

Turtles, Locks, and Bathrooms: Understanding Mental Models of Privacy Through Illustration

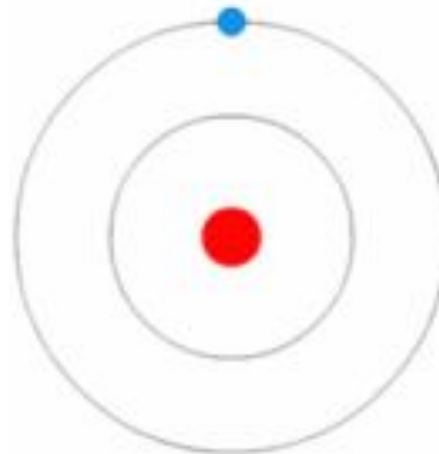
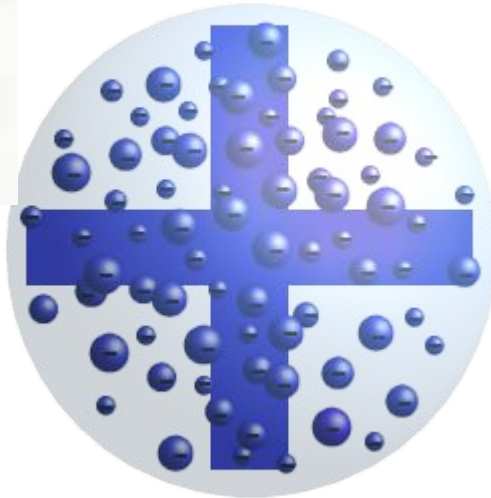
Maggie Oates, Yama Ahmadullah, Abigail Marsh, Chelse Swoopes,
Shikun Zhang, Rebecca Balebako, and Lorrie Faith Cranor

There is no “best” mental model



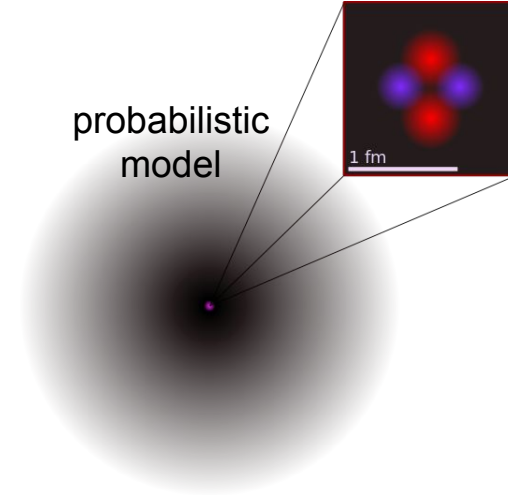
Billiard Ball

Plum Pudding



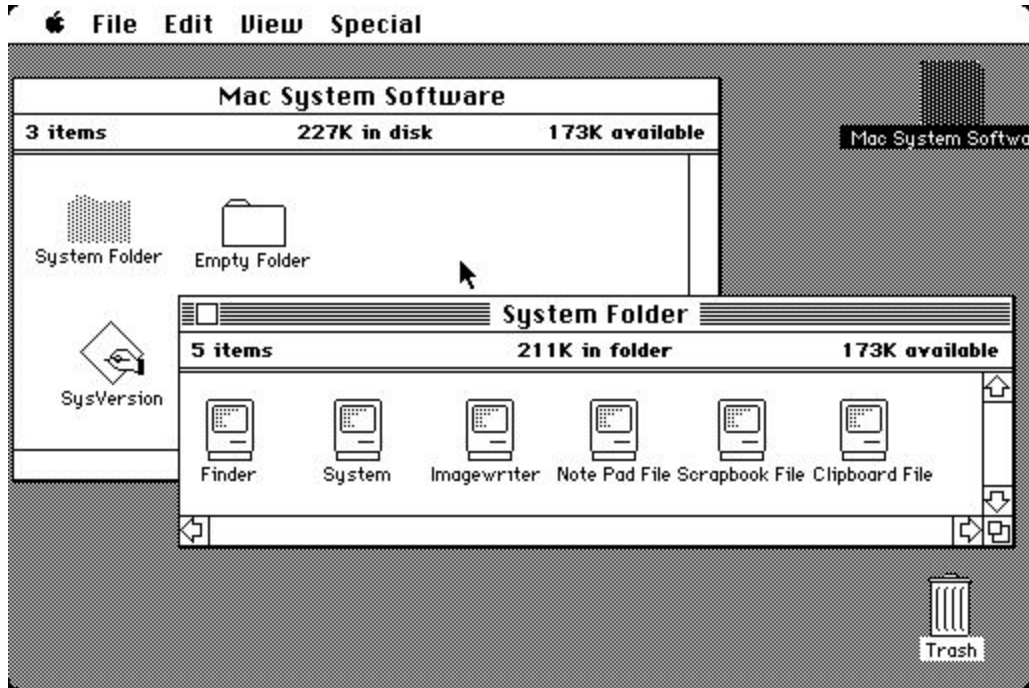
Standard Nuclear Model

probabilistic model



$1 \text{ \AA} = 100,000 \text{ fm}$

Mental models are used across fields



Copyright Apple Inc.



Why privacy mental models?

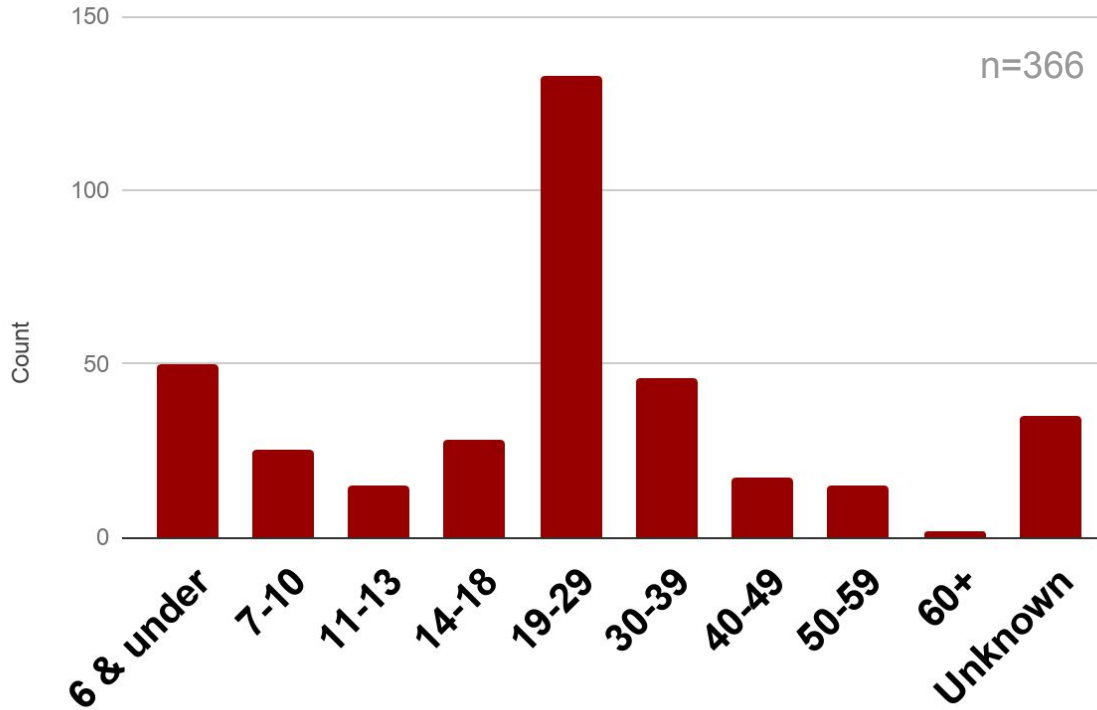
- Mental model: set of rough internal ideas and metaphors of how the world works
- Privacy behavior
 - Complicated
 - Contradictory (some believe)



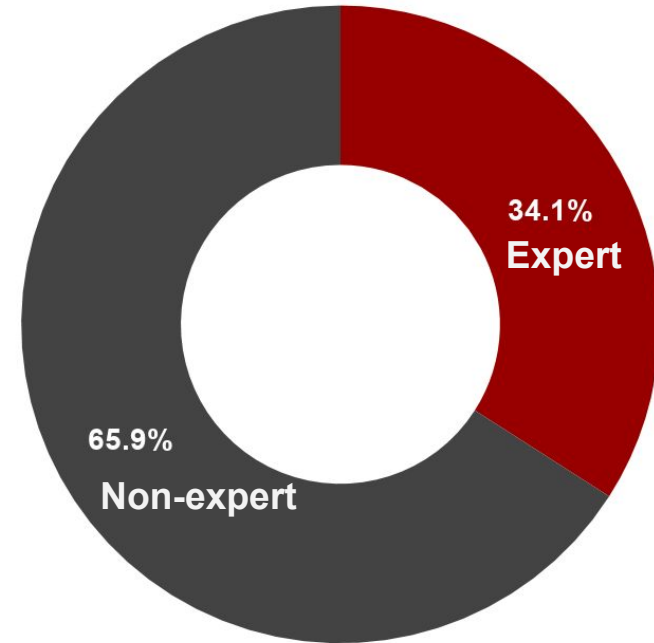
A group of people are gathered around a table in a meeting room. There are laptops, papers, and boxes of markers on the table. A large, bold, dark brown text overlay is centered on the image. The background shows a doorway leading to another room with more people and a blue balloon.

**“What does
privacy mean to
you?”**

Age



Expertise



- What metaphors and imagery can represent privacy?
- What *can* be visually represented?
- What do laypeople and experts think?

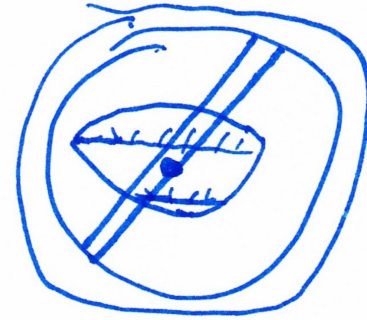
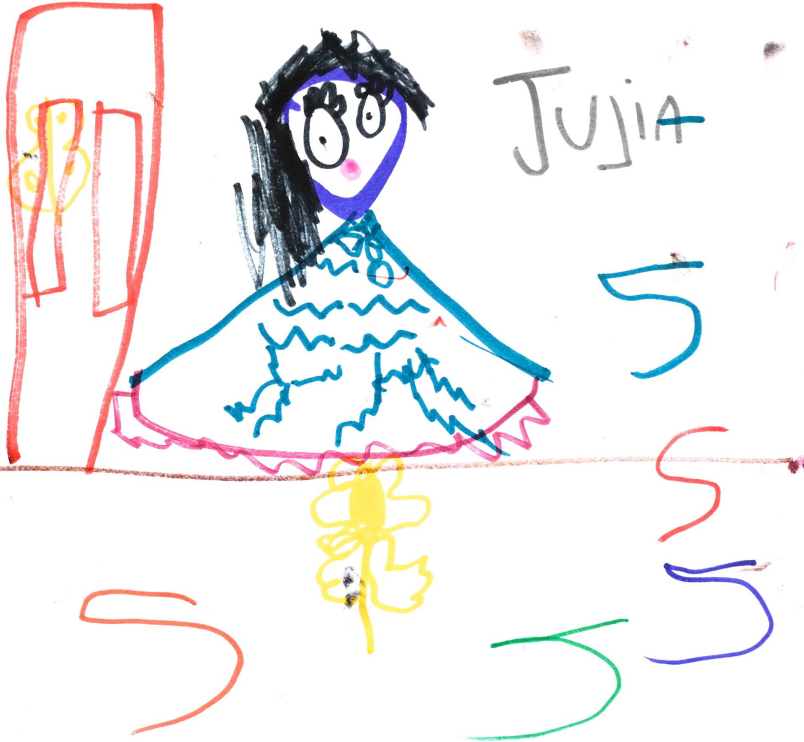
Method

- visual content analysis
- iterative codebook
- 2 coders, high inter-rater reliability

- Symbols
- Contexts
- Privacy Frameworks
- Metaphors

Symbols are visual units

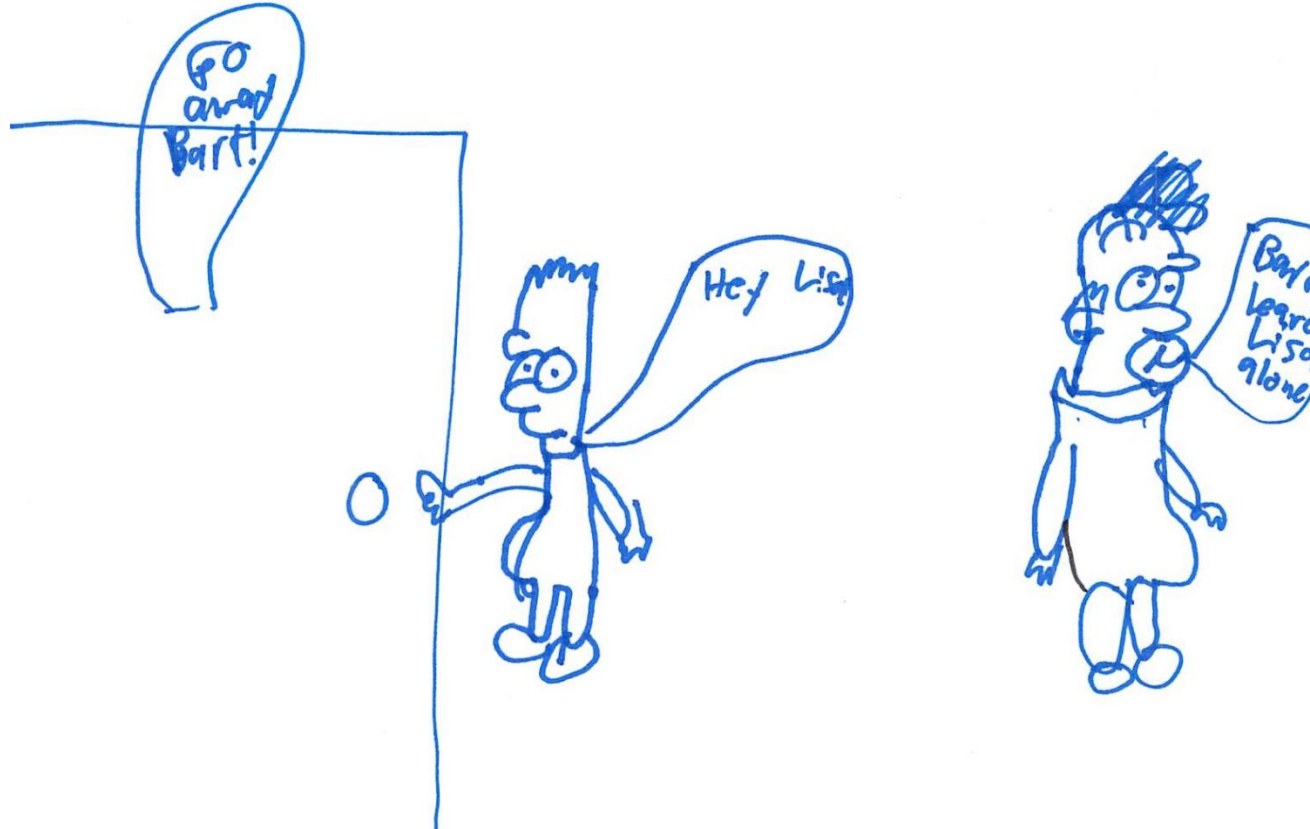
YOU NEED
PRIVACY
IN MY
ROOM.
YOU NEED
PRIVACY
TO PUT ON
MY DRESS.



Contexts are social & physical

- Who?
- What?
- Where?

Contexts: Family is harmful



Contexts: Coping with family

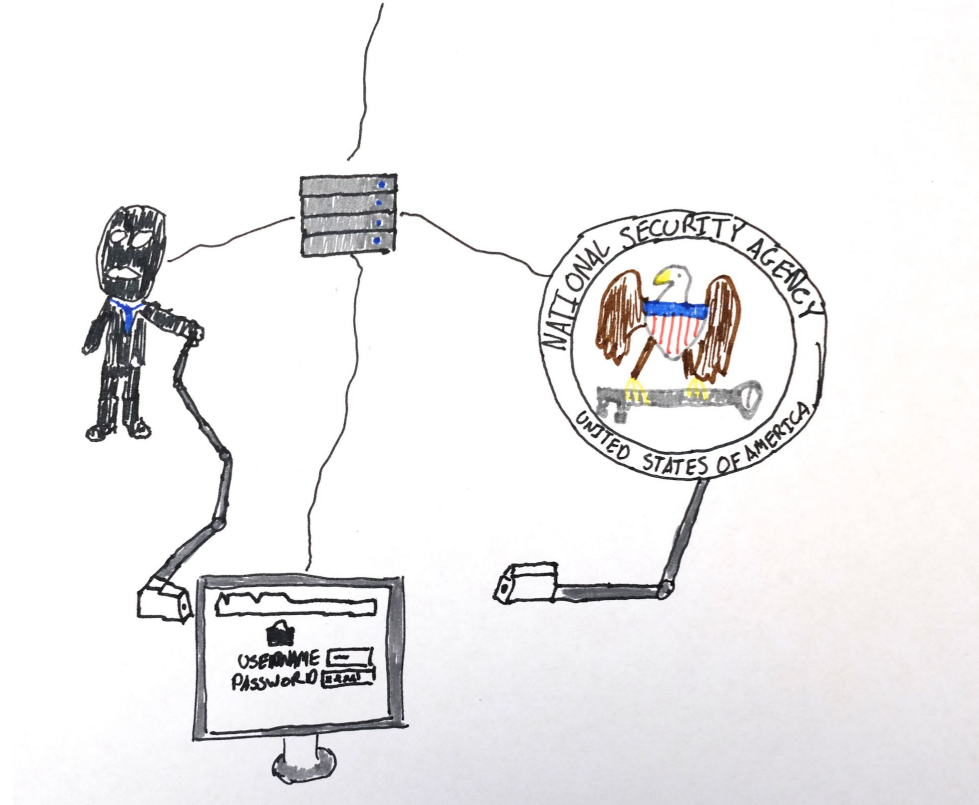
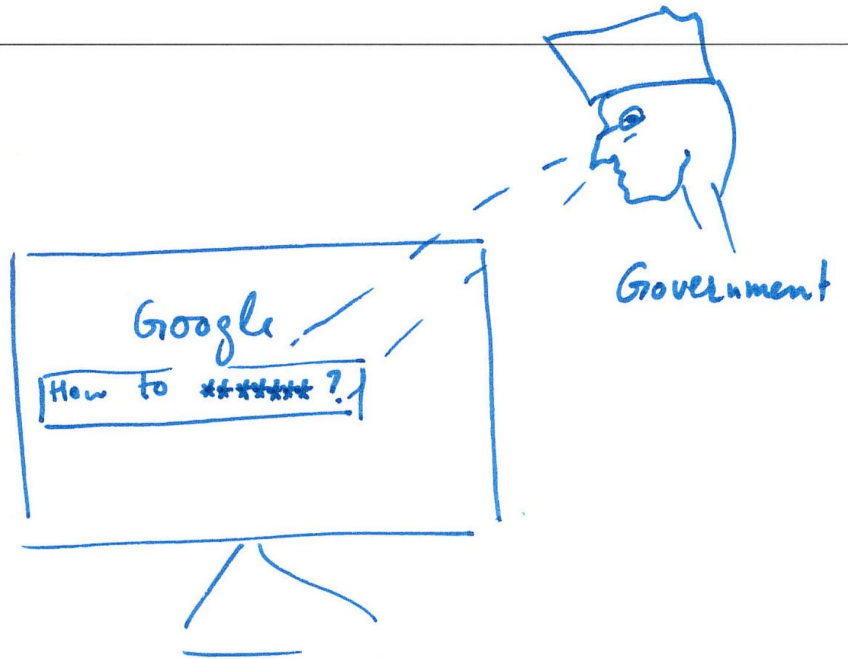
“

This is me enjoying my privacy. This is the only time during the day, were I am truly alone and nothing bothers me. No man no children no dogs. Cindy: age 54

”



Contexts: Government is harmful



Contexts: Copying

“

I'm not showing my work with others.
I'm not showing my answers so they
take my ideas. By Rosalind, Grade 1

”



Frameworks

Alan Westin's states

Solitude
Intimacy
Anonymity
Reserve

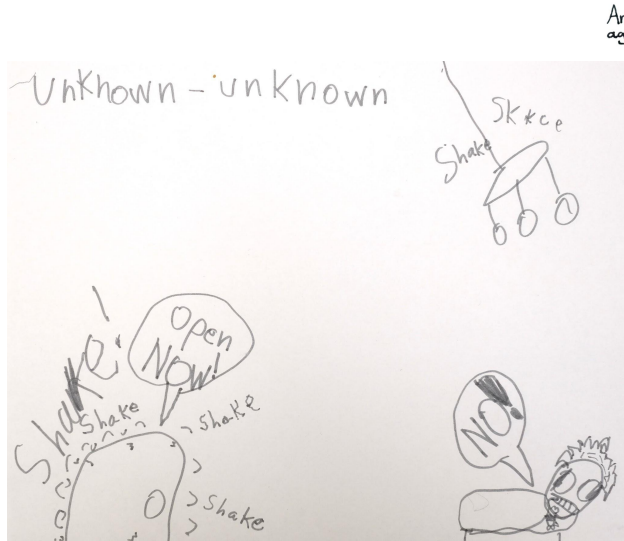
1970, "Privacy and Freedom"

Daniel Solove's harms

Surveillance	Disclosure
Interrogation	Exposure
Aggregation	Increased Access
Identification	Blackmail
Insecurity	Appropriation
Secondary Use	Distortion
Exclusion	Intrusion
Breach of Confidentiality	Decision Interference

2006, Penn Law Review

Frameworks: More harms than states



intrusion



exposure



solitude

Frameworks: Some are hard to draw

distortion

aggregation

increased access

blackmail

appropriation

interrogation

- Password
- Pictures leaked

Sam 16



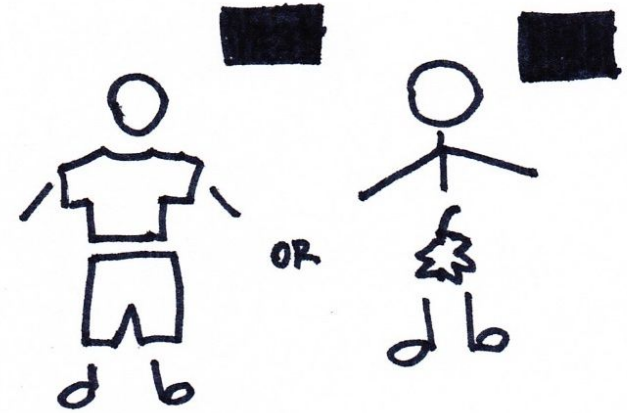
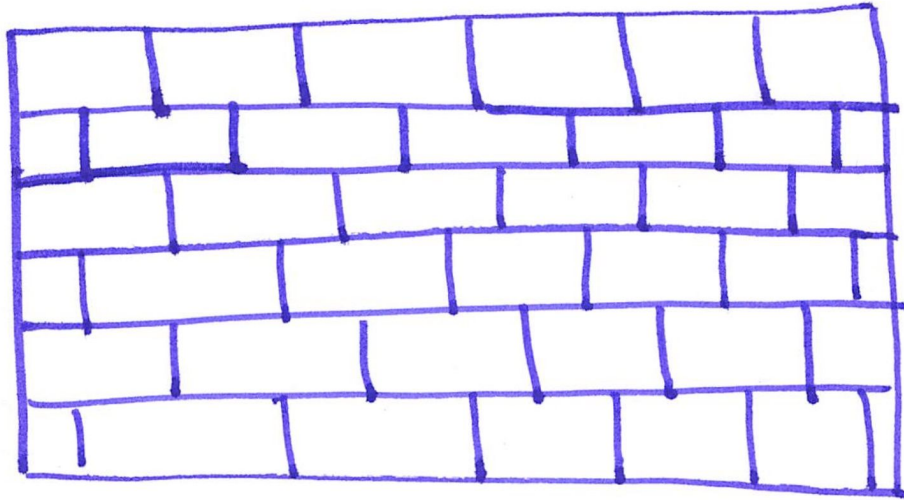
- Identity Theft

- Plankton Stealing the Krabby Patty recipe
- Copying

Metaphors: What can be modeled?

- privacy involves my diary vs privacy *is* a diary
- we use metaphors all the time
- emphasis and de-emphasis

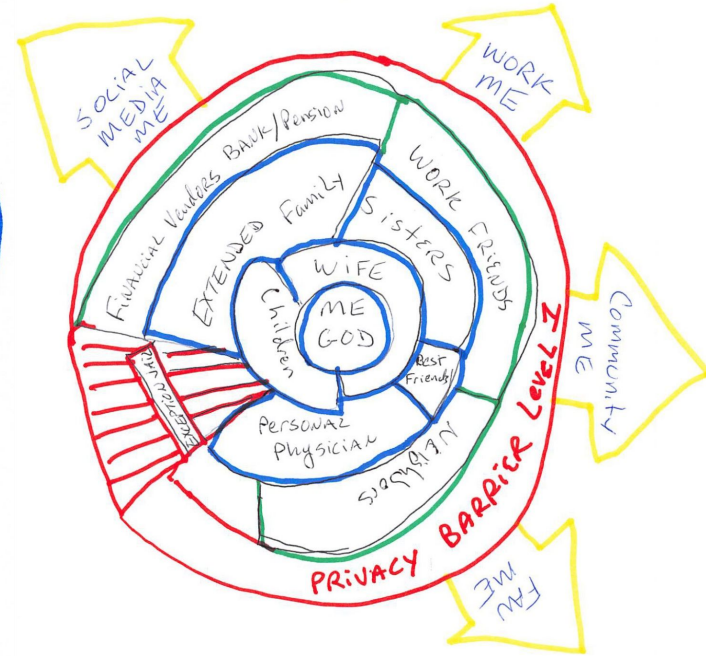
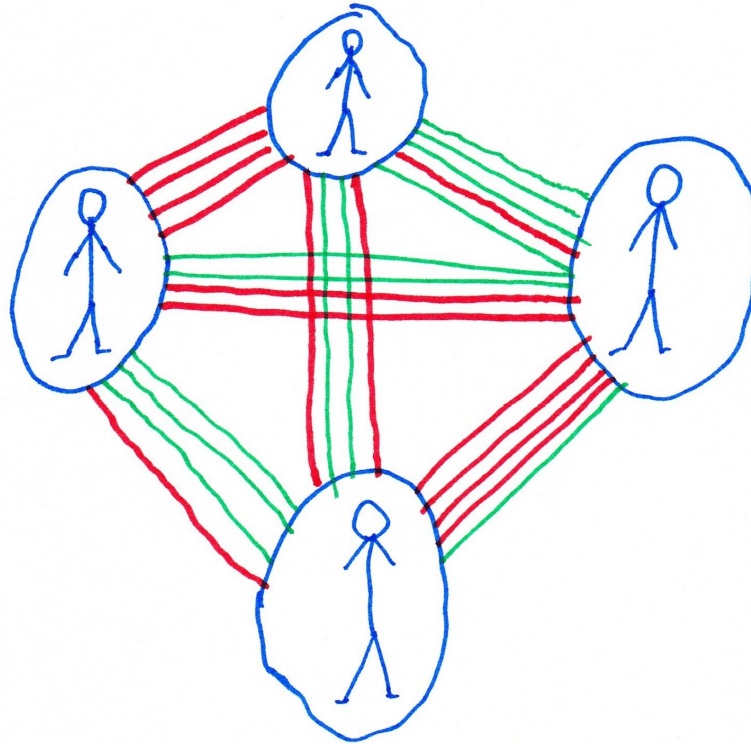
Metaphors: Barriers



" PRIVACY IS BEING
ABLE TO COVER YOURSELF
OR YOUR THINGS AS MUCH
AS YOU WANT."

(Note: image cropped for focus)

Metaphors: Organization



Metaphors: Absence



Metaphors: Interesting



What did we learn?

- privacy as individual
- public-private divide

- icons are hard

Appropriate



FIND PEOPLE

FOLLOWING

FOLLOWERS

Your circles



Friends empty - in "Your circles"



Family empty - in "Your circles"



Acquaintances empty - in "Your circles"



Connect with Google 34 people



Technology 59 people



Science & Nature 60 people



Education 58 people



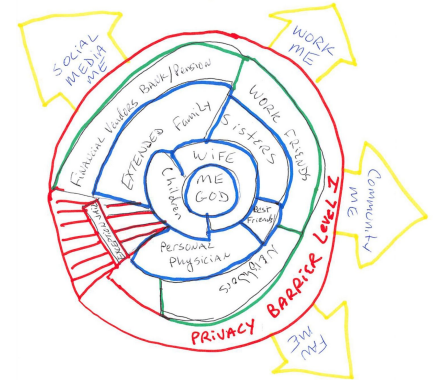
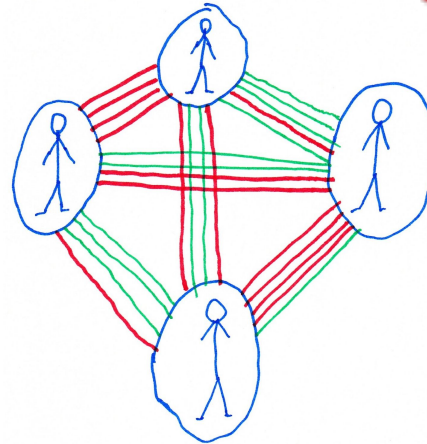
History & Museums 23 people



Politics 60 people



Appropriate models help users



What should you take away?

- Choose metaphors & models wisely
 - Writing
 - Building
 - Teaching

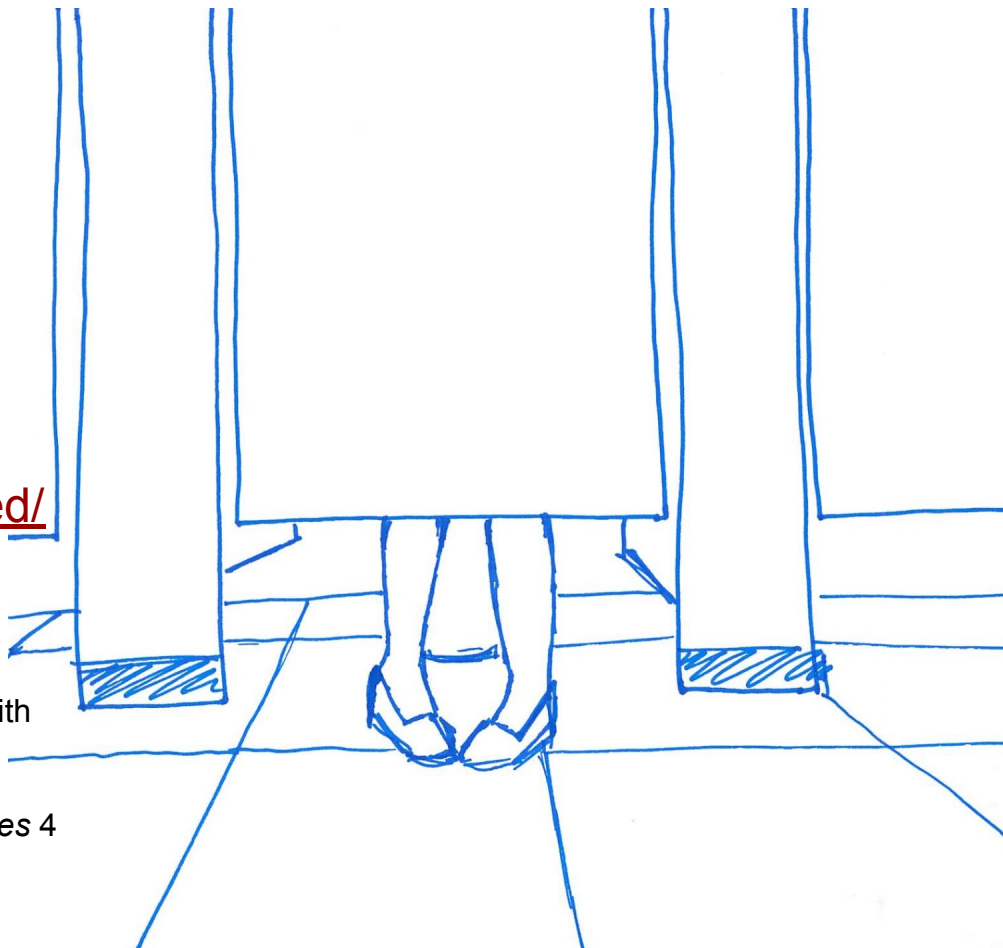
Maggie Oates
moates@cmu.edu

 @oatesmeal

Check out the images at:

<https://cups.cs.cmu.edu/privacyillustrated/>

Maggie Oates, Yama Ahmadullah, Abigail Marsh, Chelse Swoopes, Shikun Zhang, Rebecca Balebako, and Lorrie Faith Cranor. 2018. **Turtles, Locks, and Bathrooms: Understanding Mental Models of Privacy Through Illustration.** *Proceedings on Privacy Enhancing Technologies 4* (2018).



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SOFTWARE
RESEARCH

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Security and Privacy Institute

 **privacy**
ENGINEERING

CUPS
CyLab Usable Privacy & Security Laboratory

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<https://cups.cs.cmu.edu/privacyillustrated>

- Johnson-Laird's definition of mental models is from: David Jonassen and Young Hoan Cho. 2008. Externalizing Mental Models with Mindtools. In *Understanding Models for Learning and Instruction*, Dirk Ifenthaler, Pablo Pirnay-Dummer and J. Michael Spector (eds.). Springer US, Boston, MA, 145–159.
- Alan Westin. 1970. *Privacy and Freedom*. Antheum, New York.
- D. J. Solove. 2005. A taxonomy of privacy. *Univ. PA Law Rev.*

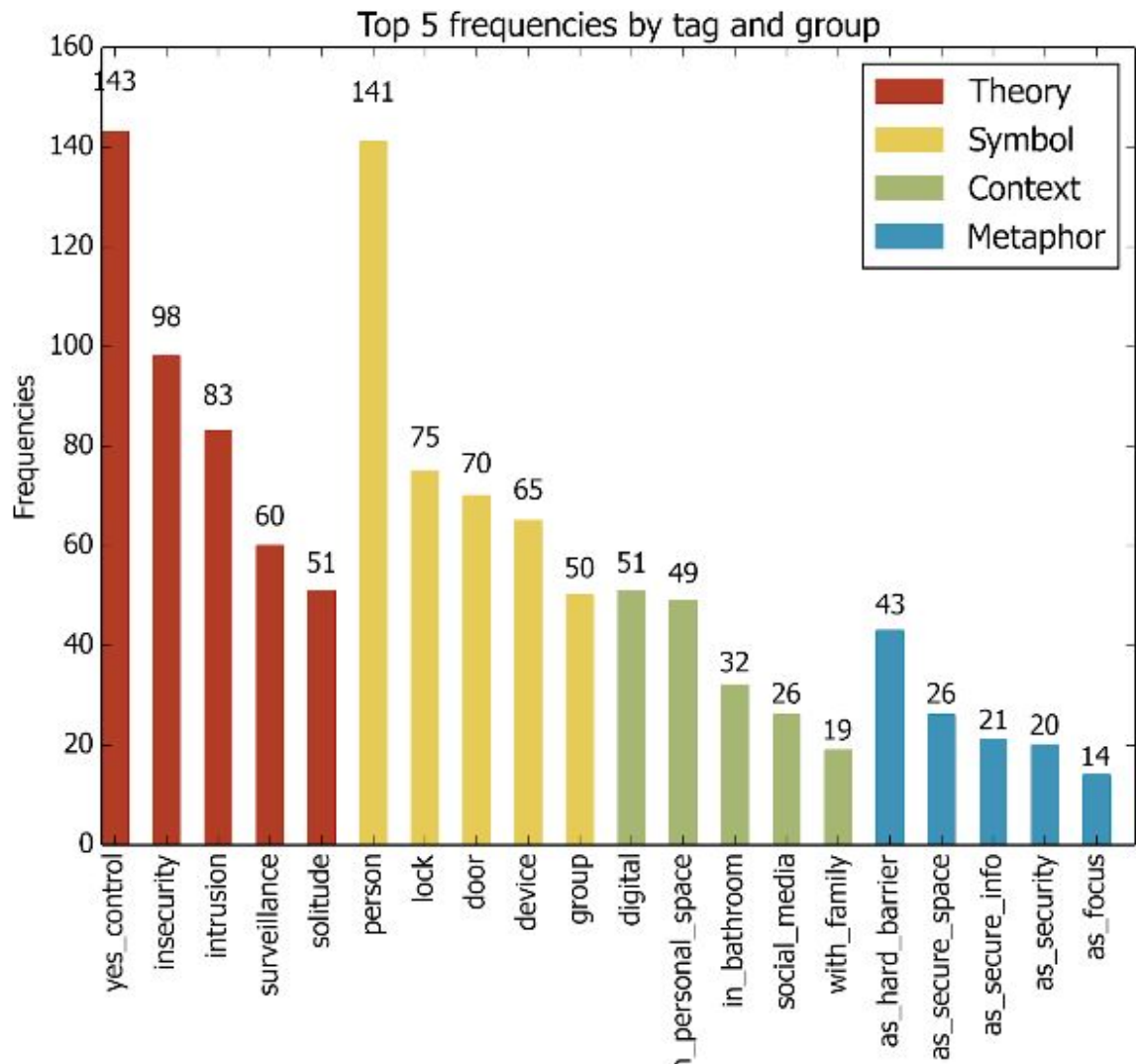
Backup Slides

What is the “best” metaphor?

- Best for what?
- Environmental metaphors seem promising (Hirsch, 2006)
 - Pollution
 - Emissions
 - Shared space, individual impacts
 - See Hirsch’s: “Protecting the Inner Environment: What Privacy Regulation Can Learn from Environmental Law” (2006)

Most Common Themes?

- n=366 images
- See Appendix B



As a consumer



Privacy to me is sealing my box of data from web applications and services which try to collect it. By Hana H. age 23.

Pop culture

By Charlotte, age 18



Mixed Metaphor

“ Privacy is control over who I am and what I know, filtering it so that the right people get only what they need, and protecting it from the rest of the world. By Krista Maddigan, VP, Regulatory Affairs, Age 45 ”



Abstract/Hopeless

I feel like my privacy is always being "pierced" by malicious companies and government entities online. This is a rotten egg being attacked by bacteria. By Cassidy, age 22

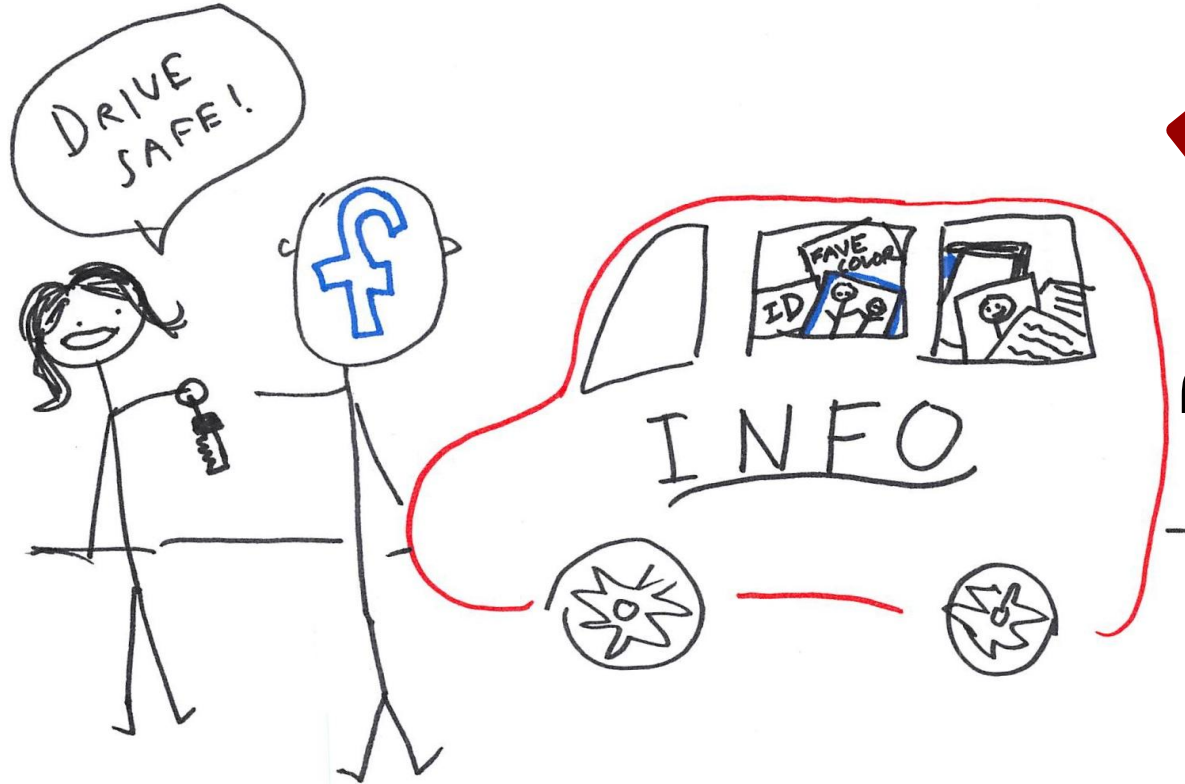


Hopelessness

“
Privacy is an illusion.
By Briana, age 16
”

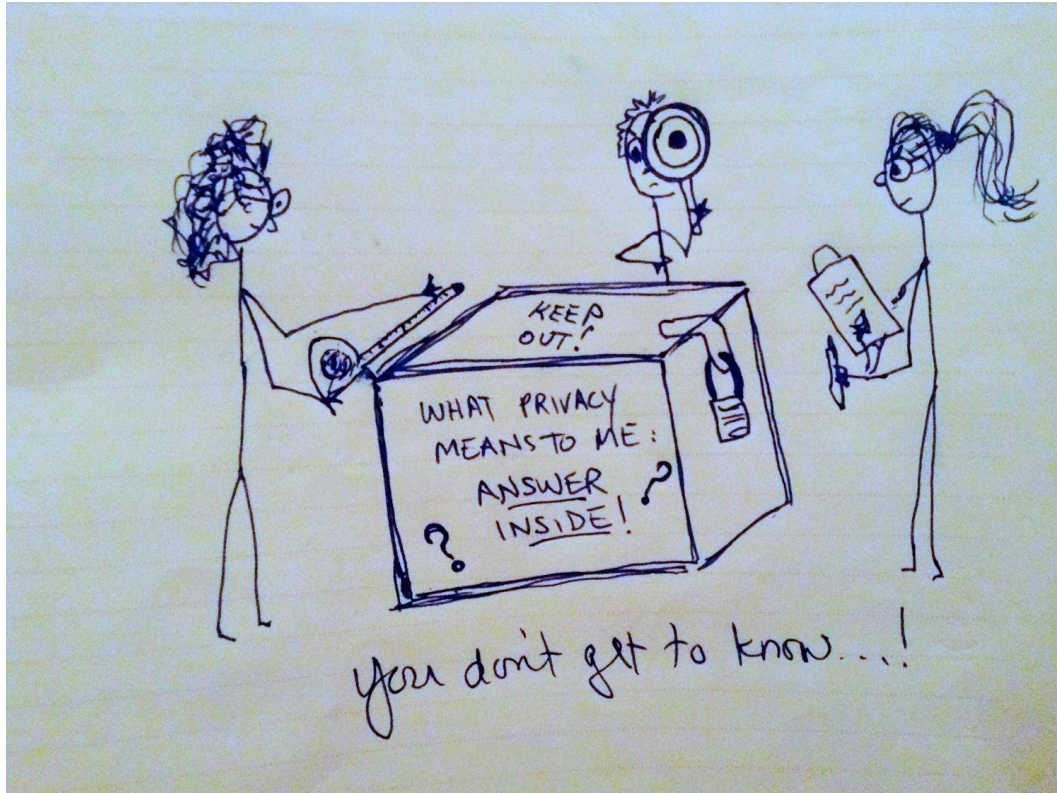


What did *you* draw?



Privacy is a fragile combination of control and trust. By Maggie, age 20-25

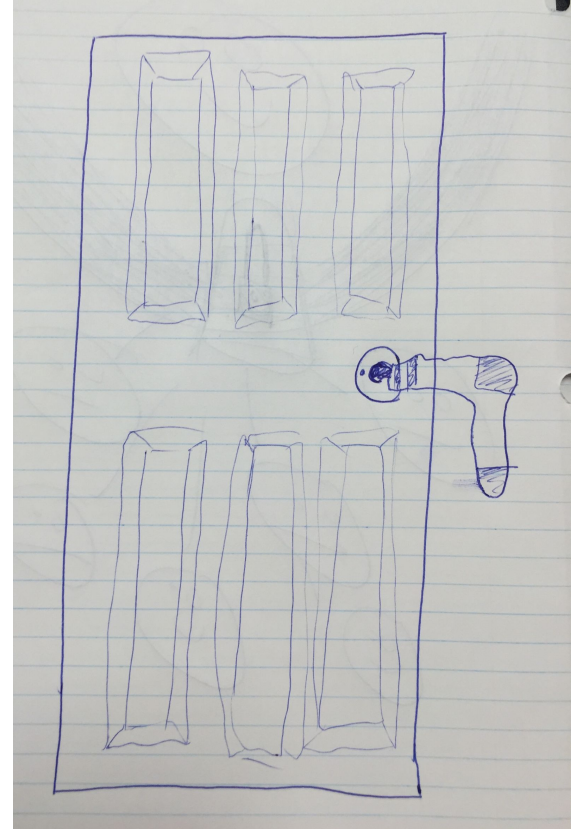
What is your favorite?



It's a box containing the answer to "What privacy means to me." You researchers are measuring it and studying it, but can't actually get the answer, because it's PRIVATE. ha ha....
By Heather, age 44

Age Differences

- Children
 - less likely to draw metaphors
 - More likely to emphasize specific contexts
- Very young children
 - don't draw digital privacy (increases with age until adult)
 - Draw bathrooms, family, personal space
 - Soft barriers (blankets)
- Copying: only children & teens
- Not much difference between adult age groups



Gender Differences

Predicted Gender	n
woman	153
man	147
unknown	67

No substantive differences across gender when accounting for the large unknown portion.

Age & Expert Breakdown

<i>Age Range</i>	<i>Expertise</i>	
	<i>Expert</i>	<i>Non-expert</i>
(6 & under		100%
(7-10		100%
11-13		100%
14-18	4%	96%
19-29	59%	41%
30-39	20%	80%
40-49	53%	47%
50-59	53%	47%
60+		100%
Unknown	51%	49%
Grand Total	34%	66%

Coding Details

- Codebook: 102 items
 - 2,374 codes over 366 images
 - Average of 6.5 codes/image
 - Cohen's $\kappa > 0.8$
-
- Identification vs Interpretation of content
 - Coders rated their own confidence
 - With & without descriptions
-

Terminology

- Definition: “structural analogues of the world as perceived and conceptualized, which enable people to make inferences and predictions, to understand phenomena, to decide and control actions...by proxy”
-Johnson-Laird, 1991
-

Future Work

- Cultural differences
- Controlled collection
- Case studies & experiments of metaphor use in privacy tools
- Usability evaluations of icons & imagery
- Incorporation of imagery in privacy policies