: General Use. Coppertop Alkaline Batteries, 1.5v, 8 Batteries per Pack, AA

www.instawares.com/coppertop-alkaline-lithium-batt... - [Privacy Policy](#)



\$15.75 (w/shipping)

Duracell Alkaline Battery 8-Packs

Duracell AA8 DURACELL Alkaline Battery Value Packs DURACELL AA ALKALINE BATTERY - 8 PACK Cardboard card for peg hook 8 pack Specifications Weight 0.45 lbs Length 4.5 inches Width 3.75 inches Height 1 inches Manufactures Web site www.duracell...

www.officequarters.com/product.php/item/DUR-MN1500B8Z/D... - [Privacy Policy](#)



\$16.00 (w/shipping)

Duracell Coppertop Alkaline AA Batteries

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www.ontimesupplies.com/Duracell_Coppertop_Alkaline_Batteri... - [Privacy Policy](#)



\$16.25 (w/shipping)

AA8 DURACELL DURACELL AA ALKALINE

Manufacturer: DURACELL Model: AA8DURACELL Part Number: AA8 DURACELL UPC: 41333825014 Cardboard card for peg hook Dimensions: 4.5x3.75x1 Comments:...

www.shopfoodex.com/duracell-batteries-count-p-31250.html - [Privacy Policy](#)






\$17.04 (w/shipping)

ontimesupplies.com

http://cups.cs.cmu.edu/search/frame.php?id=b4


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Coppertop Alkaline Batteries, AA, 8/pack


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Results

- Privacy information had the greatest impact when presented alongside search results
- Privacy-sensitive nature of product has an impact on the amount of desired privacy



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**Engineering &
Public Policy**

Privacy and the control paradox

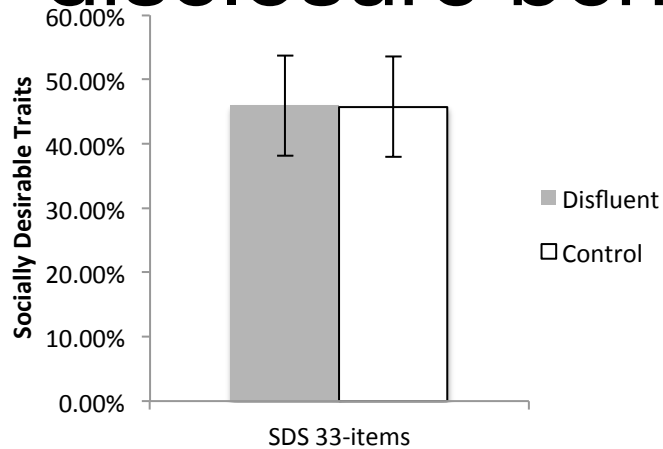
- What is the control paradox?
- Which actually gives you more control?
 - Control over release of personal info
 - Control over access and use of personal info
- What did the study find?
- When does control enhance privacy? When does it reduce privacy?

Disfluent fonts (typesets)

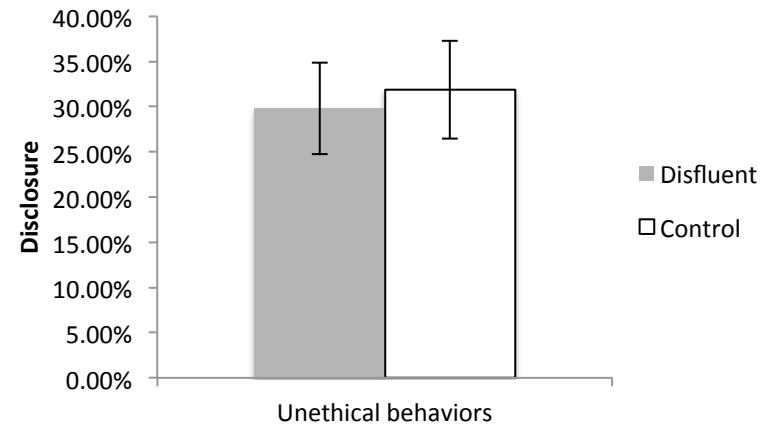
- *Do you eat apples?*
- Do you eat apples?

Is it the typeset or the type of statistics? Disfluent font does not reduce self-disclosure
Balebako, R., Peer, E., Brandimarte, L., Cranor, L., Acquisti, A., In Proc. of the 2013
Learning from Authoritative Security Experiment Results (LASER) Workshop

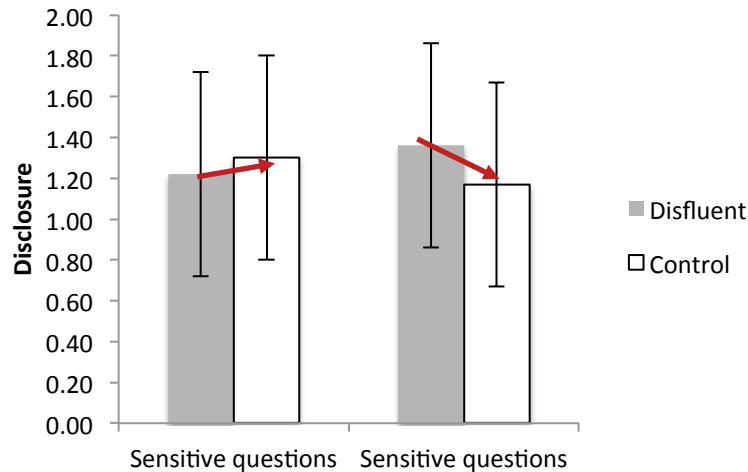
Disfluent font did not change disclosure behavior



$p = .91$

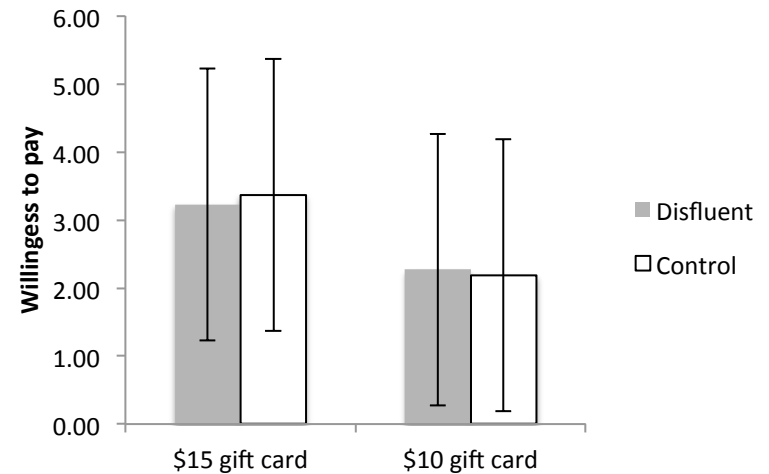


$p = .21$



$p = .04$

$p = .03$



$p = .81$

$p = .83$

Smart, Useful, Scary, Creepy: Perceptions of Behavioral Advertising

Blase Ur, Pedro G. Leon,
Lorrie Faith Cranor, Richard Shay,
and Yang Wang
SOUPS 2012

Research goals

- Gain insight into what users think about online behavioral advertising (OBA)
- Identify how participants' mental models correspond with notice and choice mechanisms

Methodology

- 48 participants
- Recruited from the Pittsburgh, PA region
 - Non-technologists
 - Interested in testing privacy tools
- Combination semi-structured interview and usability study
- Part way through interview showed WSJ video to inform participants about OBA

Participants unaware of OBA


- Participants believed ads were tailored, but only based on context or on a single site

amazon Blase's Amazon.com | Today's Deals | Gift Cards | Help


Shop by Department ▾ Search All ▾ Go

Your Amazon.com | Your Browsing History | Recommended For You | Amazon Betterizer | Improve Your Recommendations | Your Profile | Learn More


Your Amazon.com




New Release
Elixir Strings Acoust...
\$31.98 **\$12.67**
Why recommended?



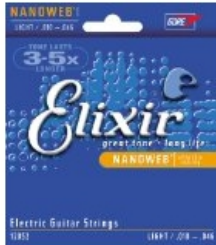
New Release
Kyser 6 String Capo,...
\$24.95 **\$15.16**
Why recommended?




Planet Waves Pro Wind...
★★★★☆ (153)
\$13.99 **\$6.99**
Why recommended?



Elixir Strings Acoust...
★★★★☆ (39)
\$30.00 **\$12.12**
Why recommended?



Elixir Strings Electr...
★★★★☆ (34)
\$22.00 **\$8.64**
Why recommended?



Snark SN-2 All Instru...
★★★★☆ (546)
\$39.00 **\$11.20**
Why recommended?

> See all recommendations in Musical Instruments

Participants unaware of OBA

- Participants believed ads were tailored, but only based on context or on a single site
- Thought it was only hypothetical
 - “I guess if they were monitoring what I did on the Internet...But I’d hope they weren’t...”

Didn't recognize OBA icon

- Not sure what would happen if they clicked on icon
 - Express interest in product
 - Purchase your own ads
 - Go to product's website
 - See related ads



Mixed opinion about OBA

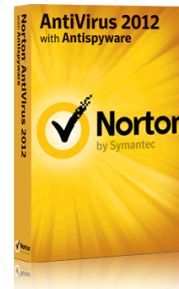
- Recognized benefits
 - Advertisers can reach consumers interested in their products
 - Consumers find things they're interested in and don't get ads for things they're not interested in
- Concerned about privacy

Beliefs about OBA

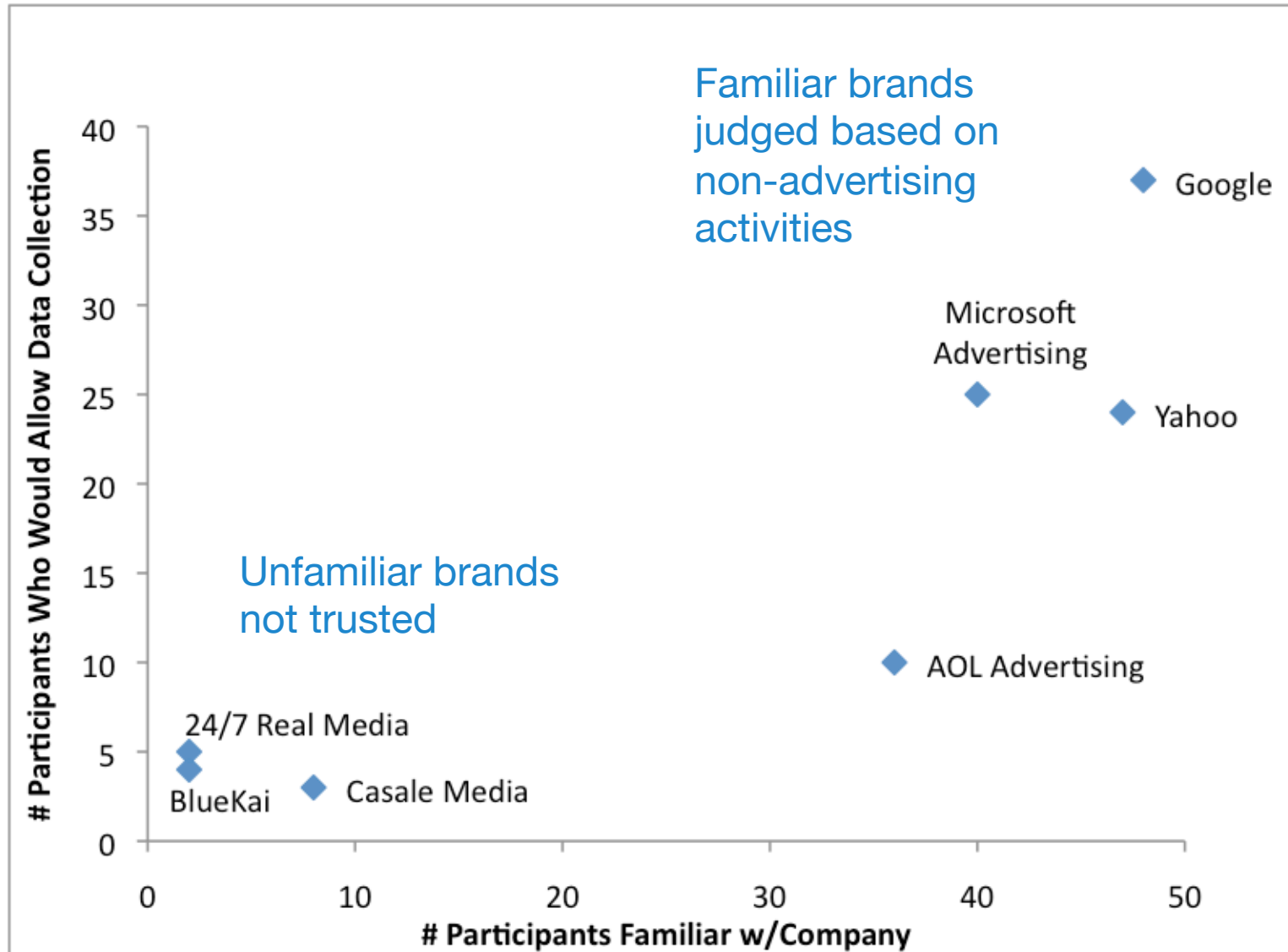
- Advertisers collect information including name, financial information, and address
- This information, along with browsing history, is stored in cookies

Participants' impressions: available choice mechanisms

- Deleting cookies
- No options
- Antivirus software suites
- Web browser



Familiarity and trust are important



Takeaways

- Opinions about OBA mixed – both useful and creepy
- Participants did not understand OBA technologies
- Some of the worst fears based on misconceptions
- Participants did not know how to effectively exercise choice