

Why Privacy Matters

Alessandro Acquisti
Carnegie Mellon University

Cybersecurity and You – University of Maryland, Baltimore – April 2016

privacy

economics

behavioral decision research

data mining

"DATA IS THE NEW OIL"

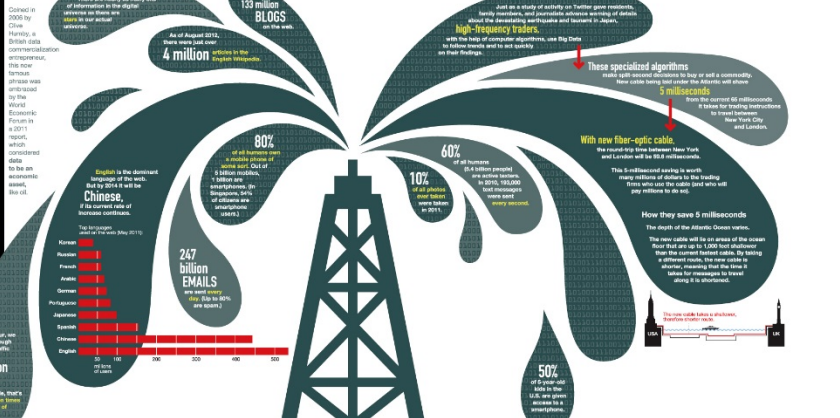
From the beginning of recorded time until 2000, we created 5 exabytes of data.

In 2011 the same amount was created every hour.

By 2015, it's expected that the time will shrink to 10 minutes.

7 billion DVDs.

Side by side, that's more than the height of Everest.



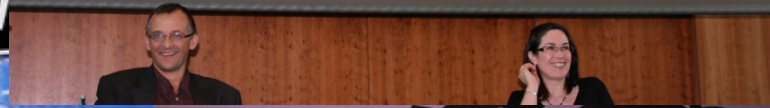
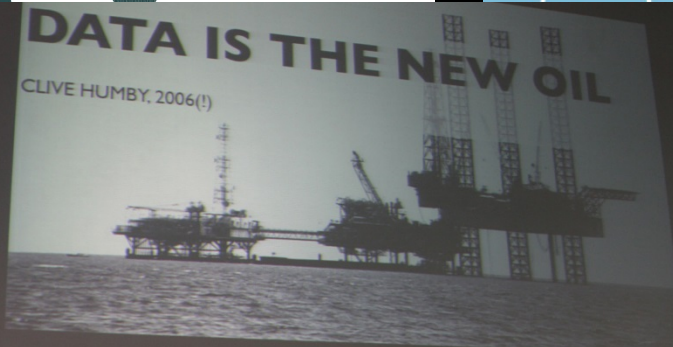
Data is the new oil.

We see in data the same transformative, wealth-creating power that 19th-century visionaries once sensed in the crude black ooze trapped underground.

If "crude" data can be extracted, refined, and piped to where it can impact decisions in real time, its value will soar. And if data can be properly shared across an entire ecosystem and made accessible in the places where analytics are most useful, then it will become a true game changer, altering the way we live, work, learn, and play.



Source: Cisco IBSG, 2012. #DataInMotion



Data is the new Oil



Image licensed from Shutterstock



SAY BIG DATA

ONE MORE TIME

Big data will be an
economic win-win

Privacy and security are
antithetical

People don't really care
about privacy

We can balance analytics
and privacy via
transparency and control

Big data will be an
economic win-win

*"Targeting is **not only good for consumers [...]** it's a rare **win for everyone.** [...] It ensures that ad placements display content that you might be interested in rather than ads that are irrelevant and uninteresting. [...] Advertisers achieve [...] a greater chance of selling the product. Publishers also win as [...] behavioral targeting increases the value of the ad placements."*

“The Economics of Privacy,” Acquisti, Taylor, and Wagman,
Journal of Economic Literature, 2016 (forthcoming)



"An Experiment in Hiring Discrimination via Online Social Networks,"
Alessandro Acquisti and Christina Fong, *ongoing*

SAMPLE JOHN DOE CV & GRANTS

UNIVERSITY OF PENNSYLVANIA - SCHOOL OF MEDICINE
Curriculum Vitae

John Doe, M.D., Ph.D.

Date: Month, year

Office Address: 1234 Maloney Building
Hospital of the University of Pennsylvania
Philadelphia, PA 19104-4283

If you are not a U.S. citizen please indicate the type of visa you have:
(If applicable)

Visa type or Permanent Resident status

Education:

1988 B.S. Yale University (English)

1992 M.D. University of Pennsylvania

1994 Ph.D. University of Pennsylvania (Physiology)

Postgraduate Training and Fellowship Appointments:

1994-1995 Intern in Medicine, Temple Hospital, Philadelphia

1995-1996 Resident in Medicine, Graduate Hospital, Philadelphia

1997-1999 Fellowship, Pulmonary Diseases, Hospital of the University of Pennsylvania, Philadelphia

Military Service:

1996-1997 U.S. Public Health Service, Tuberculosis Control Section, Philadelphia

Faculty Appointments:

1999-2008 Assistant Professor of Medicine, Department of Medicine
University of Pennsylvania School of Medicine

2008- present Associate Professor of Medicine, Department of Medicine
University of Pennsylvania School of Medicine

Hospital and Administrative Appointments:

1999-present Assistant Chief, Pulmonary Division, Department of Medicine,
University of Pennsylvania School of Medicine

2001-2005 Chief, Pulmonary Function Laboratory, Department of Medicine,
University of Pennsylvania School of Medicine

2005-present Director, Inhalation Therapy, University of Pennsylvania School of Medicine

Other Appointments:

1999-present Senior Fellow, Leonard Davis Institute, University of Pennsylvania School of
Medicine

1999-present Faculty Member, Cell and Molecular Biology Graduate Group, University of

BUD LIGHT

JOHN DOE

HERE WE GO

JOHN DOE

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John Doe

Washington, District of Columbia (Washington D.C. Metro Area) | Staffing and Recruiting

Join LinkedIn and access John Doe's full profile.

As a LinkedIn member, you'll join 200 million other professionals who are sharing connections, ideas, and opportunities. And it's free! You'll also be able to:

- See who you and John Doe know in common
- Get introduced to John Doe
- Contact John Doe directly

View full profile

John Doe's Overview

Recommendations 4 people have recommended John

Connections 500+ connections

Name Search:

Search for people you know from over 200 million professionals already on LinkedIn.

First Name Last Name

Example: John Doe

Viewers of this profile also viewed...

Joanne Piscopo

Sr. Account Manager/Recruiter in...

Joseph rasoori

recruiter at Airmic Inc

Gary Calka

Owner, R&T ASSOCIATES

Donny Soucy

Senior Technical Recruiter at Kinetix...

Meredith Skiadous

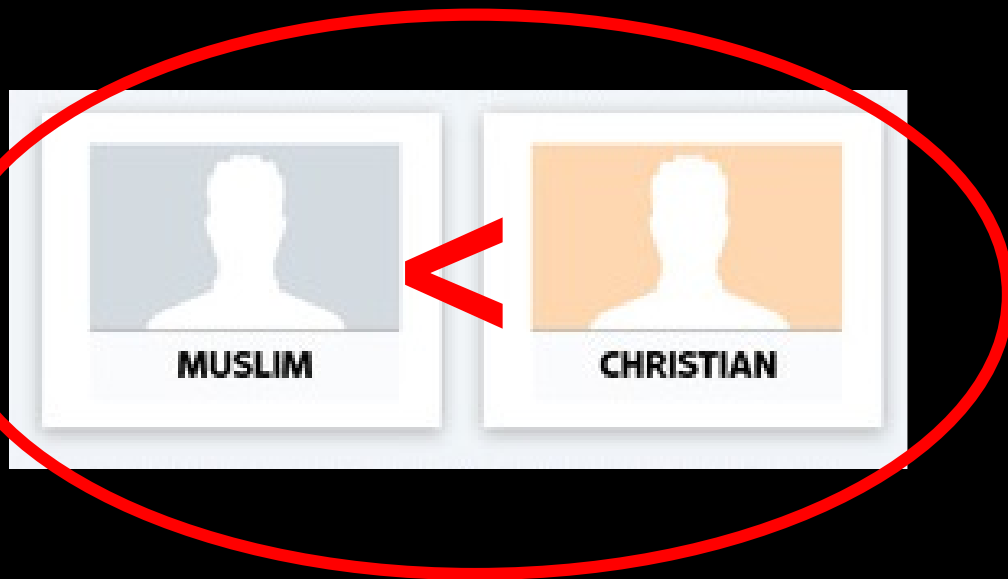
Kelly Mahler

Sr. Recruiter at SA Technologies Inc.

Ewelina Wanczycki

Account Manager at SA Technologies Inc.

"An Experiment in Hiring Discrimination via Online Social Networks,"
Alessandro Acquisti and Christina Fong, ongoing



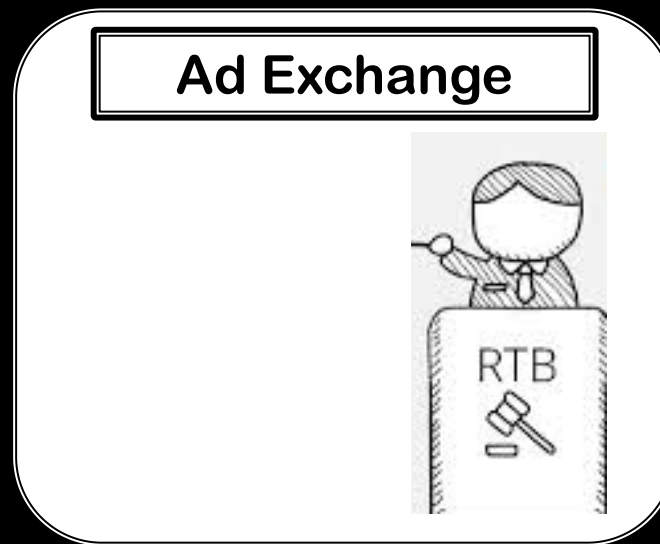
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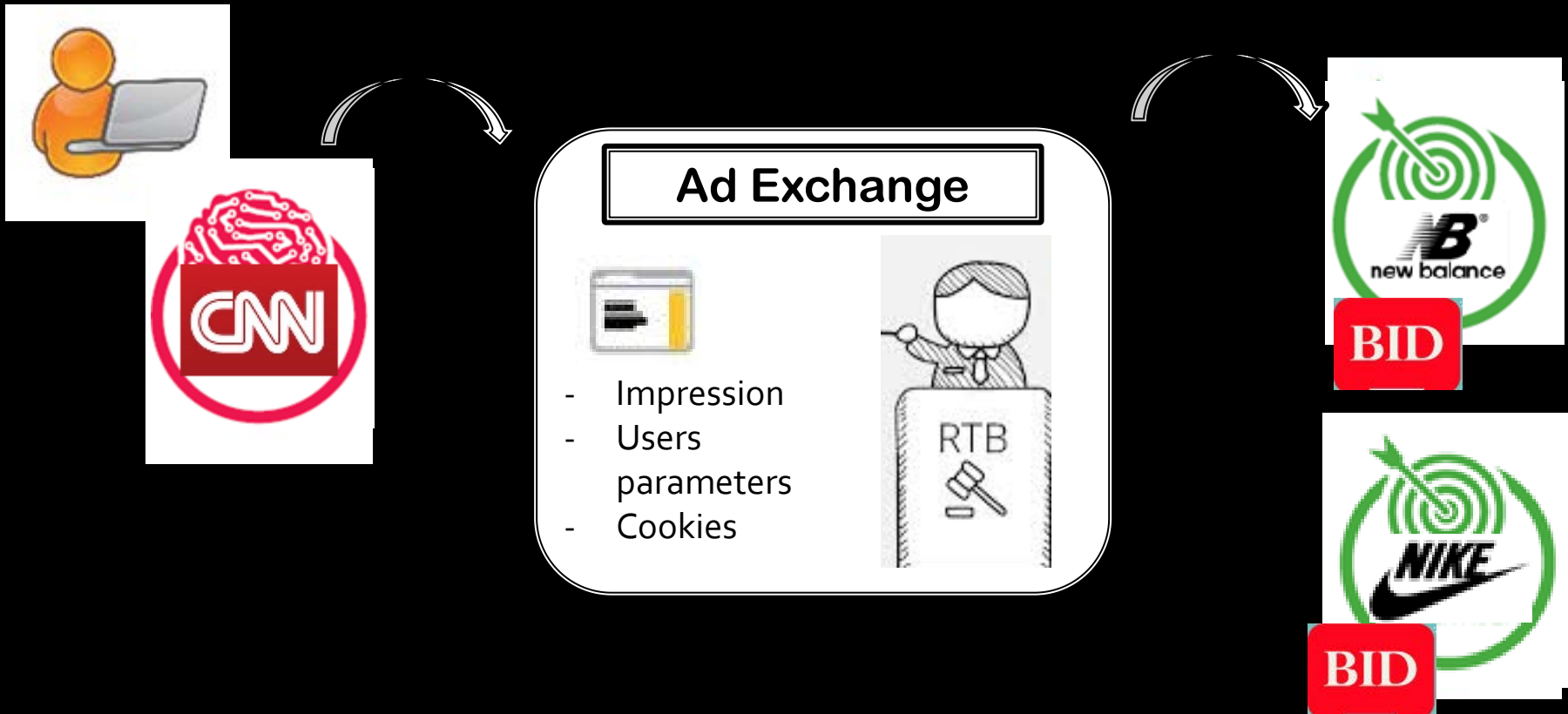
"An Experiment in Hiring Discrimination via Online Social Networks,"
Alessandro Acquisti and Christina Fong, *ongoing*

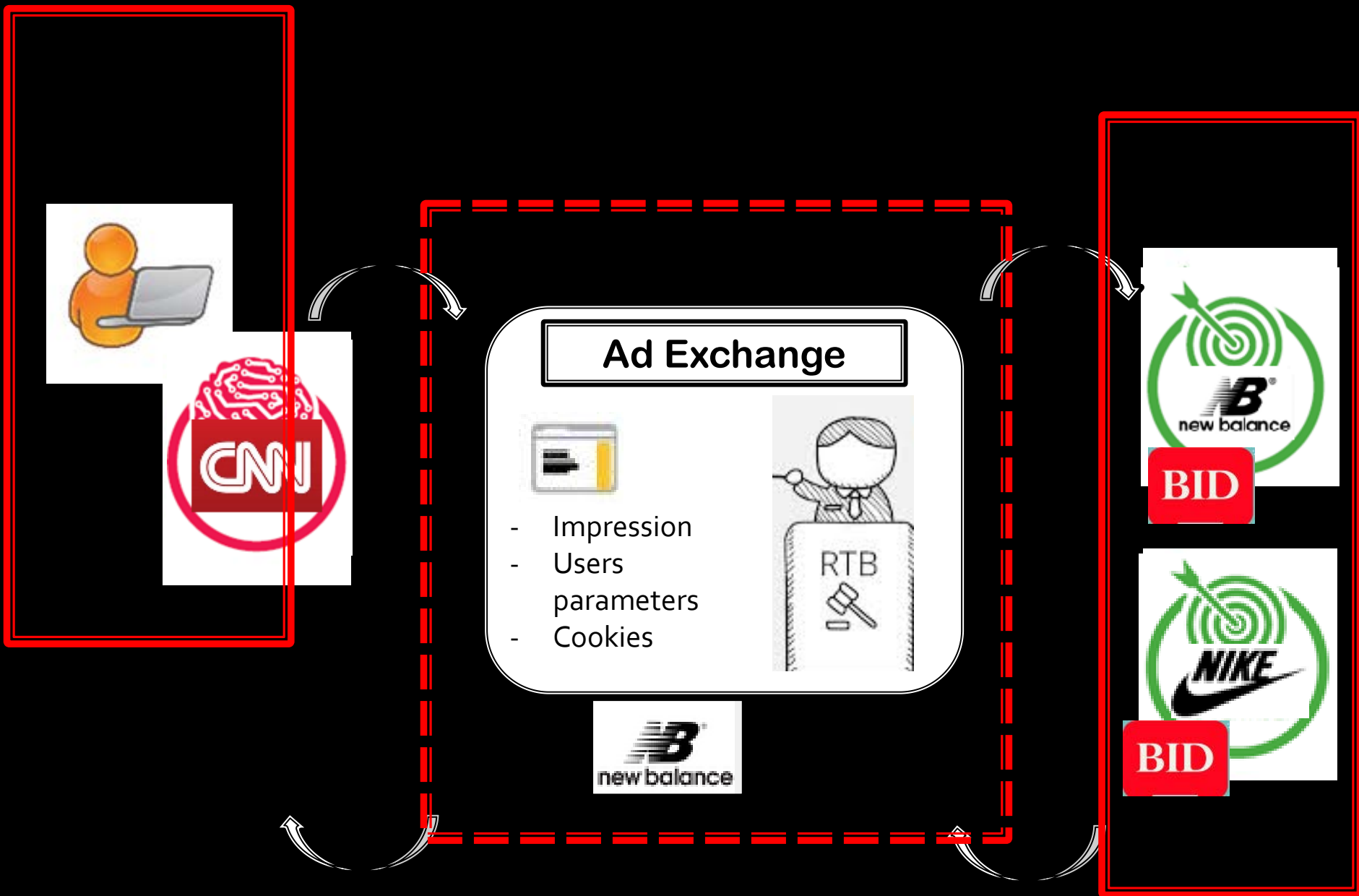
The Empirics of Health Privacy Economics

- Privacy *reduces* technology adoption/innovation
 - *Miller and Tucker, 2009*
- Privacy *increases* technology adoption/innovation
 - *Adjerid, Acquisti, Padman, and Telang, 2015*

Real Time Bidding (RTB)







Welfare analysis

Allocation Benefits (proportions)

- Intermediary
- Advertiser
- Consumer

Big data will be an
economic win-win

Privacy and security are
antithetical

- In 2000, 100 billion photos were shot worldwide
- In 2010, 2.5 billion photos *per month* were uploaded by Facebook users alone
- In 2014, 1.8 billion photos *per day* uploaded and shared online
- In 1997, the best face recognizer in FERET program scored error rate of 0.54 (false reject rate at false accept rate of 1 in 1000)
- In 2006, the best recognizer scored 0.01 (almost two order of magnitudes better)
- In 2010, the best recognizer scored 0.003



Heinz College foyer



Facebook

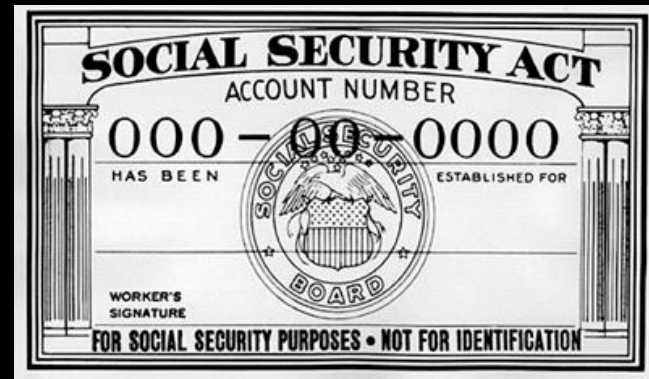
"Faces of Facebook: Privacy and Face Recognition in the Age of Augmented Reality,"
Alessandro Acquisti, Ralph Gross, and Fred Stutzman, *Journal of Privacy and Confidentiality*, 2014.

1 out of 3 subjects identified

"Faces of Facebook: Privacy and Face Recognition in the Age of Augmented Reality,"
Alessandro Acquisti, Ralph Gross, and Fred Stutzman, *Journal of Privacy and Confidentiality*, 2014.

facebook®

+



= SSN

"Predicting Social Security Numbers from Public Data,"

Alessandro Acquisti and Ralph Gross, *Proceedings of the National Academy of Science*, 2009.

Can you do $1+1$?



+

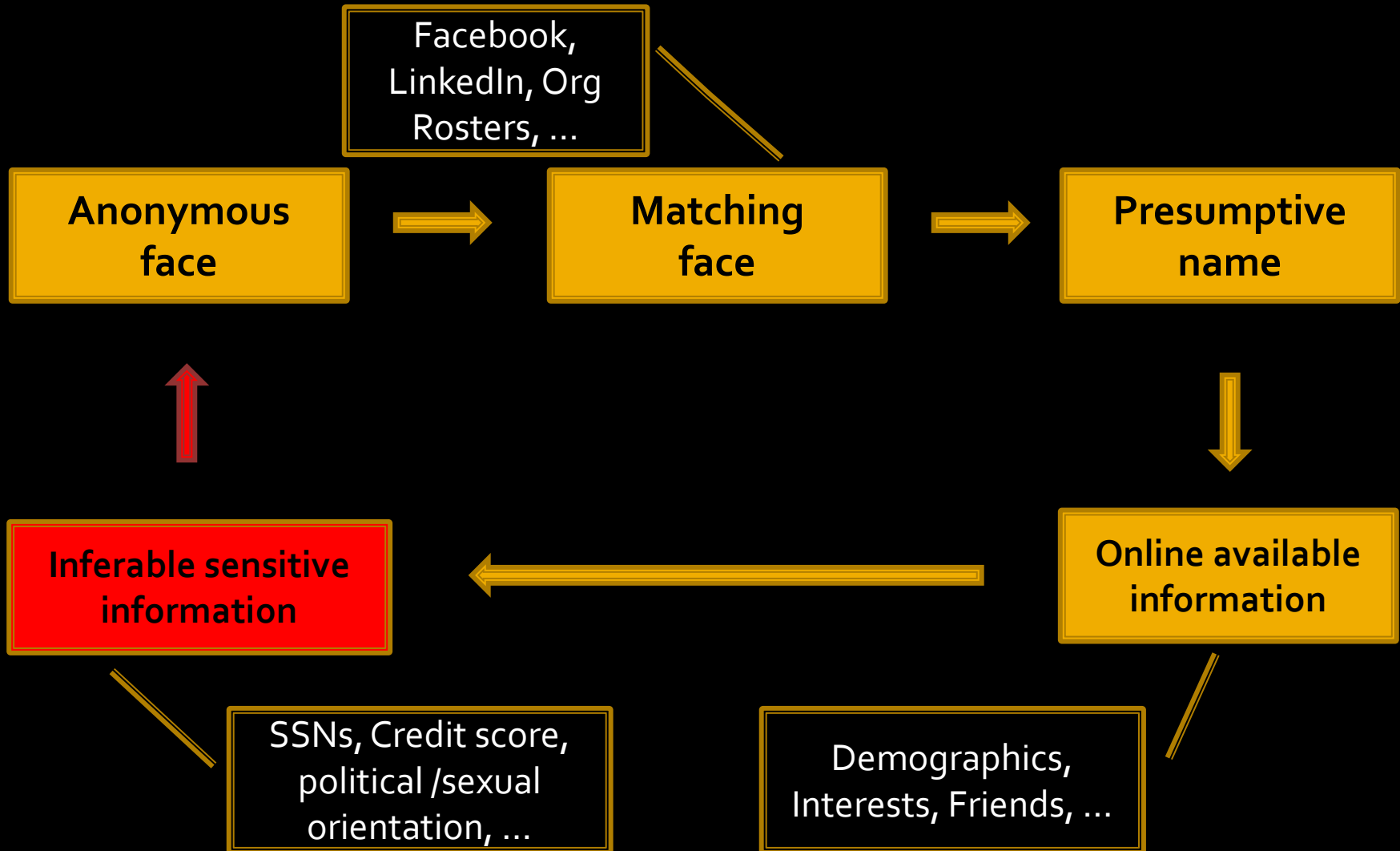
facebook®

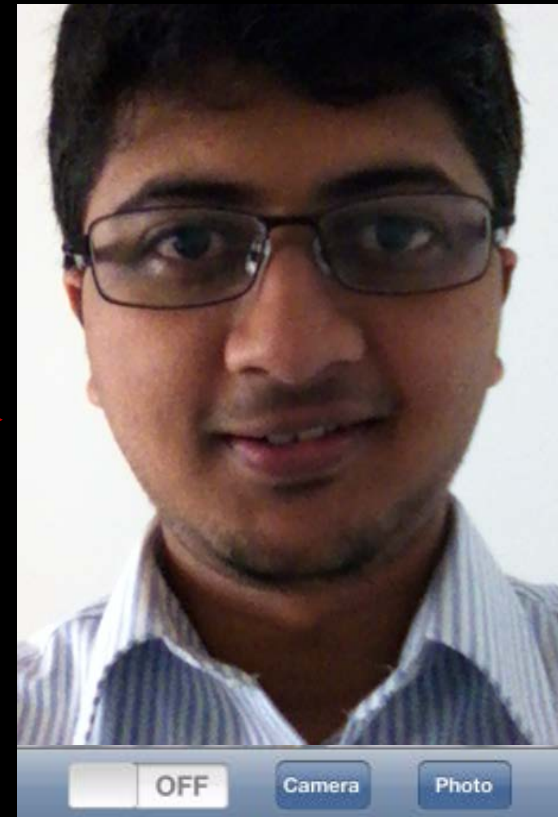
= SSN

"Faces of Facebook: Privacy and Face Recognition in the Age of Augmented Reality,"
Alessandro Acquisti, Ralph Gross, and Fred Stutzman, *Journal of Privacy and Confidentiality*, 2014.

27% of subjects' first 5 SSN digits
identified (with 4 attempts)

Data “accretion”





Focus: continuous
Name: Nithin Betegeri
SSN: 055-09-0001
DOB: 02/22/1989
State: NY



Privacy and security are
antithetical

People don't really care
about privacy



Analysis & Opinion | Anthony De Rosa

Most people don't care about their digital privacy

By Anthony De Rosa | December 17, 2012



49



32



Tags: [FACEBOOK](#) | [INSTAGRAM](#) | [SOCIAL NETWORKS](#)

Most of us simply don't care about our digital privacy. Sure, you see people citing their displeasure every time Facebook changes their terms of service, but with more than a billion users, few actually leave. Today, Instagram took a chance on [its own privacy policy](#), betting that people will treat its service the same way. Instagram now will feature advertising on its mobile application that uses your name, likeness and content, tracks your location and shares the data with Facebook.

The geek chorus is again warming up its pipes. However, I doubt that many will bother to stop taking fauxstalagically filtered photos of every waking moment.

Here are the key additions from Instagram:



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CrunchGov

Popular Posts



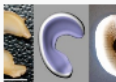
This Guy Took 4
Leafblowers And
A Skateboard...
3 days ago



Chromecast
Finally Gets That
Kind-Of-Magic...
4 days ago



Tinder
Competitor
Hinge scores
4 days ago



Doctors Can Now
Successfully 3D
Print A Knee
2 hours ago



An Open Letter
To Tim Cook
About Game
18 hours ago



Yahoo Starts
Prompting
Chrome Users...
3 days ago

Google's Cerf Says "Privacy May Be An Anomaly". Historically, He's Right.

Posted Nov 20, 2013 by [Gregory Ferenstein \(@ferenstein\)](#)

1,812
SHARES



One of the original architects of the Internet wants to remind us that privacy is a relatively new concept. "Privacy is something which has emerged out of the urban boom coming from the industrial revolution," [said](#) Google's Chief Internet Evangelist and a lead engineer on the Army's early 1970's Internet prototype, ARPANET. As a result, 'privacy may actually be an anomaly,' he told a gathering of the Federal Trade Commission.

Looking back at history, Cerf is mostly right.

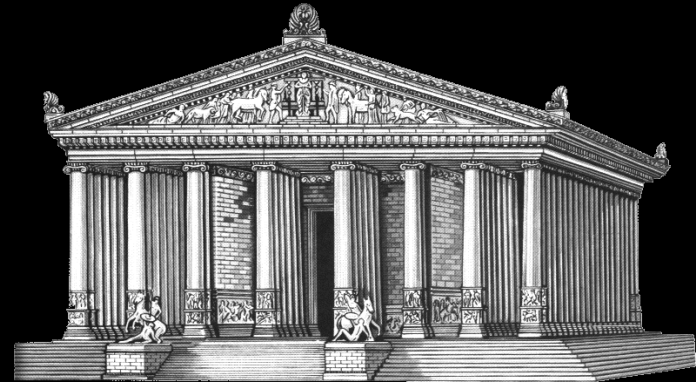
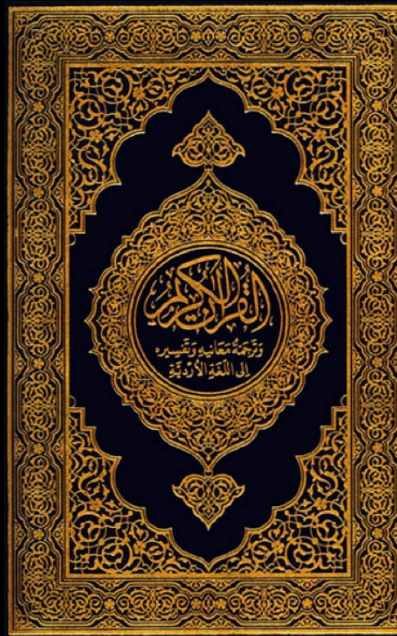
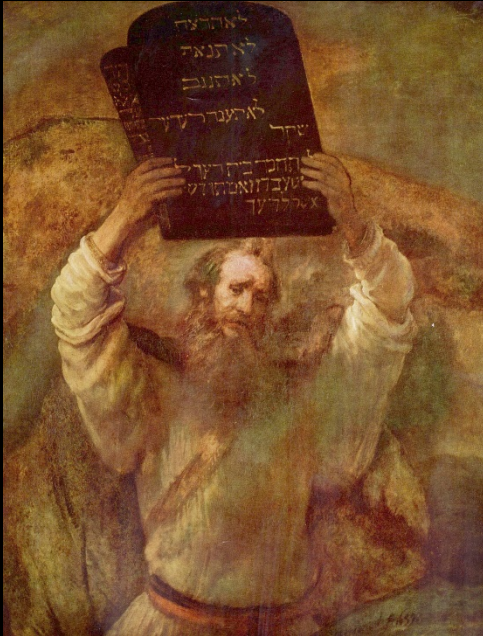
Up until the 19th century, most houses had few or no internal walls. [Bathing was a public act.](#) For most of the post-Roman era, the very concept of "solitude" [was limited to clergy](#), who dedicated their lives to private worship. "Intercourse, birth, death, just about every aspect of the life cycle plays out with some sort of audience," architectural historian Bernard Herman explained to me.

ADVERTISEMENT

Tech Champs Vs. Threats



“Privacy and Human Behavior in the Age of Information”,
Acquisti, Brandimarte, and Loewenstein, *Science*, 2015







Privacy norms, desires, expectations, and behaviors take profoundly different forms across cultures and societies

And yet, evidence of privacy seeking behavior seems to be found in **all cultures across time and space**

Altman (1977): Privacy is simultaneously culturally universal and culturally specific

Ok, but why?

An evolutionary conjecture (Acquisti, Brandimarte, Hancock, 2015)

Our responses to threats in the physical world may be sensitive to sensorial stimuli (physical, auditory, visual, olfactory, ...) signaling proximate, 'extraneous' presences, and which we have **evolved to use as cues of potential risk**

So-called **privacy concerns** may be evolutionary by-products of those visceral responses

Four sets of lab experiments ($N > 800$) manipulating ability to detect physical presence of a stranger via sensorial stimuli

- Proximity stimulus
- Visual stimulus
- Auditory stimulus
- Olfactory stimulus



>



"Online Self-Disclosure and Offline Threat Detection,"
Alessandro Acquisti, Laura Brandimarte, and Jeff Hancock, *WEIS*, 2015.

We found evidence that **offline sensorial cues** affected **online privacy behavior**

However: those cues we evolved to use to detect threats are absent, subdued, or even manipulated, in cyberspace

This may help explain...

- Why it is so hard to protect privacy online...
- Why privacy is very much contextual – and privacy behaviors at times seemingly paradoxical
- Why the design of privacy (and security) technologies may need to consider visceral interventions...

People don't really care
about privacy

We can balance analytics
and privacy via
transparency and control

Delivering More Control and Transparency

By [Matt Hicks](#) on Thursday, August 27, 2009 at 7:08am

This morning, we [announced](#) plans to give you more control over your information and to help you make more informed choices about privacy. We'll be making a series of improvements that include notifications and information about privacy settings and practices, additions to Facebook's privacy policy, and technical changes designed to give people more transparency and control over the information they provide to third-party applications.

These planned changes are a result of collaborative discussions we've had with the Office of the Privacy Commissioner of Canada, which has spent more than a year reviewing Facebook's privacy policies and controls. You can read more about their announcement [here](#). If you are a developer, you can read more about the potential impact for applications [here](#).

The improvements we announced today are in addition to the [tests we began](#) in July of simpler privacy settings and tools for migrating people to the new controls. Those tests continue and we hope to roll them out to more of you in the coming months.



Notes by Facebook

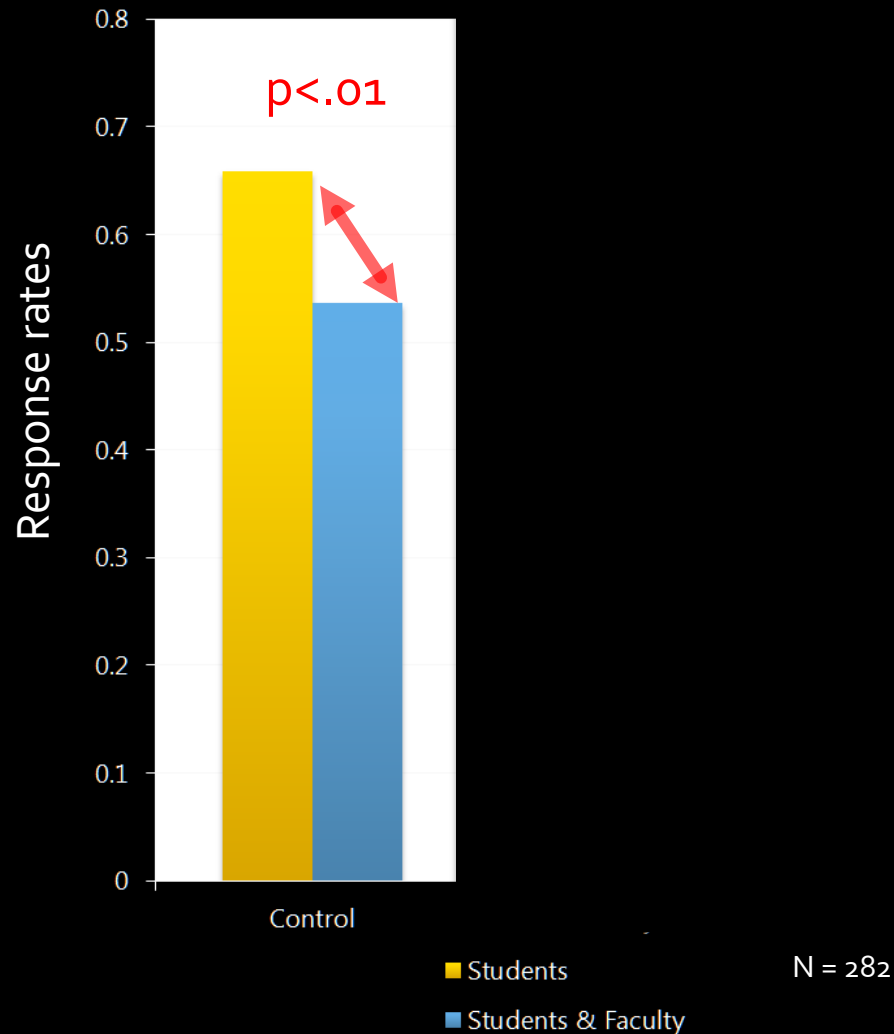
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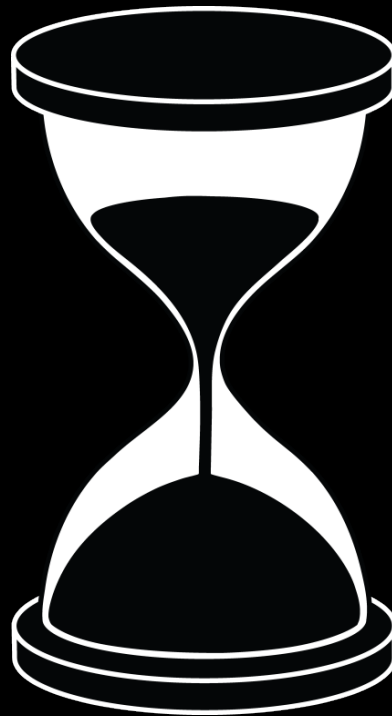
"Sleight of Privacy," Idris Adjerid, Alessandro Acquisti, Laura Brandimarte, and George Loewenstein. *SOUPS*, 2013



"Sleight of Privacy," Idris Adjerid, Alessandro Acquisti, Laura Brandimarte, and George Loewenstein. *SOUPS*, 2013



"Sleight of Privacy," Idris Adjerid, Alessandro Acquisti, Laura Brandimarte, and George Loewenstein. *SOUPS*, 2013

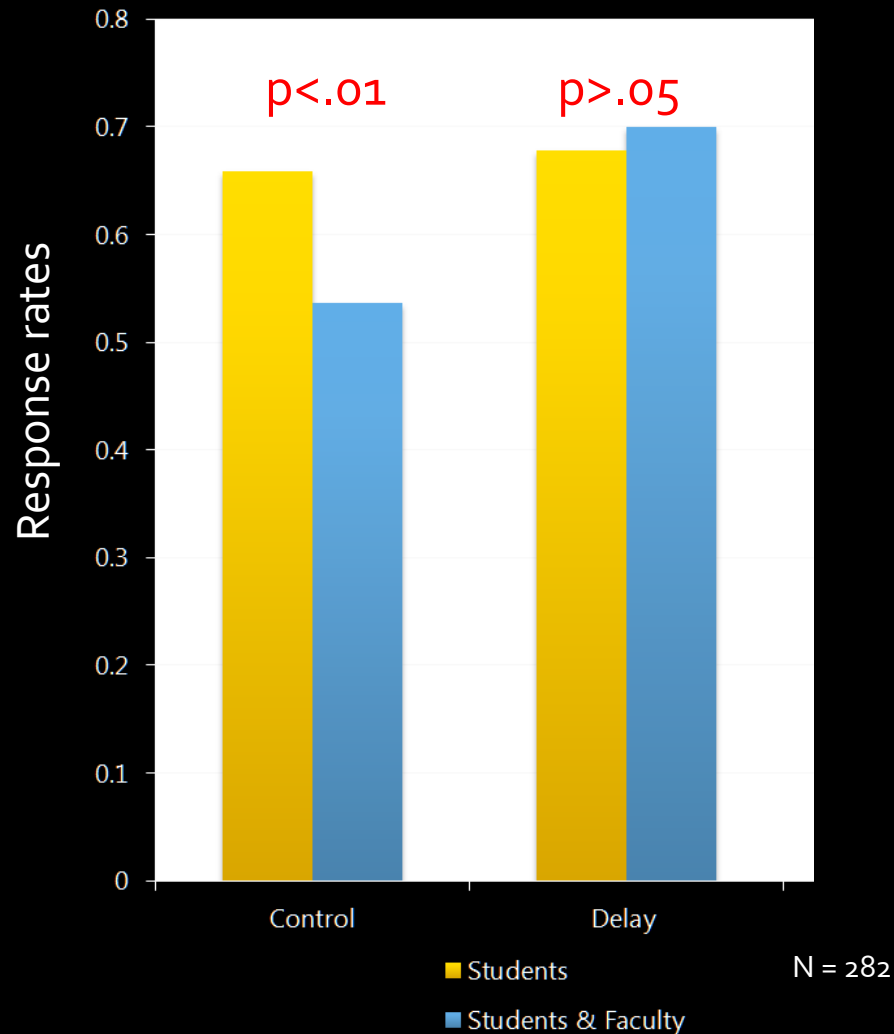


"Sleight of Privacy," Idris Adjerid, Alessandro Acquisti, Laura Brandimarte, and George Loewenstein. *SOUPS*, 2013



15 seconds delay

"Sleight of Privacy," Idris Adjerid, Alessandro Acquisti, Laura Brandimarte, and George Loewenstein. *SOUPS*, 2013



"Sleight of Privacy," Idris Adjerid, Alessandro Acquisti, Laura Brandimarte, and George Loewenstein. *SOUPS*, 2013

Privacy and paradox of **Control**

Control :: Privacy

+

Privacy and paradox of **Control**

Control :: Privacy



Study on Ethical Behavior

IMPORTANT: All answers are voluntary. By answering a question, you agree to give the researchers permission to publish your answer.

	Yes	No
1. Are you married?	<input type="radio"/>	<input type="radio"/>
2. Have you ever been fired by your employer?	<input type="radio"/>	<input type="radio"/>
3. Have you ever stolen anything (e.g.: from a shop, a person)?	<input type="radio"/>	<input type="radio"/>
4. Have you ever used drugs of any kind (e.g.: weed, heroin, crack)?	<input type="radio"/>	<input type="radio"/>
5. Have you ever lied about your age?	<input type="radio"/>	<input type="radio"/>
6. Have you ever had cosmetic surgery?	<input type="radio"/>	<input type="radio"/>
7. Have you ever done any kind of voluntary service?	<input type="radio"/>	<input type="radio"/>
8. Have you ever had sex in a public venue (e.g.: restroom of a club, airplane)?	<input type="radio"/>	<input type="radio"/>
9. Have you ever made a donation to a non-profit organization?	<input type="radio"/>	<input type="radio"/>
10. Do you have any permanent tatoos?	<input type="radio"/>	<input type="radio"/>

Close

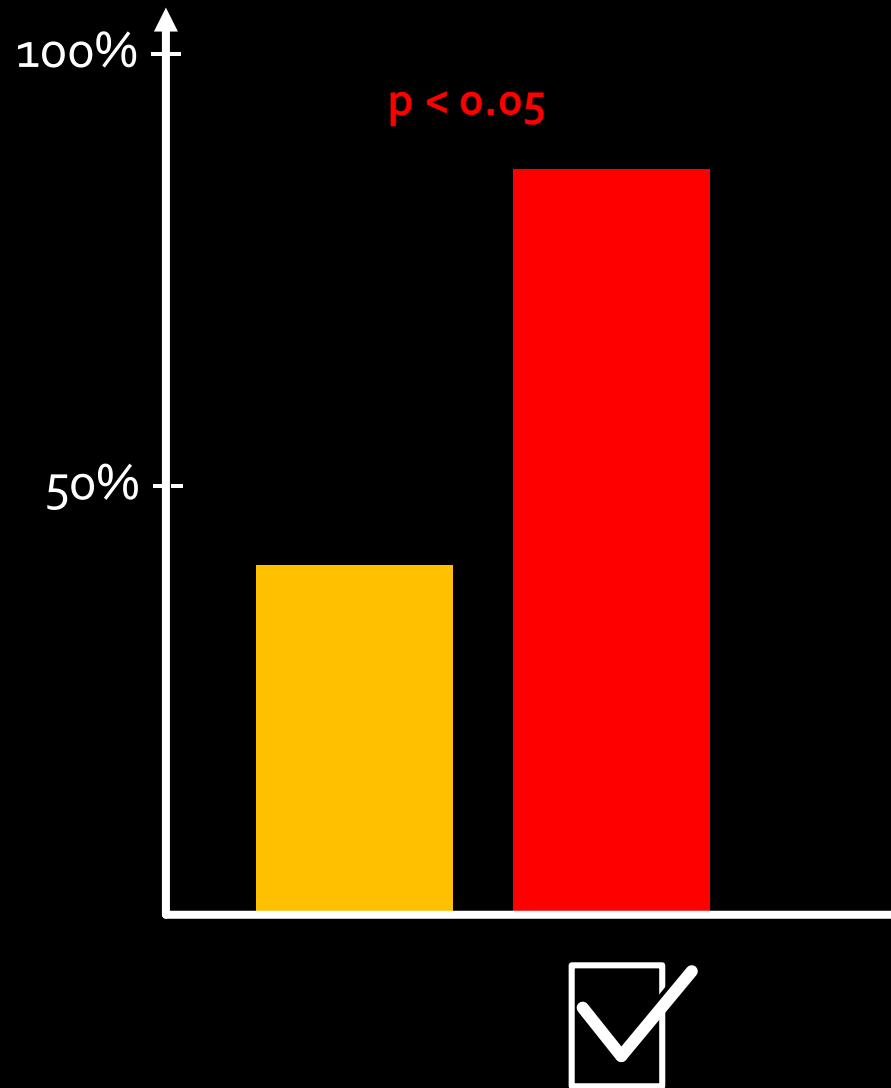
Study on Ethical Behavior

IMPORTANT: All answers are voluntary. In order to give the researchers permission to publish your answer to a question, please check the corresponding box.

	Publication permission	Yes	No
1. Are you married?	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>
2. Have you ever been fired by your employer?	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>
3. Have you ever stolen anything (e.g.: from a shop, a person)?	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>
4. Have you ever used drugs of any kind (e.g.: weed, heroin, crack)?	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>
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6. Have you ever had cosmetic surgery?	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>
7. Have you ever done any kind of voluntary service?	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>
8. Have you ever had sex in a public venue (e.g.: restroom of a club, airplane)?	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>
9. Have you ever made a donation to a non-profit organization?	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>
10. Do you have any permanent tatoos?	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>

Close

Response rates



"Misplaced confidences: Privacy and the control paradox," Laura Brandimarte, Alessandro Acquisti, and George Loewenstein. *Social Psychological and Personality Science*, 2013



Visceral targeting



We can balance analytics
and privacy via
transparency and control

Big data will be an
economic win-win

Privacy and security are
antithetical

People don't really care
about privacy

We can balance analytics
and privacy via
transparency and control

Big data will be an
economic win-win

(Lack of) privacy is
redistributive

Privacy and security are
antithetical

Any personal information
can be sensitive

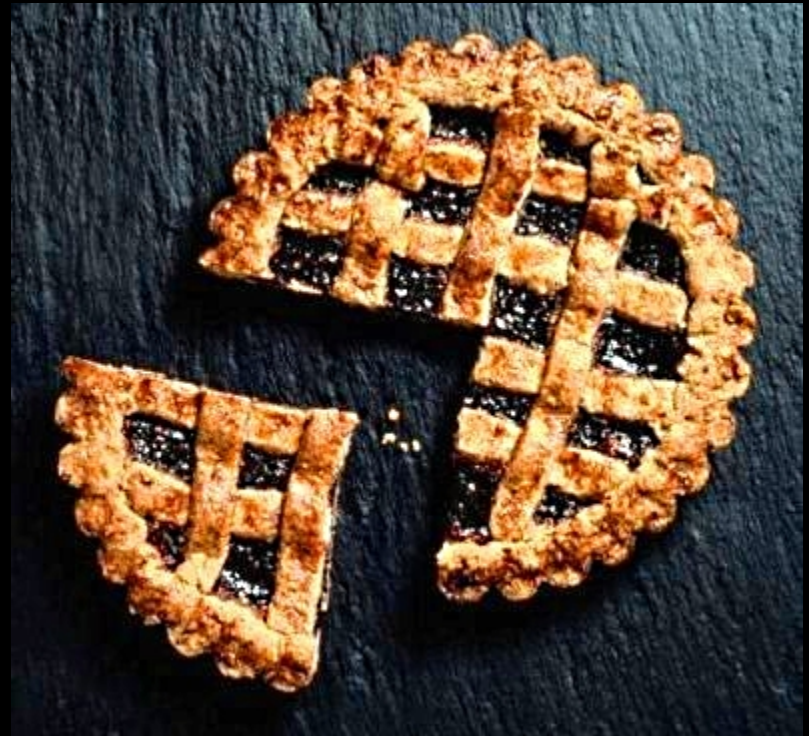
People don't really care
about privacy

People value both sharing
and protecting information

We can balance analytics
and privacy via
transparency and control

Privacy is about
protection from control

What “big data” do we want?



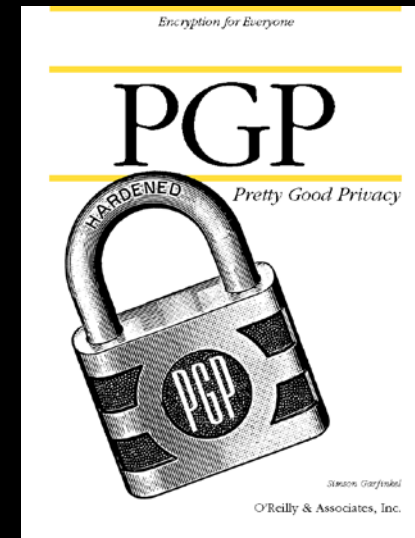
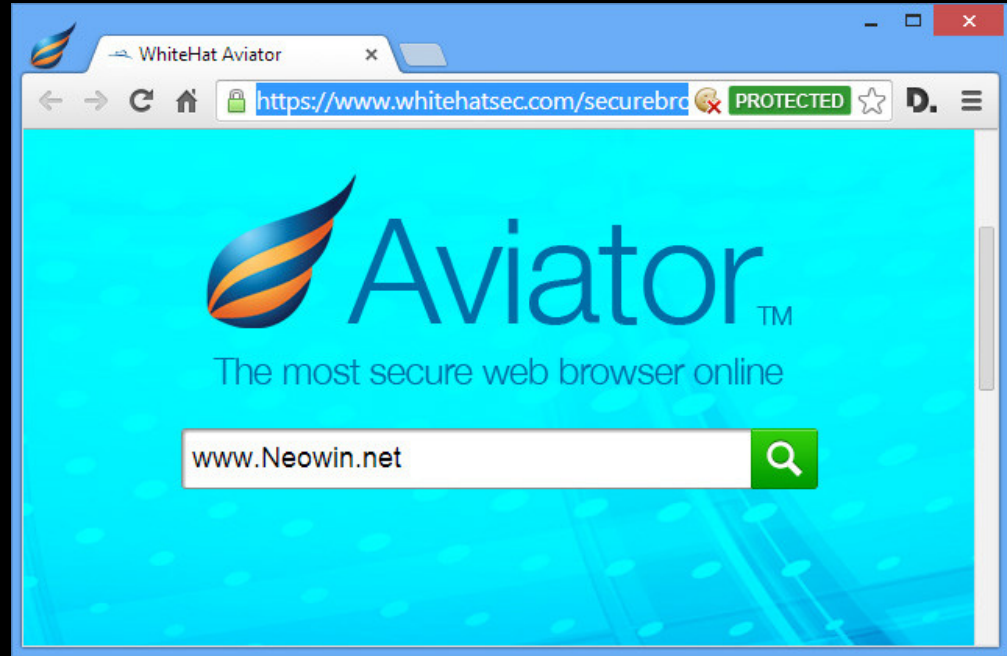
For more information

- Google/Bing: economics privacy
- Visit: <http://www.heinz.cmu.edu/~acquisti/economics-privacy.htm>
- Email: acquisti@andrew.cmu.edu

- PETs

PETs

- Privacy Enhancing Technologies allow, among other things ...
 - Authentication without identification...
 - Private information retrieval...
 - Searches in encrypted spaces...
 - Operations on encrypted spaces...
 - Privacy-preserving data mining, collaborative filtering, targeted advertising...

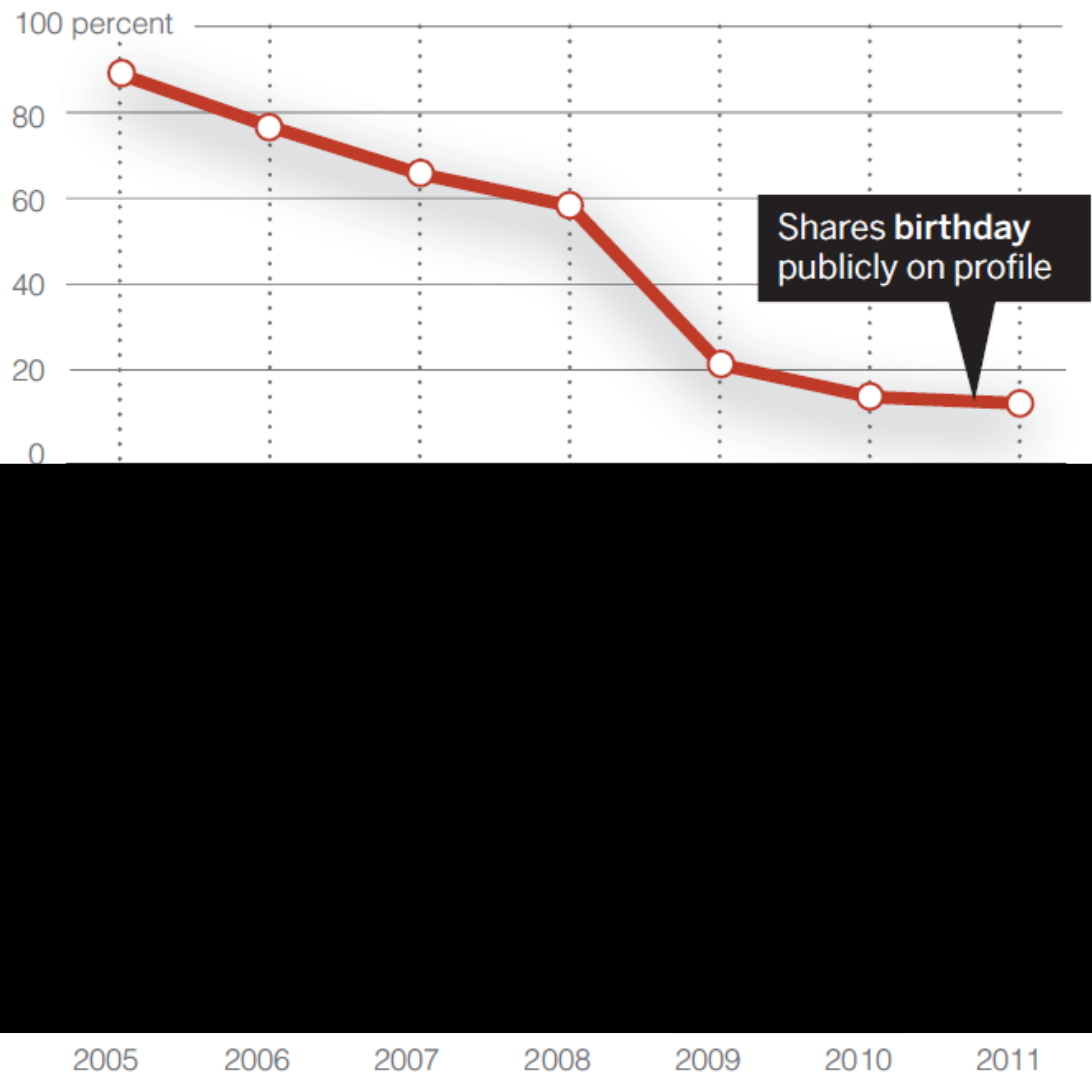


Possible role of regulation:

Promoting the development and the
adoption of those privacy enhancing
("balancing"?) technologies

Disclosure behavior in online social media

Percentage of profiles publicly revealing information over time
(2005-2011)



"Privacy and Human Behavior in the Age of Information," Alessandro Acquisti, Laura Brandimarte, and George Loewenstein. *Science*, 2015



\$10

Anonymous

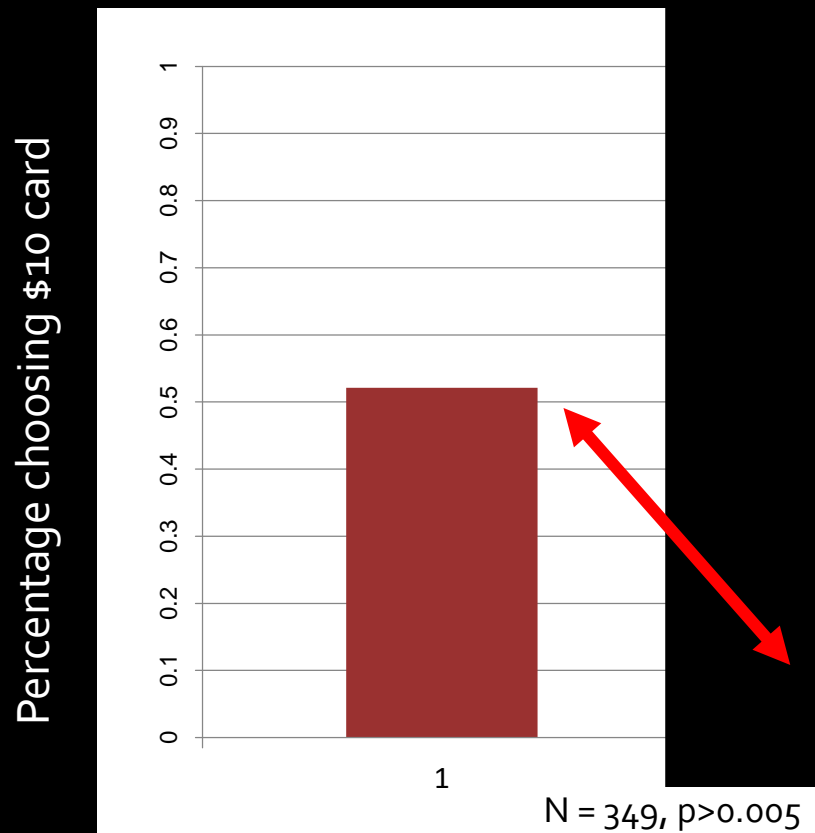


\$12

Tracked



"What is Privacy Worth?," Alessandro Acquisti, Leslie John, and George Loewenstein.
Journal of Legal Studies, 2013.



"What is Privacy Worth?," Alessandro Acquisti, Leslie John, and George Loewenstein.
Journal of Legal Studies, 2013.

