

# Keeping the Human in the Loop

Shari Lawrence Pfleeger

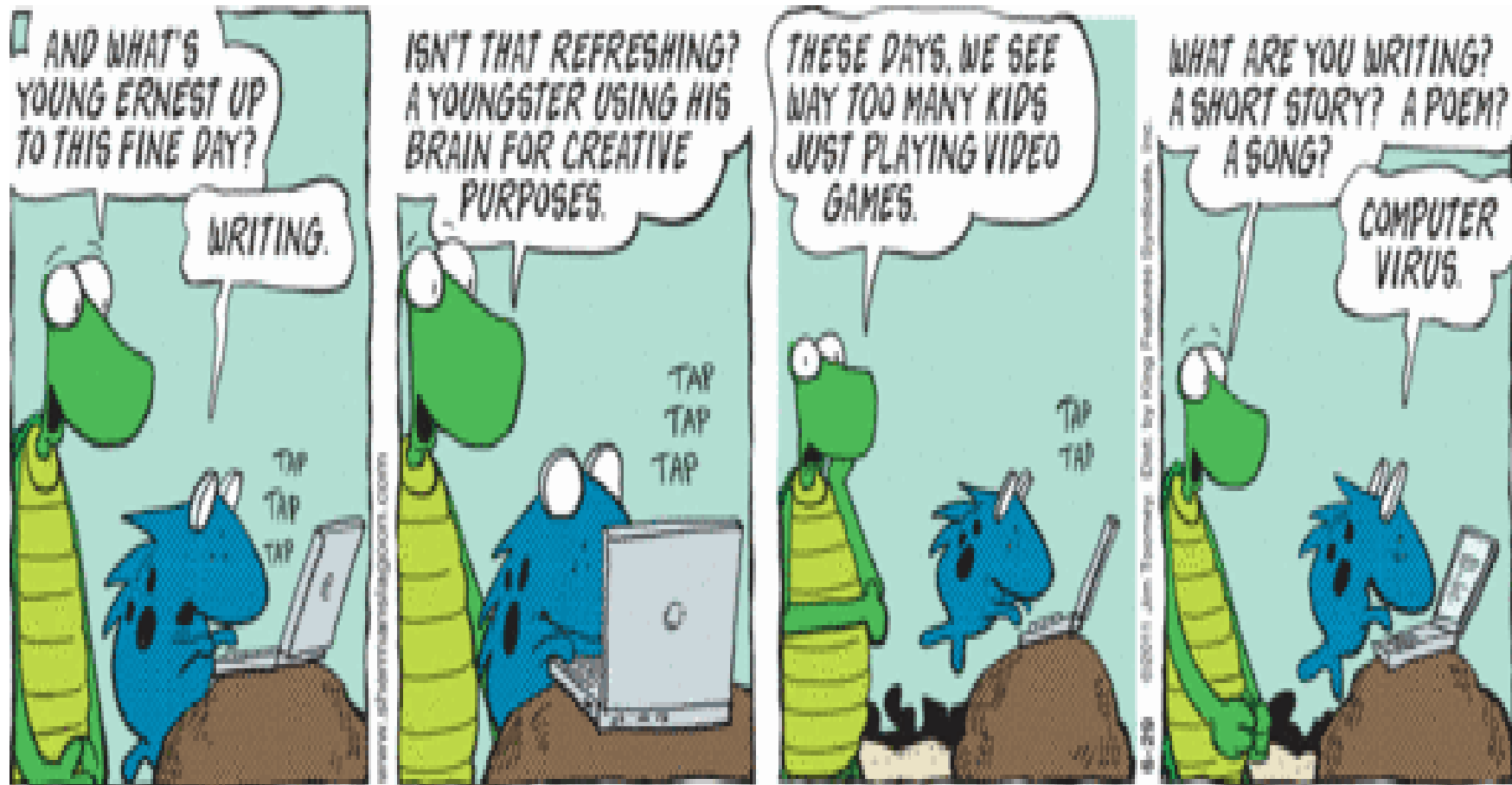
I3P Research Director

JISBD, La Coruña, September 2011

# How Do People Think About Computers?



# And What Are People Doing on Your Networks?



# Understanding the Human Perspective

- Example: Usability
- Example: Cognition
- Example: Risk perception
- What to do?

# Usability

Consider basic functionality:



# And Think About Context of Use



# Usability Example: Ulster Bank

When you open an account, the bank sends you four things:

- A smartcard reader
- A separate letter with the actual smartcard
- A separate letter with a onetime PIN for the smartcard
- A separate letter with a onetime 10-digit activation code for the service

# So How Do You Establish an Account?


There are several steps. First get out the card-reader and instructions.




# Second Step: Go to the Online Site

Ulster Bank Personal Banking, Republic of Ireland (Switch to Northern Ireland) [Accessibility](#) [Contact us](#) [Ulster Bank Group](#)

**Ulster Bank**  **Call us today**  
→ [Useful numbers](#)

 **Visit your local branch**  
Enter location → [Go](#)  
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**Anytime Internet Banking**  
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Daily Banking	Borrowing	Savings	Insurance	Advice & tools	Stay safe & secure
<ul style="list-style-type: none"><li>• Current accounts</li><li>• Credit Cards</li><li>• Anytime Banking</li></ul>	<ul style="list-style-type: none"><li>• Mortgages</li><li>• Loans</li><li>• Credit cards</li></ul>	<ul style="list-style-type: none"><li>• Instant access</li><li>• Medium term</li><li>• Longer term</li><li>• Youth savings</li><li>• Financial planning</li></ul>	<ul style="list-style-type: none"><li>• Home insurance</li><li>• Travel insurance</li></ul>	<ul style="list-style-type: none"><li>• Brochures</li><li>• Calculators</li><li>• Glossary of financial terms</li><li>• What's new</li></ul>	<ul style="list-style-type: none"><li>• Protect your identity</li><li>• Protect your computer</li><li>• Stay alert</li><li>• Simple steps to protect yourself online</li></ul>

**How can we help you?**

- Switch your current account
- Sign up to Internet banking
- Discuss your finances
- Personalise your credit card

**Help yourself**

- Apply for online savings
- Apply for a loan
- Apply for a current account
- Apply for a credit card

**Switch to us**  
With a specialist switching team, we've made it easy for you to switch your current account to us  
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**eSavings Plus**  
**5.50% AER**  
Variable, including 6 month introductory rate (5% AER Variable excluding bonus)  
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# Next Steps

- Change the PIN on the smartcard.
- Enter your customer number.
- Enter your user ID.

So far, so good.



# Enter Randomness

- Enter three digits from a different PIN.

Log On

The screenshot shows a login interface with two main input sections. The first section, titled 'Please enter the requested digits from your PIN', contains three input fields labeled '3rd', '2nd', and '4th'. The second section, titled 'Enter the requested characters from your password and select Continue', contains three input fields labeled '1st', '3rd', and '11th'. At the bottom left is a 'Back' button and at the bottom right is a 'Continue' button, both with circular icons.

The first line asks for the third, second and fourth digits of your PIN, rather than the entire PIN; this sequence changes each time you log in.

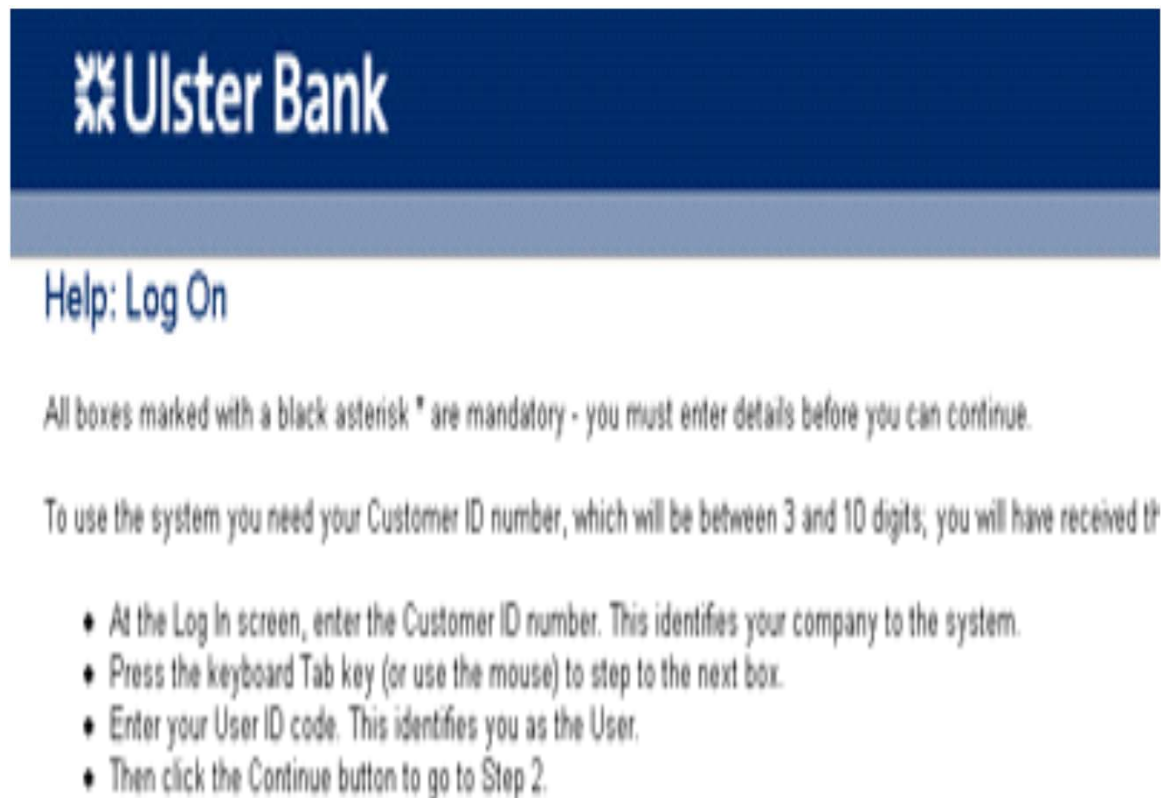
# Even More Steps

- Enter a new PIN.
- Enter a new password.
- Enter your activation code.

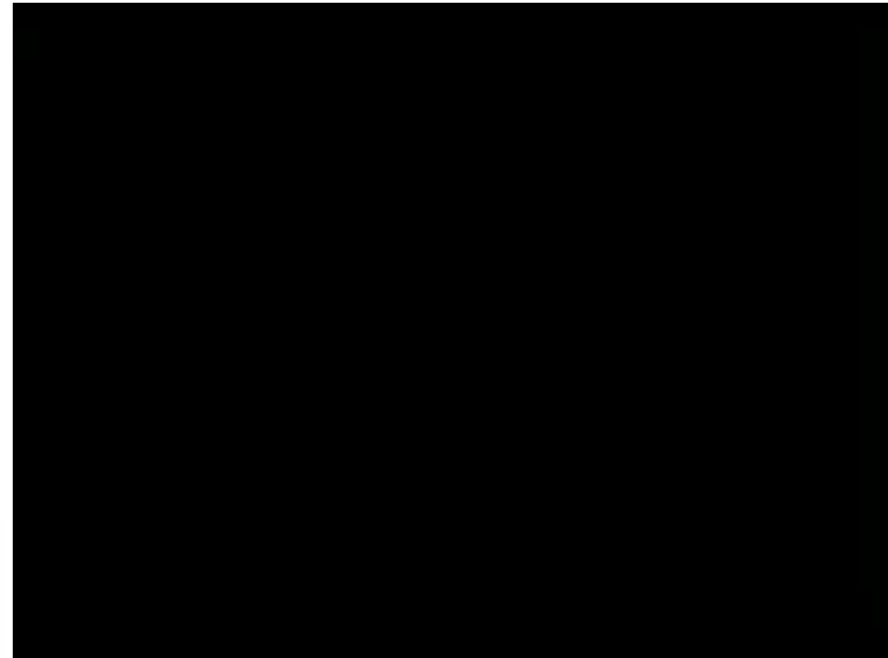
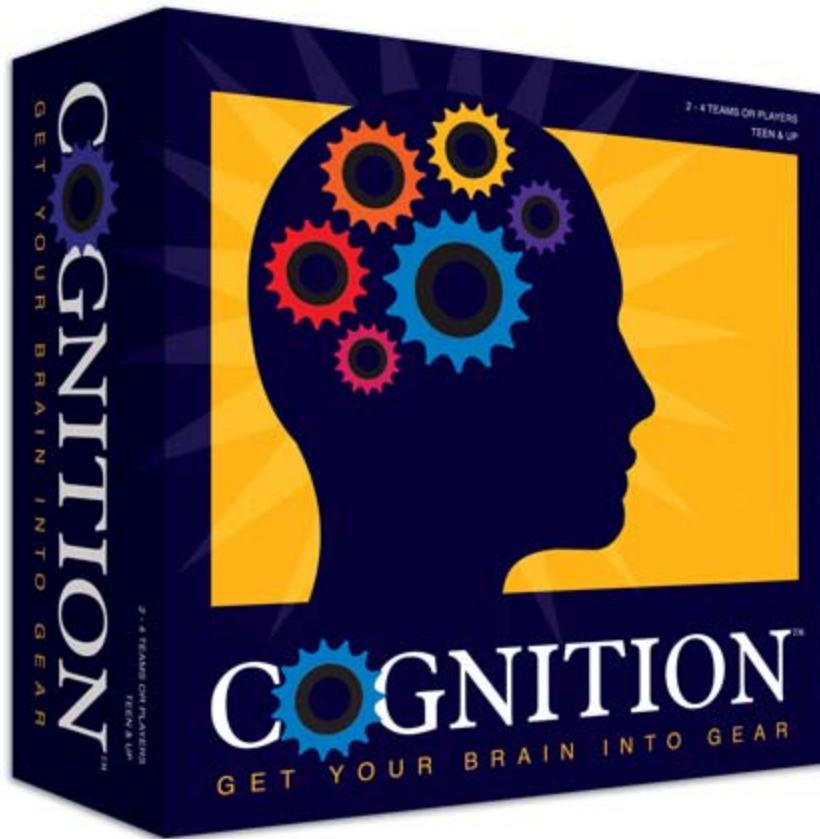


# Help!

There is a Help function, but it does not go into enough detail.



# Cognition



# We Can't Multi-Task

- Primary task vs. secondary task
  - Inattention blindness
  - Rewards for primary task
- Information overload
  - George Miller:  $7 \pm 2$
  - Intel no-email day
  - Gary Klein: Recognition-primed decision-making



# Scarcity Makes a Difference, Too (1 of 2)

Source: David Brooks, "The Unexamined Society," *NY Times*, 7 July 2011

- Financial scarcity: Consider Indian sugar farmers.
  - Before the harvest, scarcity. They have many daily decisions. The farmers do terribly on tests: lower IQs, more trouble controlling their attention, more short-sighted.
  - After the harvest, relative prosperity. Better test performance.



# Scarcity Makes a Difference, Too (2 of 2)

Source: David Brooks, "The Unexamined Society," *NY Times*, 7 July 2011

- Time scarcity: Consider Princeton students.
  - With time scarcity: They can play a timed game, and they were allowed to borrow time from future rounds. They did so, oblivious to the usurious rates the game organizers were charging.
  - Similar to behavior with payday lenders.
  - Possible relation to software quality? Perhaps need to get job done within time constraints makes people oblivious to the negative quality consequences.

# Is This Reasonable?



# Is This Information Overload?



# Too Much Information?



# Is This an Improvement?



# Is This Better?



# Add Other Cognition Effects to the Mix

- Based on experiences
  - Recency effect
  - Status quo bias
  - Recognition better than recollection
  - Interference
  - Identifiable victim effect
- Framing effects
- Confirmation bias
- Bystander effect



# Understand the Nature of Trust

Example: Tenner (1991) describes how trust in technology leads to riskier behaviors



# Risk Perception

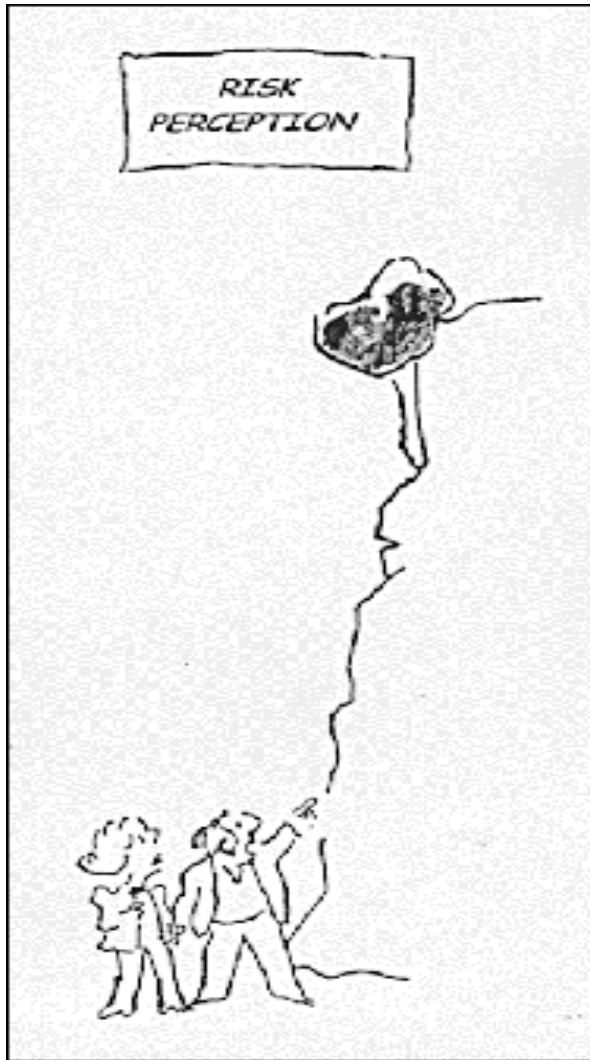


# Risk = Likelihood x Impact

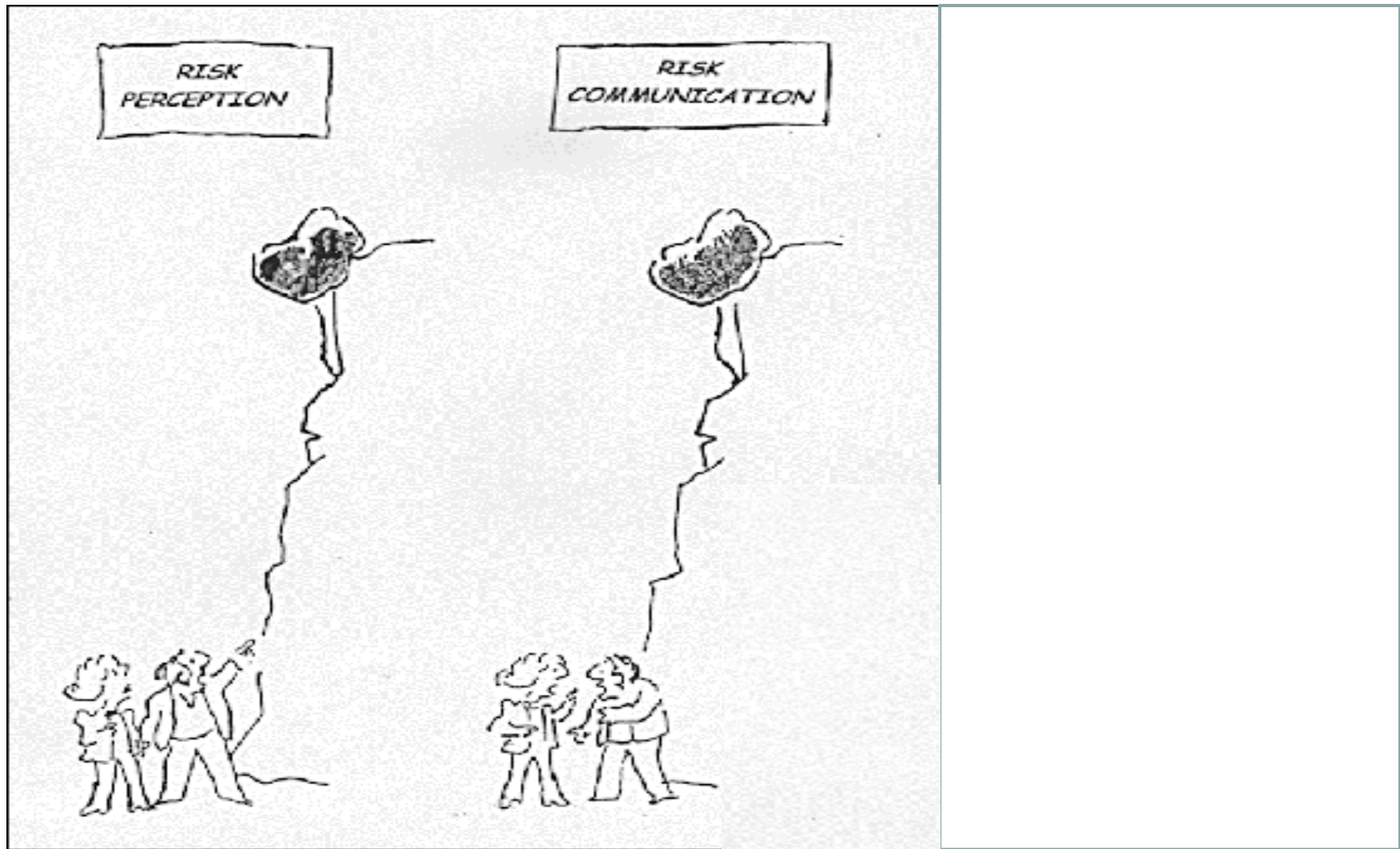
- We must understand both in order to understand the risk.
- Only then can we compare two risks and make informed choices.



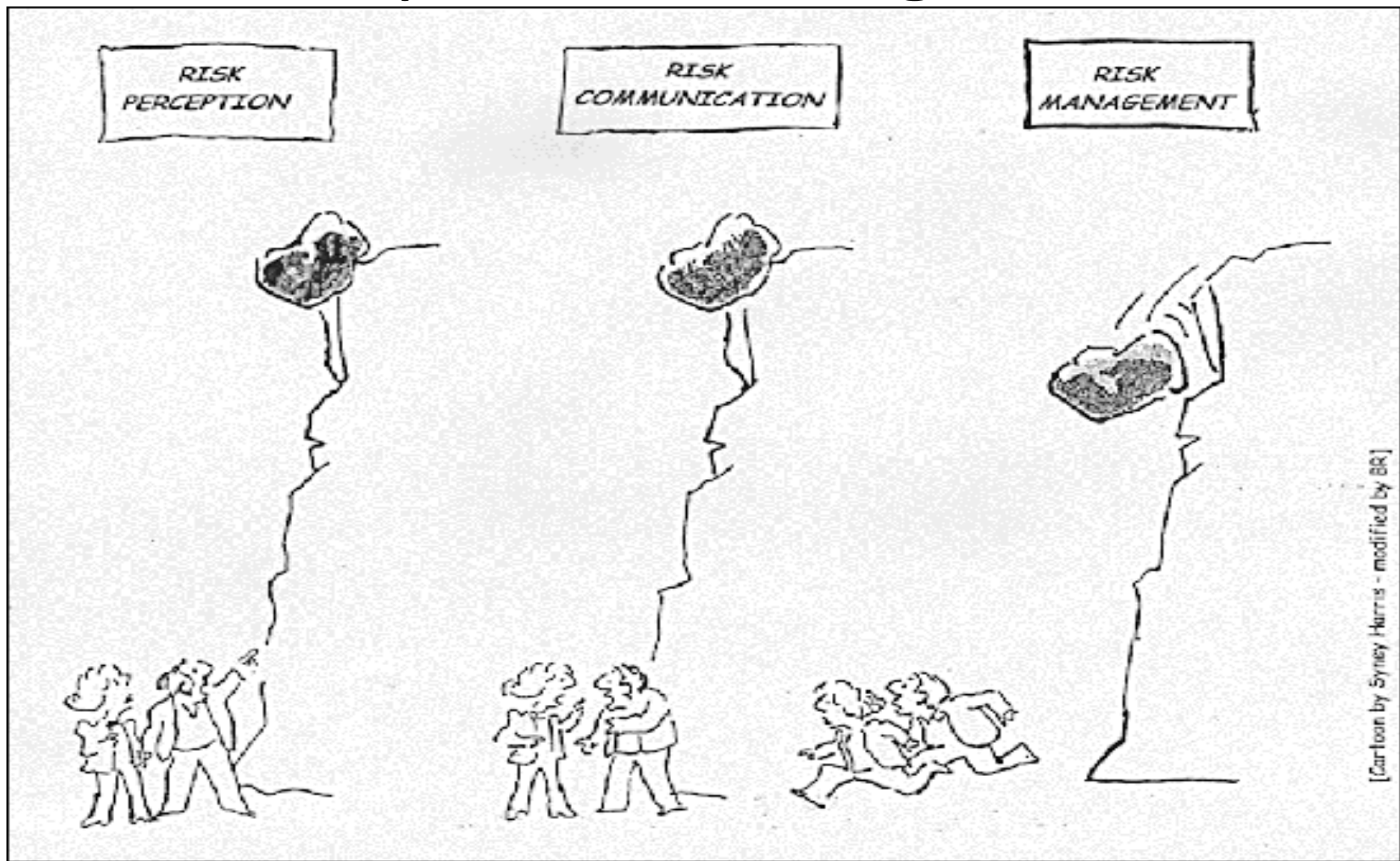
# Steps in Handling Risk



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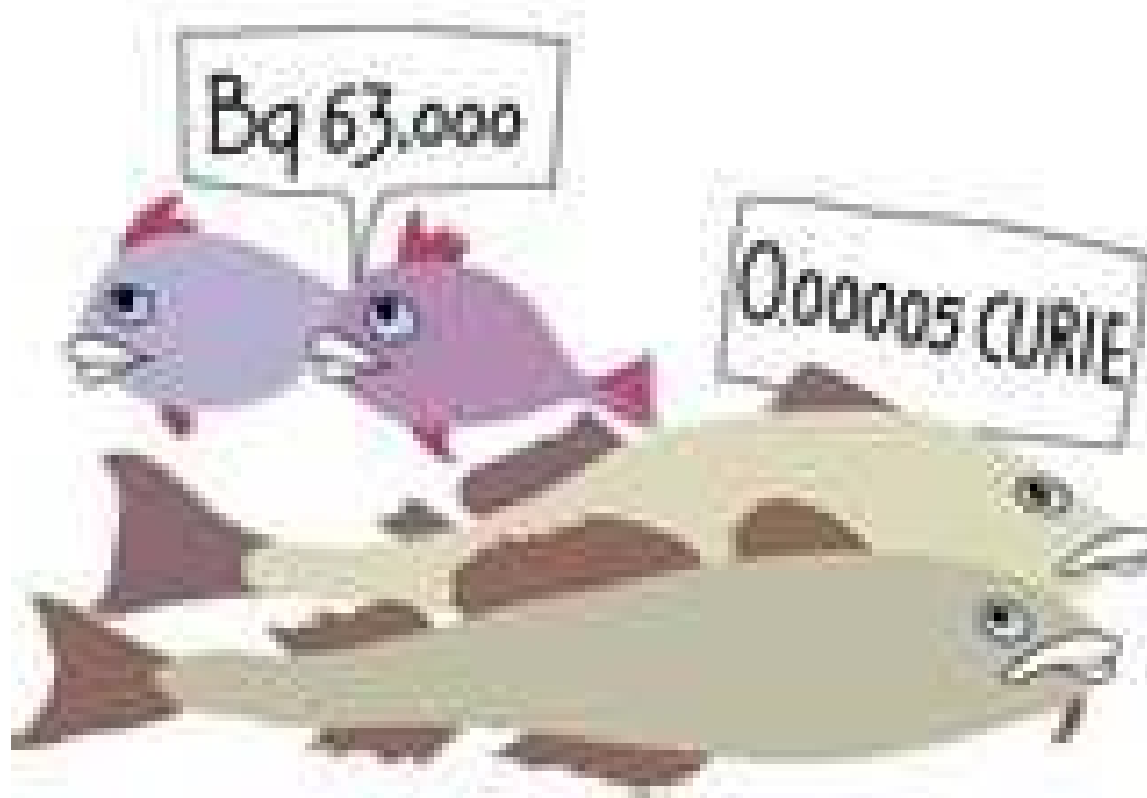


# Steps in Handling Risk



# Risk Perception

- When impact is high, we focus on it.
- When likelihood is very small, we focus on impact.



# How Often Does This Happen?



# The Black Swan Phenomenon

- Talib: Preparing for low-probability events with little data on prior occurrences
  - Japan's Sendai earthquake
  - Dependability example: AT&T phone outage
- What to do when resources are highly constrained?
  - Mitigation and remediation instead of prevention?



# Dread and Understanding

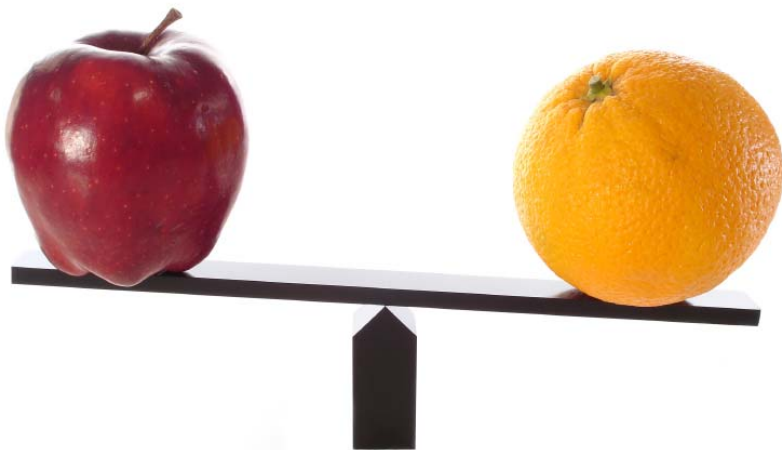
Two key factors influence how we perceive risk:

- Level of dread
- Level of understanding

Source: Slovic, Fischhoff, Lichtenstein (1980)



# But What's the Right Way to Calculate and Compare Risks?



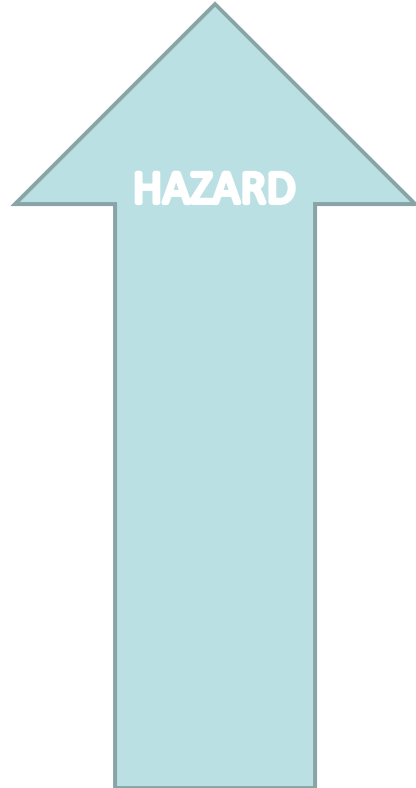
# How Should We Think About Risk?

Sandman (2007): Risk equals hazard plus outrage

- Hazard = how much harm is likely
- Outrage = how people are likely to react

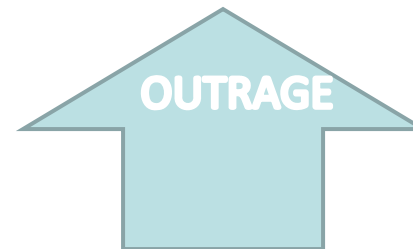
So how do we use this to  
react to risks?





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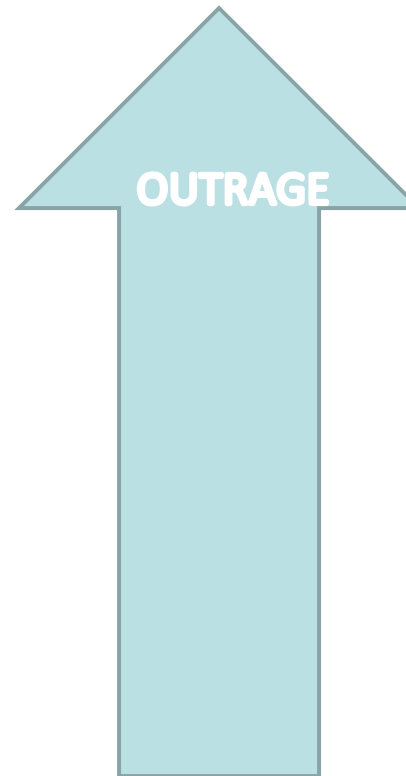


Watch out!

Warn people who are  
insufficiently worried.



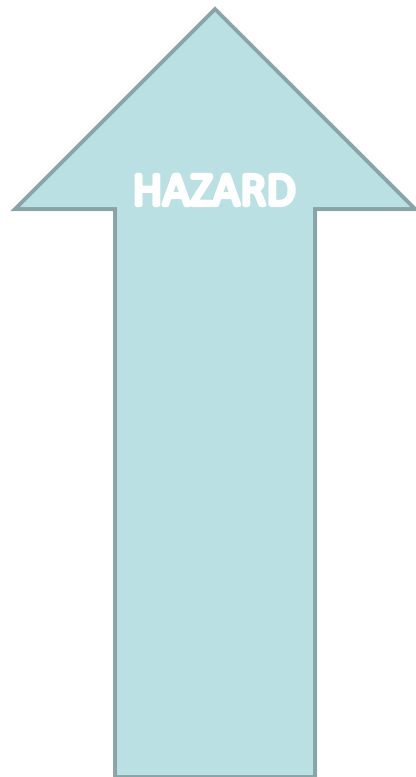
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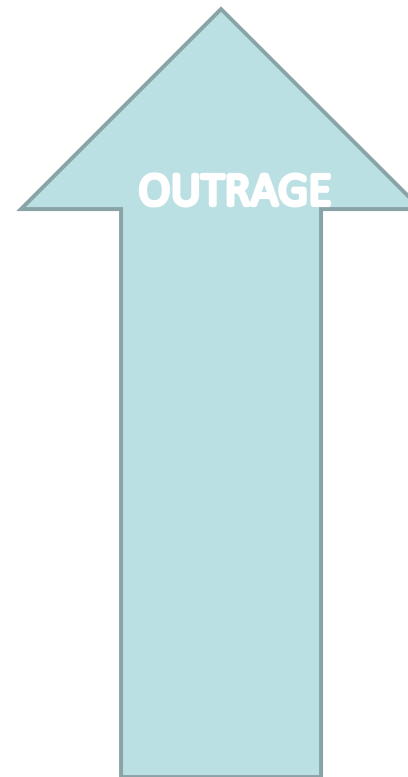
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Calm down

Reassure people who  
are upset.



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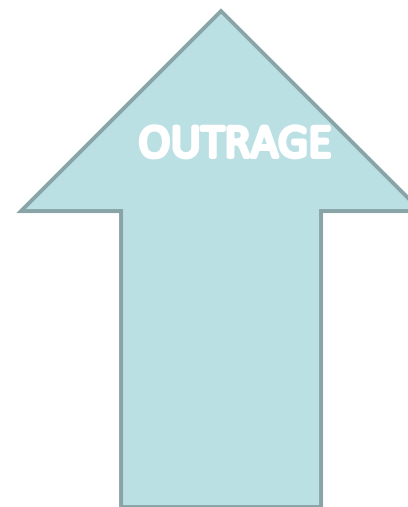
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We'll get through  
this together

Crisis  
communication.



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What do you  
think?

Discussion and  
deliberation.

# Bottom Line: We Need to Integrate Human Nature in Decision-making

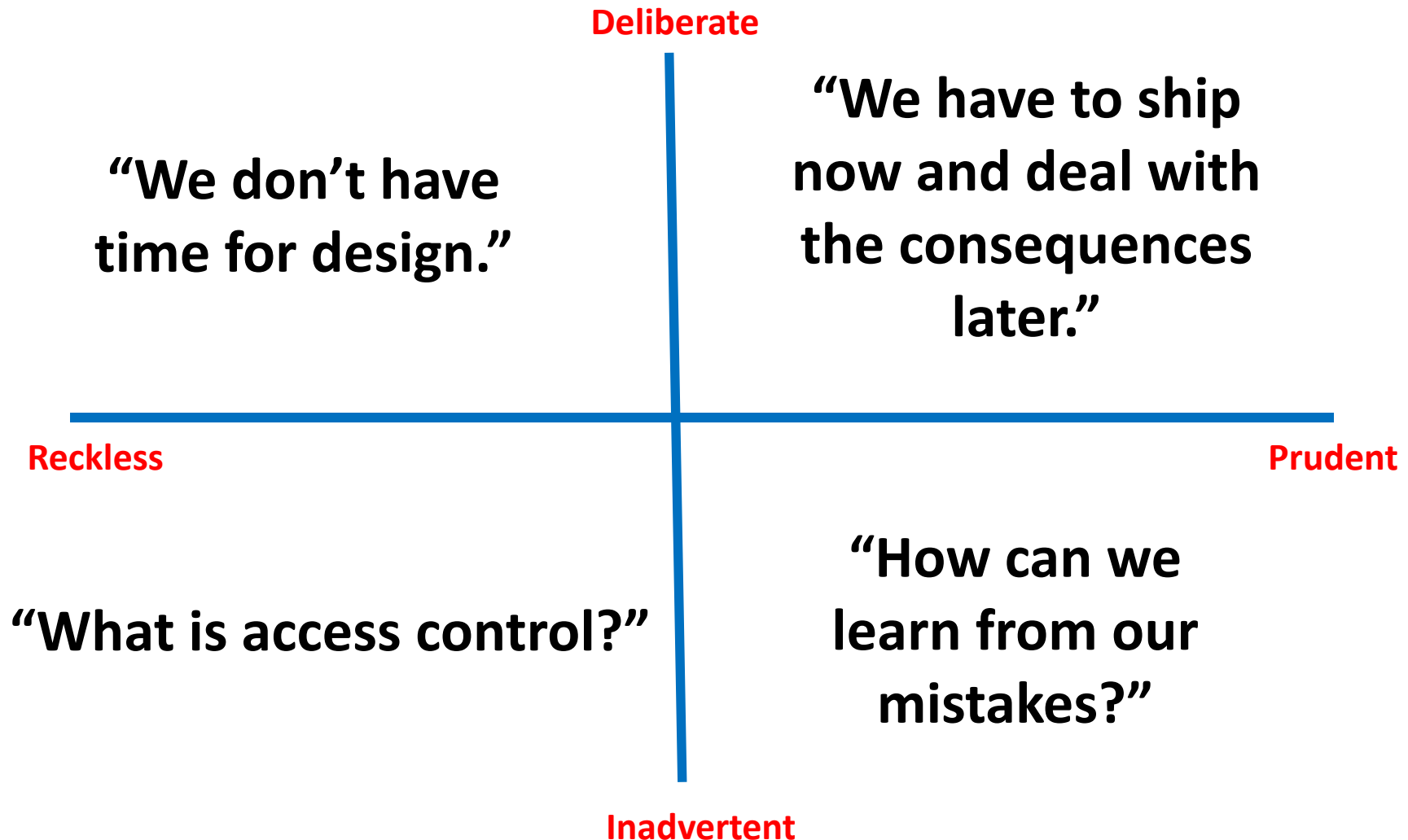


# What Should We Do?

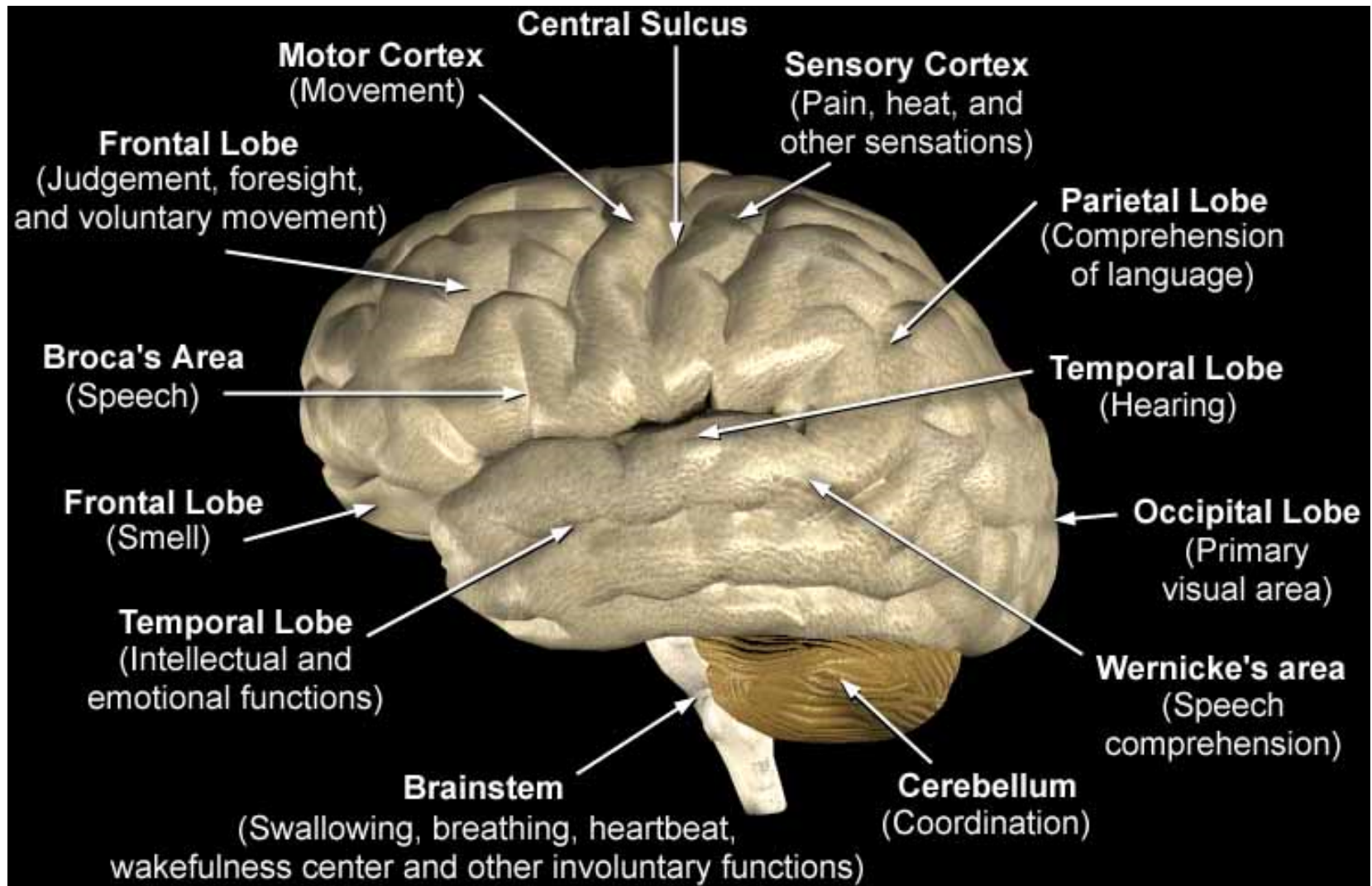


# First, Examine Your Current Approach

(Source: Gunnar Peterson)



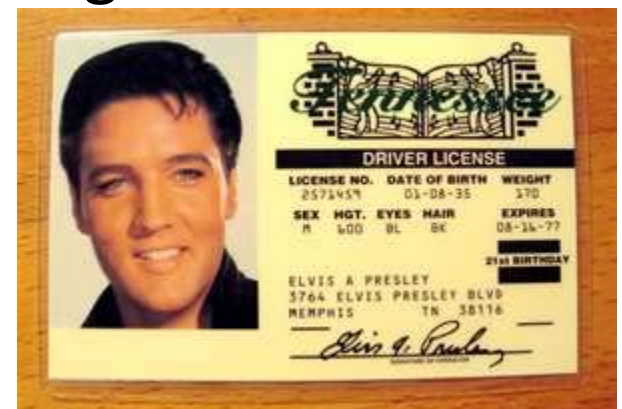
# Next, Pay Attention to This



# Example: Opt-in vs. Opt-out

Agreeing to organ donation during drivers' license registration:

- In Germany and the US: opt-in
  - Result? About 14% of drivers are organ donors
- In Poland and France: opt-out
  - Result? About 90% of drivers are organ donors



# Account for Human Variation



# Especially Novice, Master, Expert



# Account for Cognitive Load



# And Have Realistic Expectations



# What to Do? (1 of 2)

- Requirements
  - Include significant user-sensible, testable requirements that reflect how people perceive and react
- Design
  - User-centered design that can be prototyped and evaluated
- Testing
  - Simulations
  - Tests in real situations with variety of users: novices, masters, experts



# What to Do? (2 of 2)

- Evolution
  - Look at trouble tickets, other evidence of use and consequences, and redesign according to what you learn.
- Include behavioral scientists on development, evaluation and maintenance teams
  - Or at least train your developers to be sensitive to human perception and action.



# For More Information (1 of 2)



- M. Eric Johnson and Shari Lawrence Pfleeger, “Addressing Information Risk in Turbulent Times,” *IEEE Security and Privacy*, 9(1), January/February 2011, pp. 49-57.
- Gary Klein, *Sources of Power: How People Make Decisions*, MIT Press, 1998.
- Deborah Mayo and Rachelle Hollander, *Acceptable Evidence: Science and Values in Risk Management*, Oxford University Press, 1991.
- George Miller, “The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information,” *Psychological Review*, vol. 63, 1956, pp. 81-97.
- Peter Sandman, “Understanding the Risk: What Frightens Rarely Kills,” Nieman Reports, Nieman Foundation for Journalism, Harvard University, Spring 2007.

## For More Information (2 of 2)

- Daniel Simons and Christopher Chabris, “Gorillas in Our Midst: Sustained Inattention Blindness for Dynamic Events,” *Perception*, 1999, vol. 28, pp. 1059-1074.
- P. Slovic, B. Fischhoff and S. Lichtenstein, “Facts and Fears: Understanding Perceived Risk,” in R. Schwing & W. Albers (Eds.), *Societal Risk Assessment*, New York: Plenum Press, 1980, pp. 67-93.
- Nassim Talib, *The Black Swan: The Impact of the Highly Improbable*, Random House, 2007.
- Edward Tenner, *Why Things Bite Back: Technology and the Revenge of Unintended Consequences*, Vintage Press, 1991.

