CS 642: Computer Security and Privacy

Usable Security

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Announcements

- HW4 grades are out!
- HW5 is due May 5th
  - Get started as soon as possible
  - If you have completed and have feedback/thoughts about the design or new ideas, let us know via email!
- Course feedback survey:
  - Please fill out survey now

Importance of Usability in Security

- Why is usability important?
  - People are the critical element of any computer system
    - People are the reason computers exist in the first place
  - Even if it is **possible** for a system to protect against an adversary, people may use the system in other, **less secure** ways

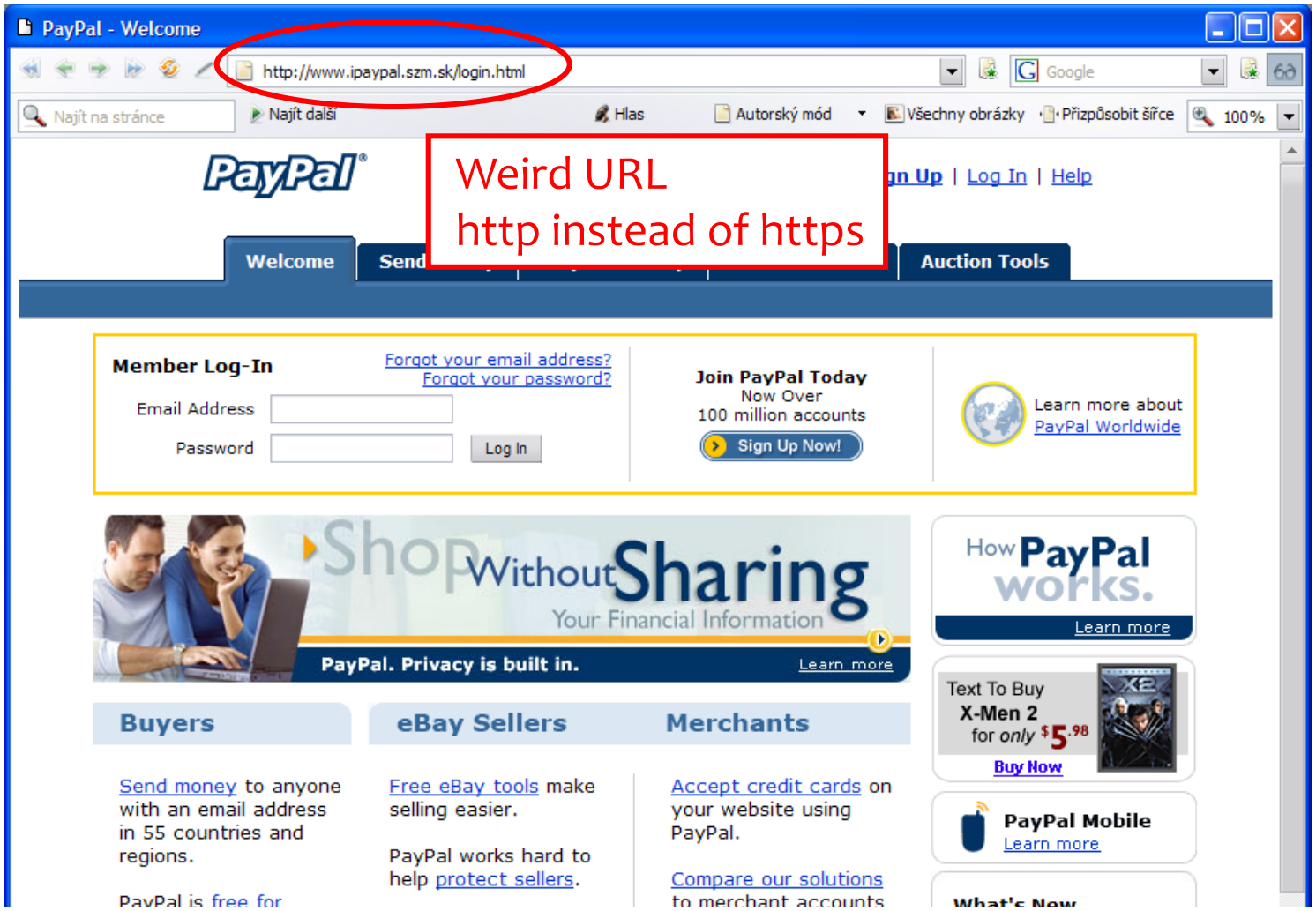
Usable Security Roadmap

- Lessons from 3 design case studies:
  1. Phishing
  2. SSL indicators
  3. Password managers
- Step back: root causes of usability problems, and how to address

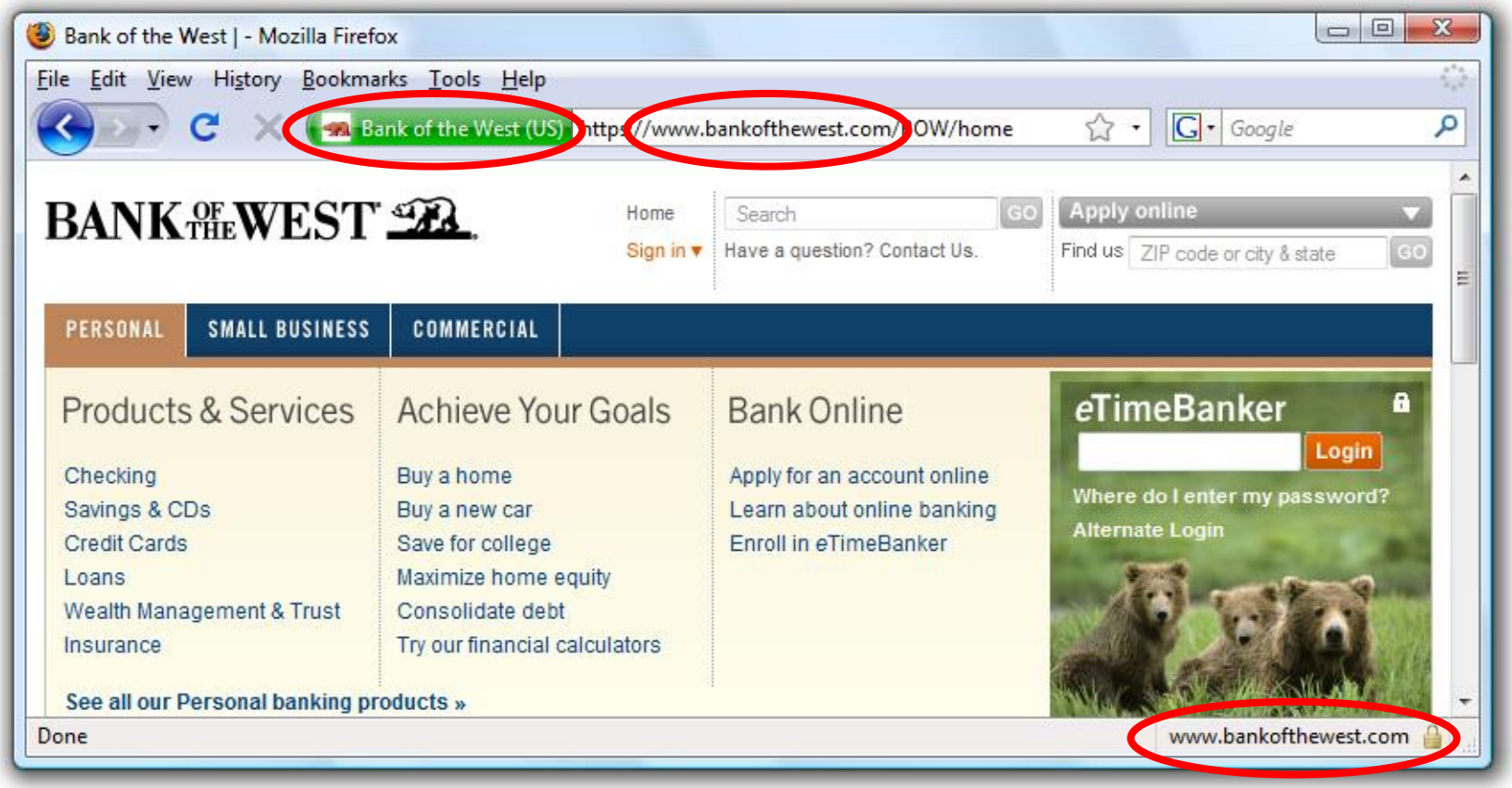
Case Study #1: Phishing

- **Design question:** How do you help users avoid falling for phishing sites?

A Typical Phishing Page



Safe to Type Your Password?



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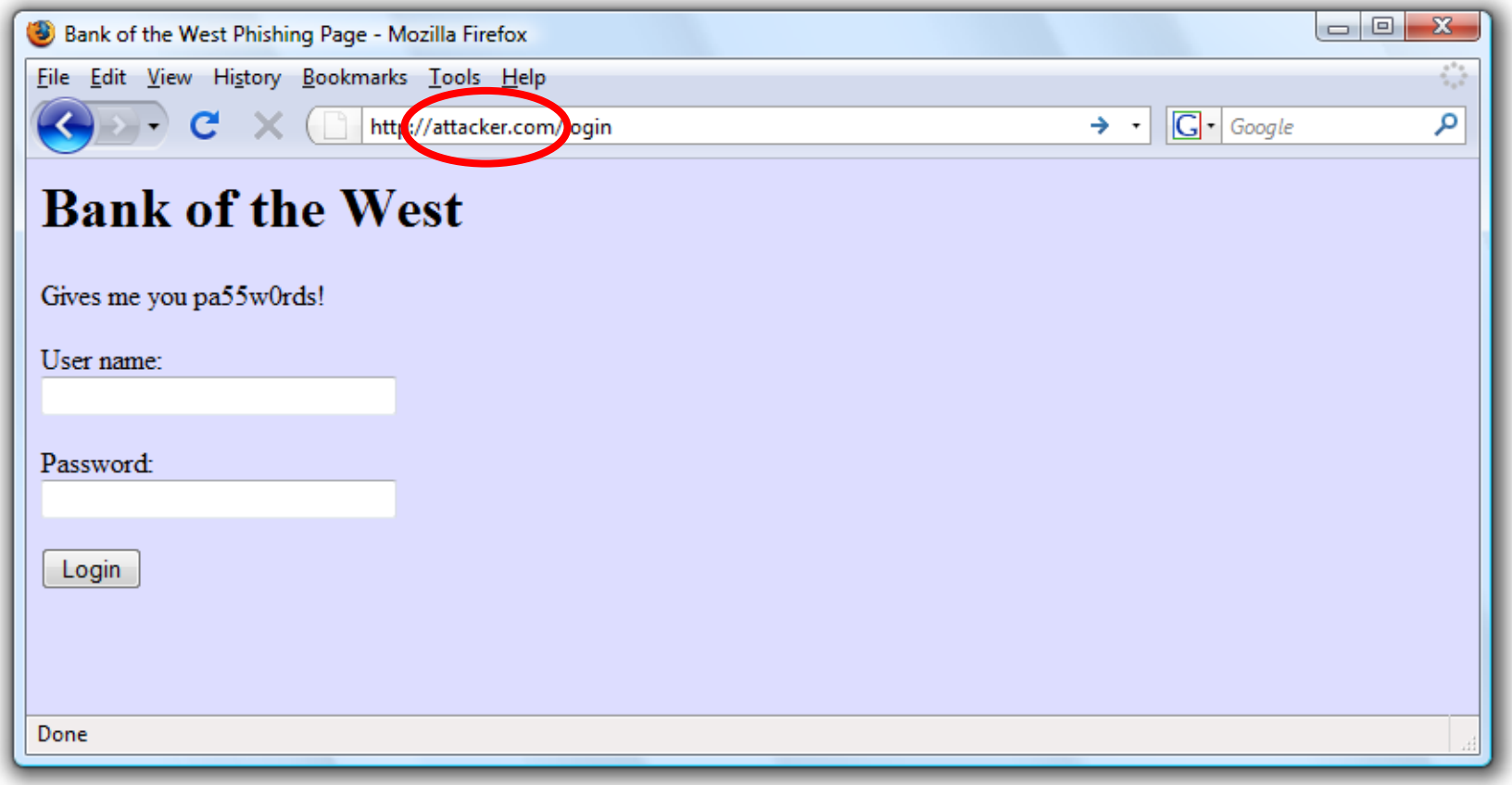

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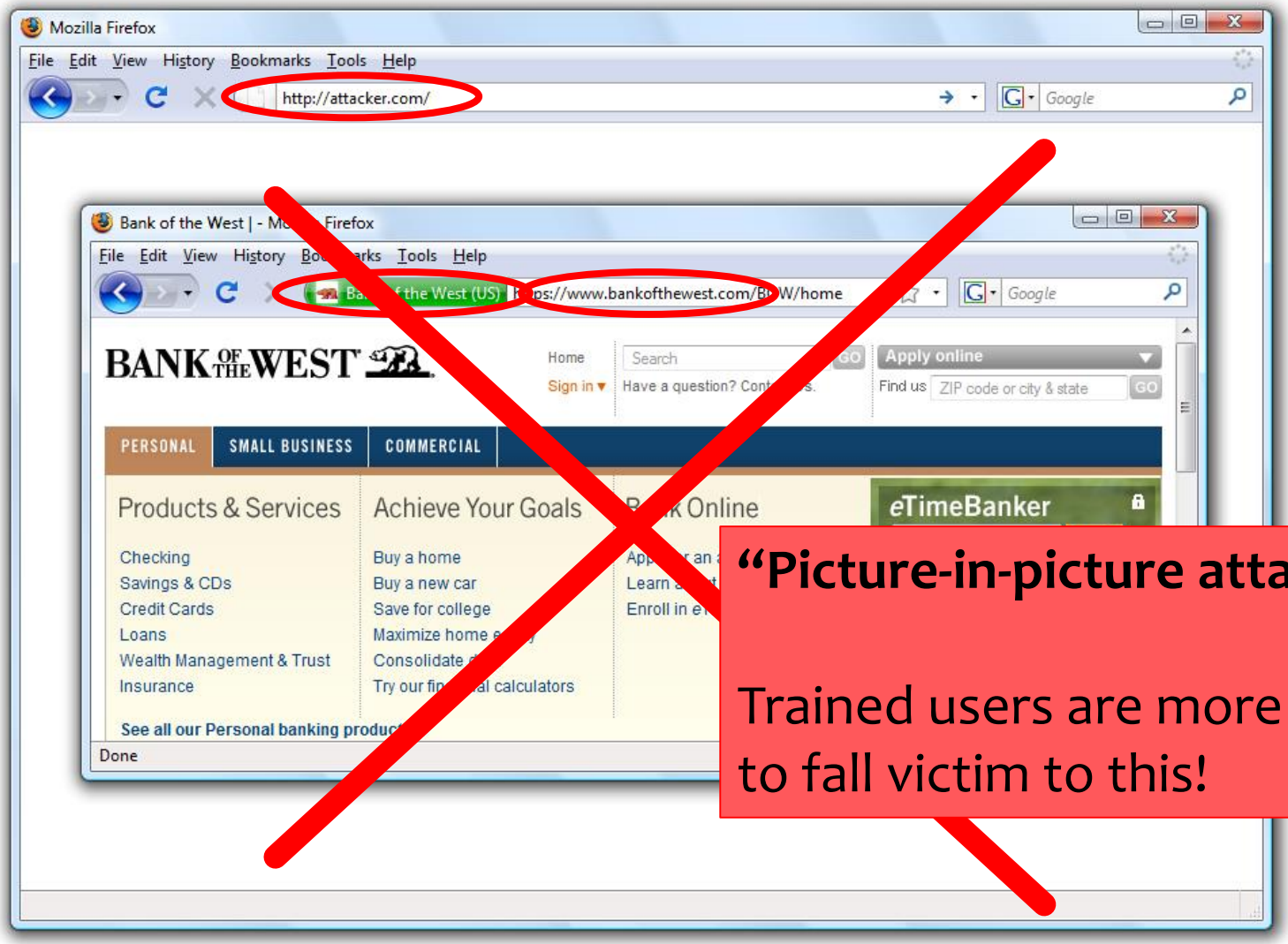
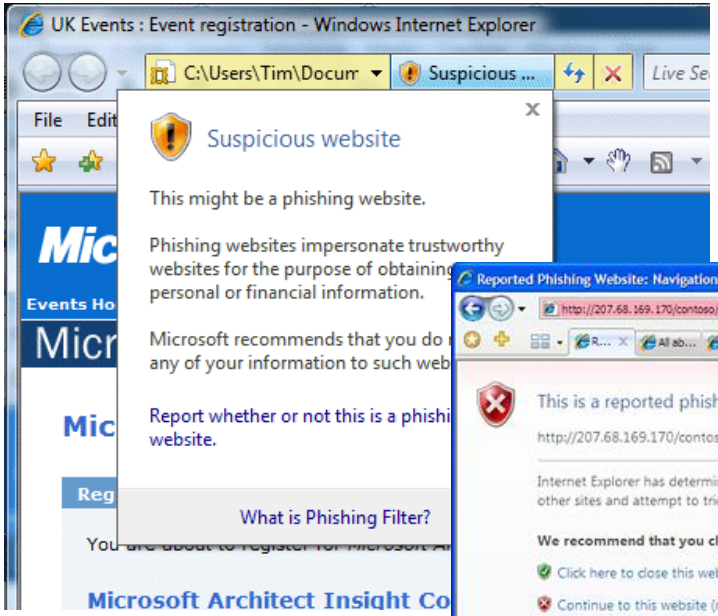


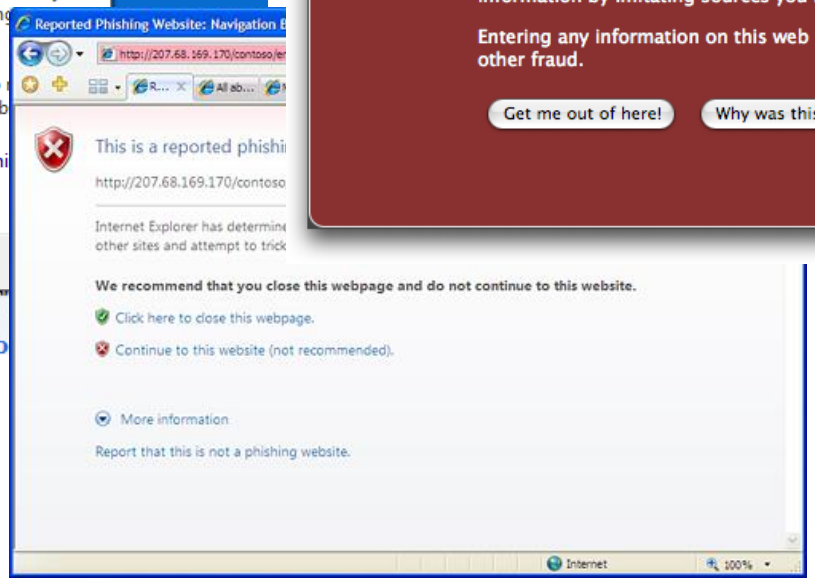
"Picture-in-picture attacks"

Trained users are more likely to fall victim to this!

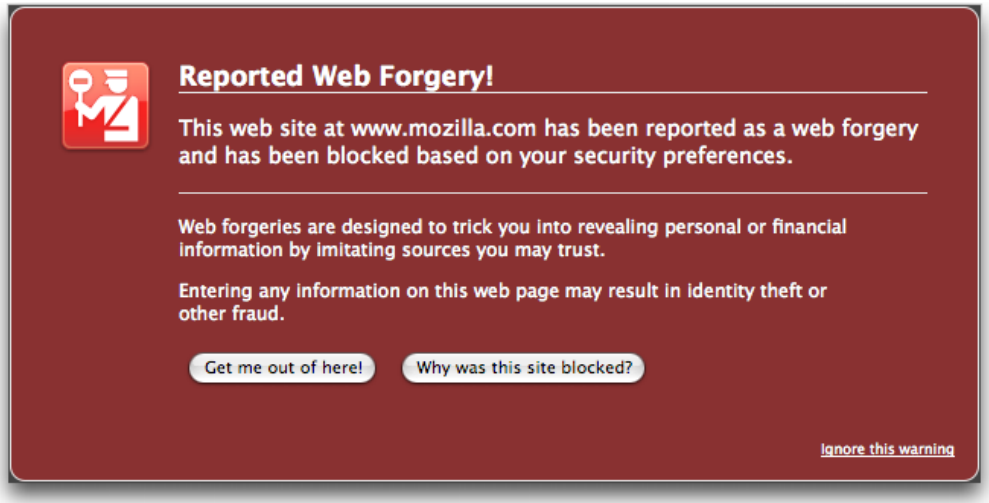
Phishing Warnings (2008)



Passive (IE)



Active (IE)



Active (Firefox)

[Egelman et al.]

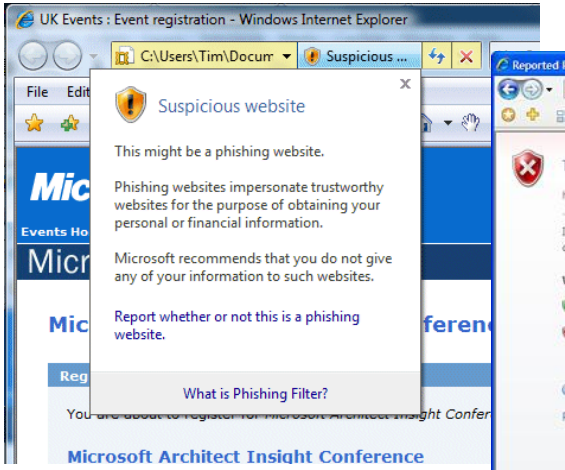
Are Phishing Warnings Effective?

- CMU study of 60 users
- Asked to make eBay and Amazon purchases
- All were sent phishing messages in addition to the real purchase confirmations
- Goal: compare active and passive warnings

[Egelman et al.]

Active vs. Passive Warnings

- Active warnings significantly more effective
  - Passive (IE): 100% clicked, 90% phished
  - Active (IE): 95% clicked, 45% phished
  - Active (Firefox): 100% clicked, 0% phished



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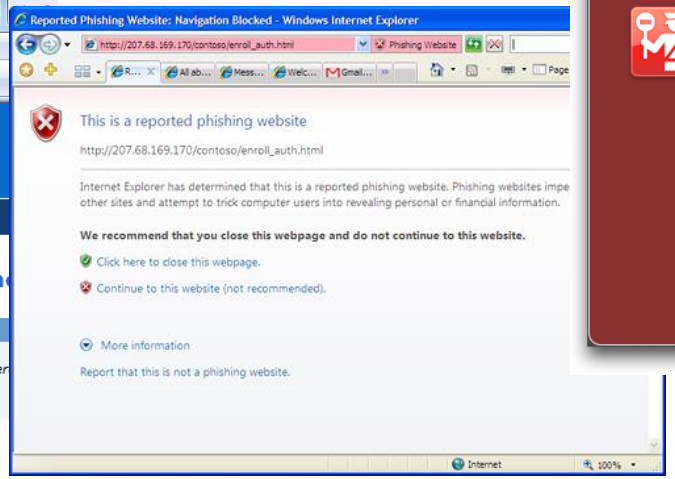

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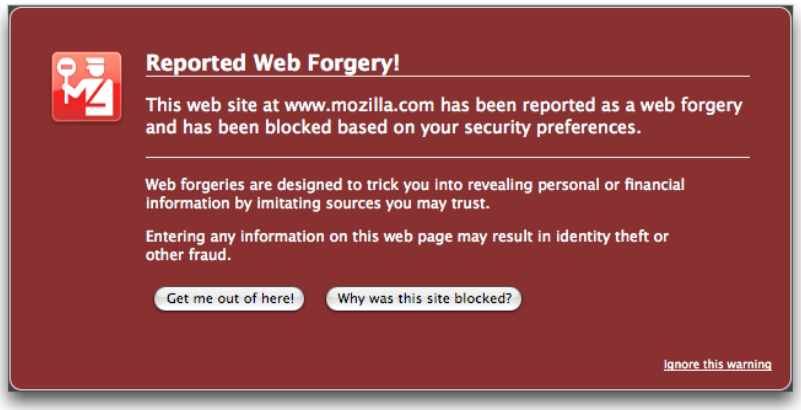


Active (Firefox)

[Egelman et al.]

Active vs. Passive Warnings

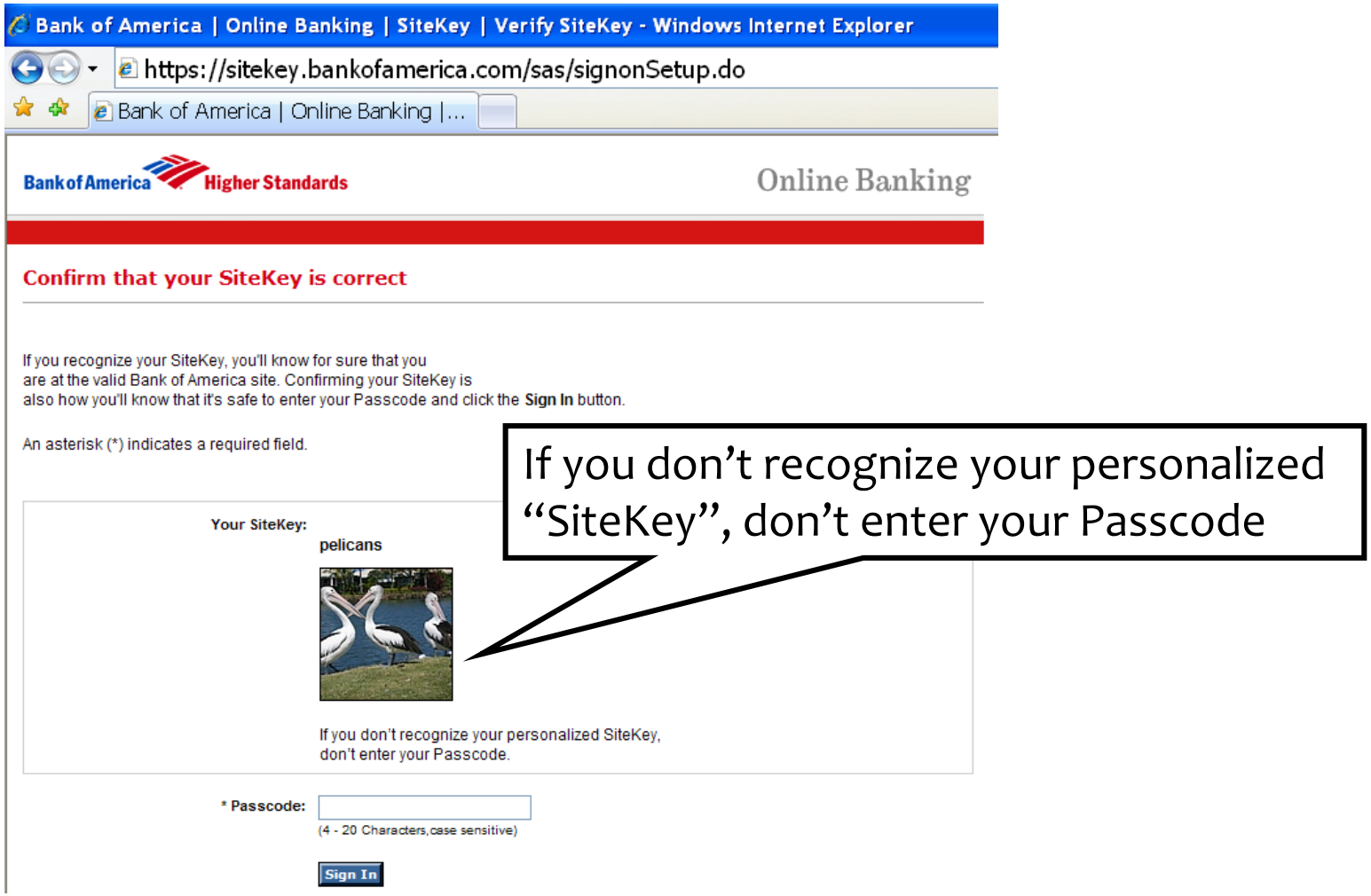
- Some fail to notice warnings entirely
  - Passive warning takes a couple of seconds to appear; if user starts typing, his keystrokes dismiss the warning
- Some saw the warning, closed the window, went back to email, clicked links again, were presented with the same warnings… repeated 4-5 times
  - Conclusion: "website is not working"
  - Users never bothered to read the warnings, but were still prevented from visiting the phishing site
  - Active warnings work!

[Egelman et al.]

Why Warnings Fail

- Don't trust the warning
  - "Since it gave me the option of still proceeding to the website, I figured it couldn't be that bad"
- Ignore warning because it's familiar (IE users)
  - "Oh, I always ignore those"
  - "Looked like warnings I see at work which I know to ignore"
  - "I thought that the warnings were some usual ones displayed by IE"
  - "My own PC constantly bombards me with similar messages"
- Common issue: Warning/prompt fatigue
  - We saw this with mobile security

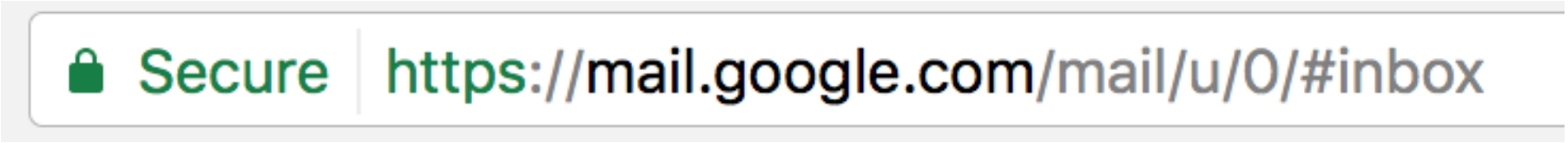
FYI: Site Authentication Image



Case Study #2: Browser HTTPS Indicators

- **Design question 1:** How to indicate encrypted connections to users?
- **Design question 2:** How to alert the user if a site's SSL certificate is untrusted?

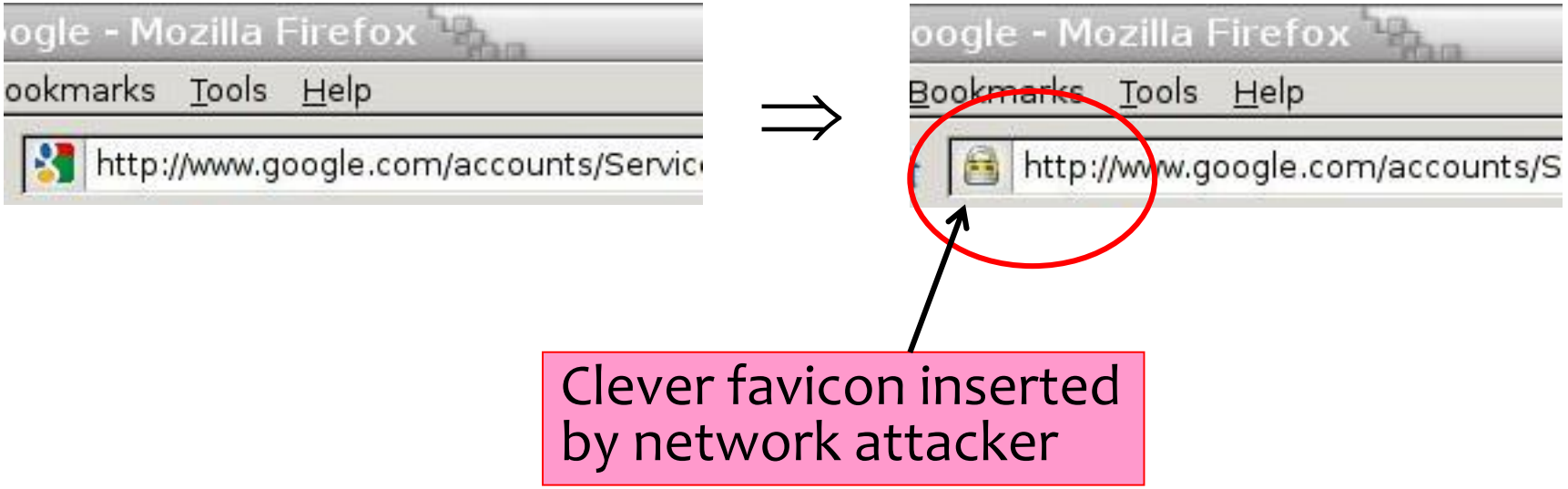
The Lock Icon



- Goal: identify secure connection
  - SSL/TLS is being used between client and server to protect against active network attacker
- Lock icon should only be shown when the page is secure against network attacker
  - Semantics subtle and not widely understood by users
  - Whose certificate is it??
  - Problem in user interface design

[Moxie Marlinspike]

Will You Notice?



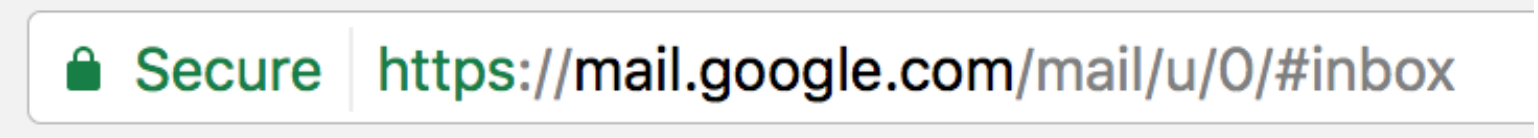
Do These Indicators Help? (2007)

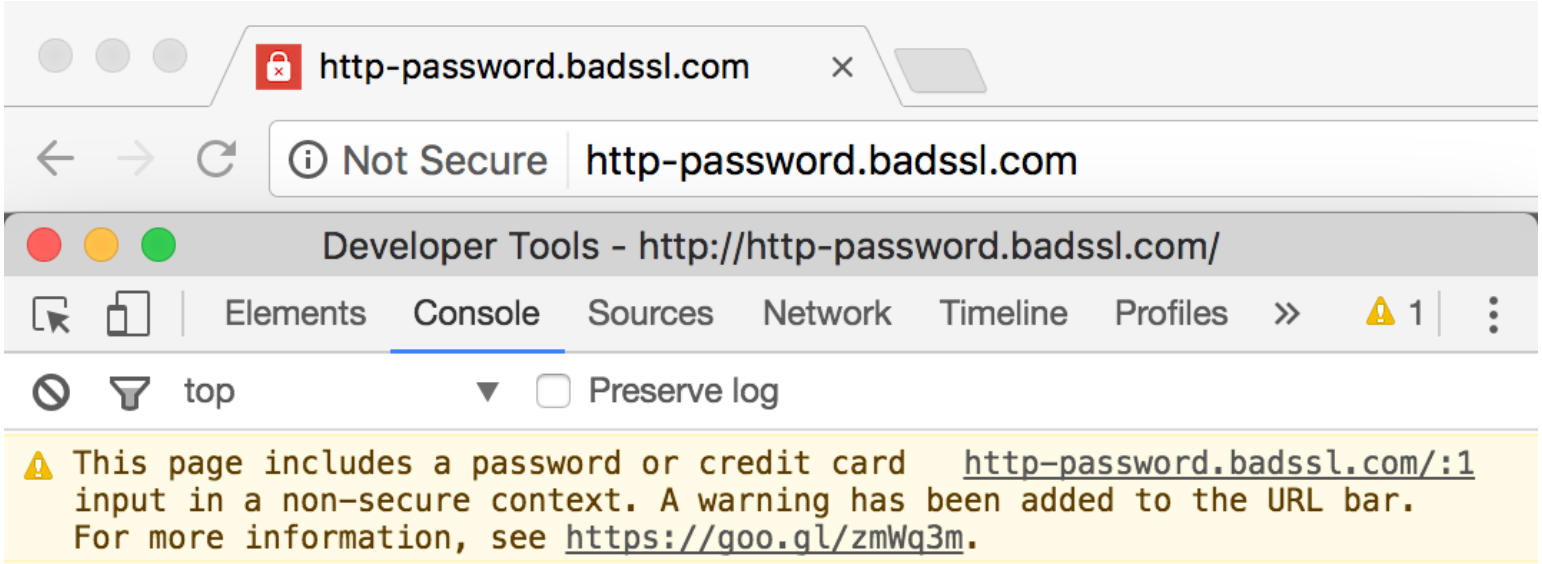
- "The Emperor's New Security Indicators"
  - http://www.usablesecurity.org/emperor/emperor.pdf

		Group				
Score	*First chose* not *to enter password...*	*1*	*2*	*3*	*1* ∪ *2*	*Total*
0	upon noticing HTTPS absent	0 0%	0 0%	0 0%	0 0%	0 0%
1	after site-authentication image removed	0 0%	0 0%	2 9%	0 0%	2 4%
2	after warning page	8 47%	5 29%	12 55%	13 37%	25 44%
3	never (always logged in)	10 53%	12 71%	8 36%	22 63%	30 53%
	Total	18	17	22	35	57

Users don't notice the **absence** of indicators!

Latest Design in Chrome

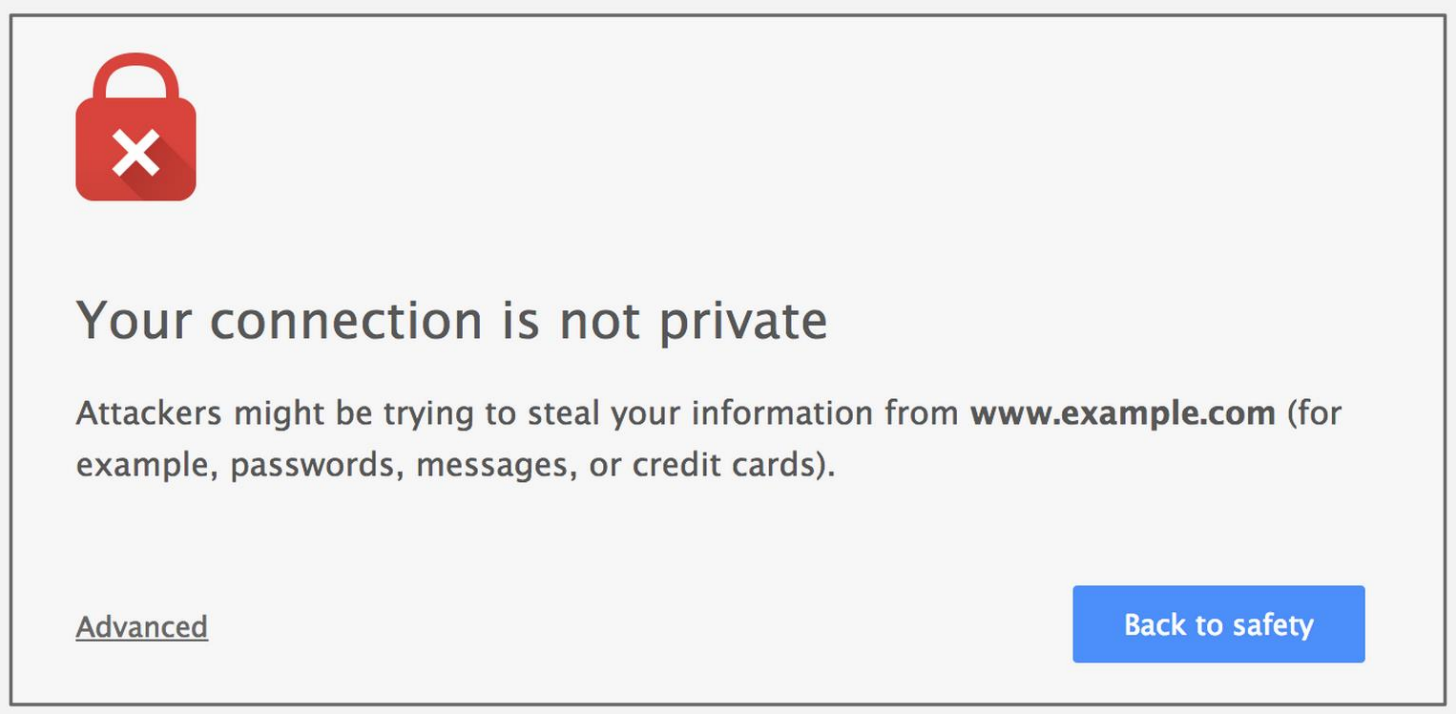




HTTPS Warnings

- When HTTPS connection is "bad" (e.g., untrusted cert)

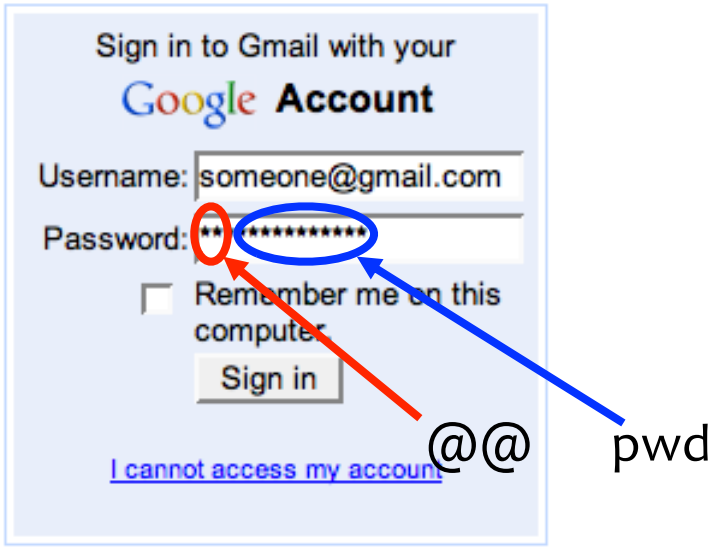
- Opinionated design helps!



Case Study #3: Password Managers

- Password managers handle creating and "remembering" strong passwords
- Potentially:
  - **Easier** for users
  - More **secure**
- Early examples:
  - PwdHash (Usenix Security 2005)
  - Password Multiplier (WWW 2005)

PwdHash



@@ in front of passwords to protect; or F2

sitePwd = Hash(pwd,domain)

Prevent phishing attacks

Password Multiplier

Activate with Alt-P or double-click

sitePwd = Hash(username, pwd, domain)

Both solutions target simplicity and transparency.

[Chiasson, van Oorschot, Biddle]

Usability Testing

- Are these programs usable? If not, what are the problems?
- Approaches for evaluating usability:
  - Usability inspection (no users)
    - Cognitive walkthroughs
    - Heuristic evaluation
  - User study
    - Controlled experiments
    - Real usage

[Chiasson, van Oorschot, Biddle]

Task Completion Results

	Success	Potentially Causing Security Exposures			
		Dangerous Success	Failures		
			Failure	False Completion	Failed due to Previous
PwdHash					
Log In	48%	44%	8%	0%	N/A
Migrate Pwd	42%	35%	11%	11%	N/A
Remote Login	27%	42%	31%	0%	N/A
Update Pwd	19%	65%	8%	8%	N/A
Second Login	52%	28%	4%	0%	16%
		Password Multiplier			
Log In	48%	44%	8%	0%	N/A
Migrate Pwd	16%	32%	28%	20%	N/A
Remote Login	N/A	N/A	N/A	N/A	N/A
Update Pwd	16%	4%	44%	28%	N/A
Second Login	16%	4%	16%	0%	16%

[Chiasson, van Oorschot, Biddle]

Problem: Mental Model

- Users seemed to have misaligned mental models
  - Not understand that one needs to put "@@" before *each* password to be protected.
  - Think different passwords generated for each session.
  - Think successful when were not.
  - Not know to click in field before Alt-P.
  - Don't understand what's happening: "Really, I don't see how my password is safer because of two @'s in front"

[Chiasson, van Oorschot, Biddle]

Problem: Transparency

- Unclear to users whether actions successful or not.
  - Should be obvious when plugin activated.
  - Should be obvious when password protected.
- Users feel that they should be able to know their own password.

[Chiasson, van Oorschot, Biddle]

Problem: Dangerous Errors

- Tendency to try all passwords
  - A poor security choice – phishing site could collect many passwords!
  - May make the use of PwdHash or Password Multiplier *worse* than not using any password manager.
- Usability problem leads to security vulnerabilities.
  - Theme in course: sometimes things designed to increase security can also increase other risks

Beyond Specific Tools: Different User Groups

- Not all users are the same!
- Designing for one group of users, or "generic" users, may leads to dangerous failures or reasons that people will not use security tools
- Examples:
  - Journalists (most sources are not like Snowden!)
  - Refugees in US (security measures may embed US cultural assumptions!)

Stepping Back: Root Causes?

- Computer systems are complex; users lack intuition
- Users in charge of managing own devices
  - Unlike other complex systems, like healthcare or cars.
- Hard to gauge risks
  - "It won't happen to me!"
- Annoying, awkward, difficult
- Social issues
  - Send encrypted emails about lunch?...

How to Improve?

- Security education and training
- Help users build accurate mental models
- Make security invisible
- Make security the least-resistance path
- …?