CSE 484 : Computer Security and Privacy

Usable Security

Winter 2021

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Admin

- Lab 3 out soon™
- Homework 2 grades out
  - https://forms.gle/C2RJNcTGv2N1dF197

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

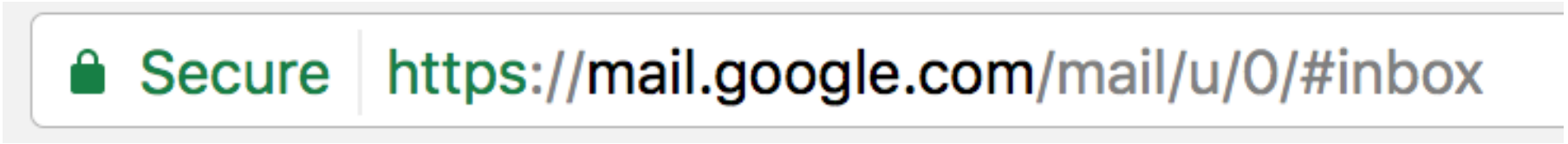
Usable Security Roadmap

- 3 case studies
  - HTTPS indicators + SSL warnings
  - Phishing
  - Password managers
- Step back: root causes of usability problems, and how to address

Case Study #1: 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?
  - You discussed this in section a couple weeks ago

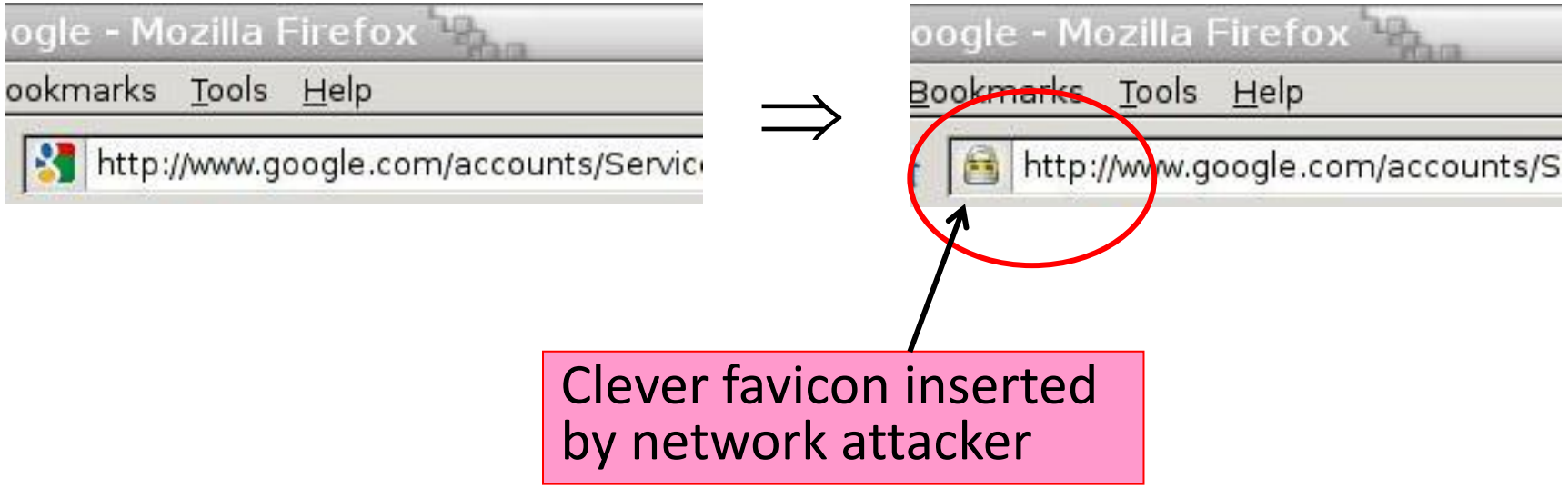
The Lock Icon



- 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

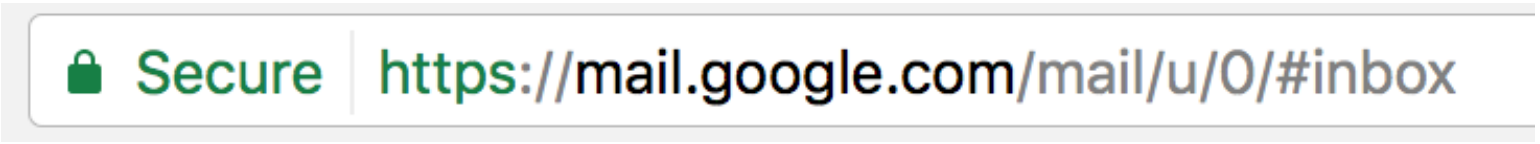
		Group				
Score	*First chose* not *to enter password...*	*1*	*2*	*3*	*1* ∪ *2*	*Total*
0	upon noticing HTTPS absent	0 0%	0 0%	0 0%	0 0%	0 0%
1	after site-authentication image removed	0 0%	0 0%	2 9%	0 0%	2 4%
2	after warning page	8 47%	5 29%	12 55%	13 37%	25 44%
3	never (always logged in)	10 53%	12 71%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

Lesson:

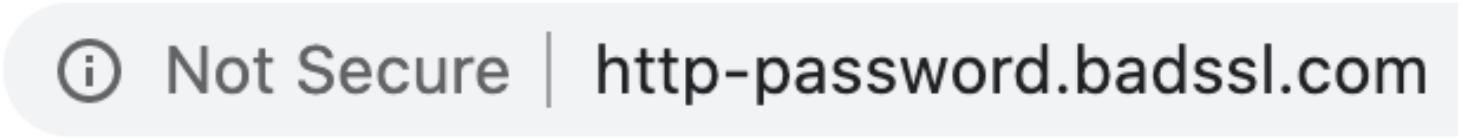
Users don't notice the **absence** of indicators!

Newer Versions of Chrome

c. 2017



2020



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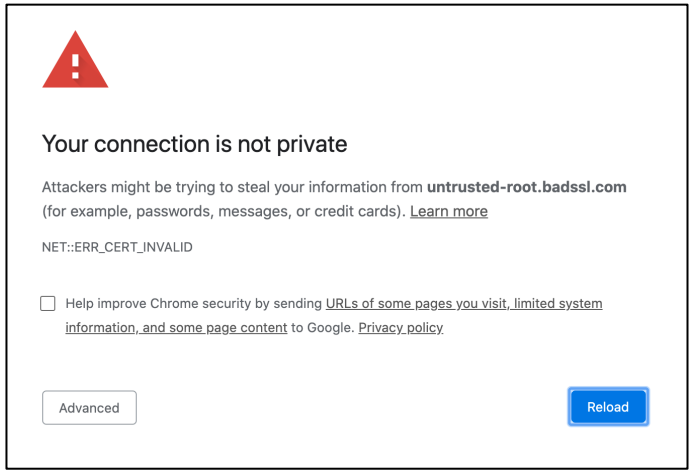
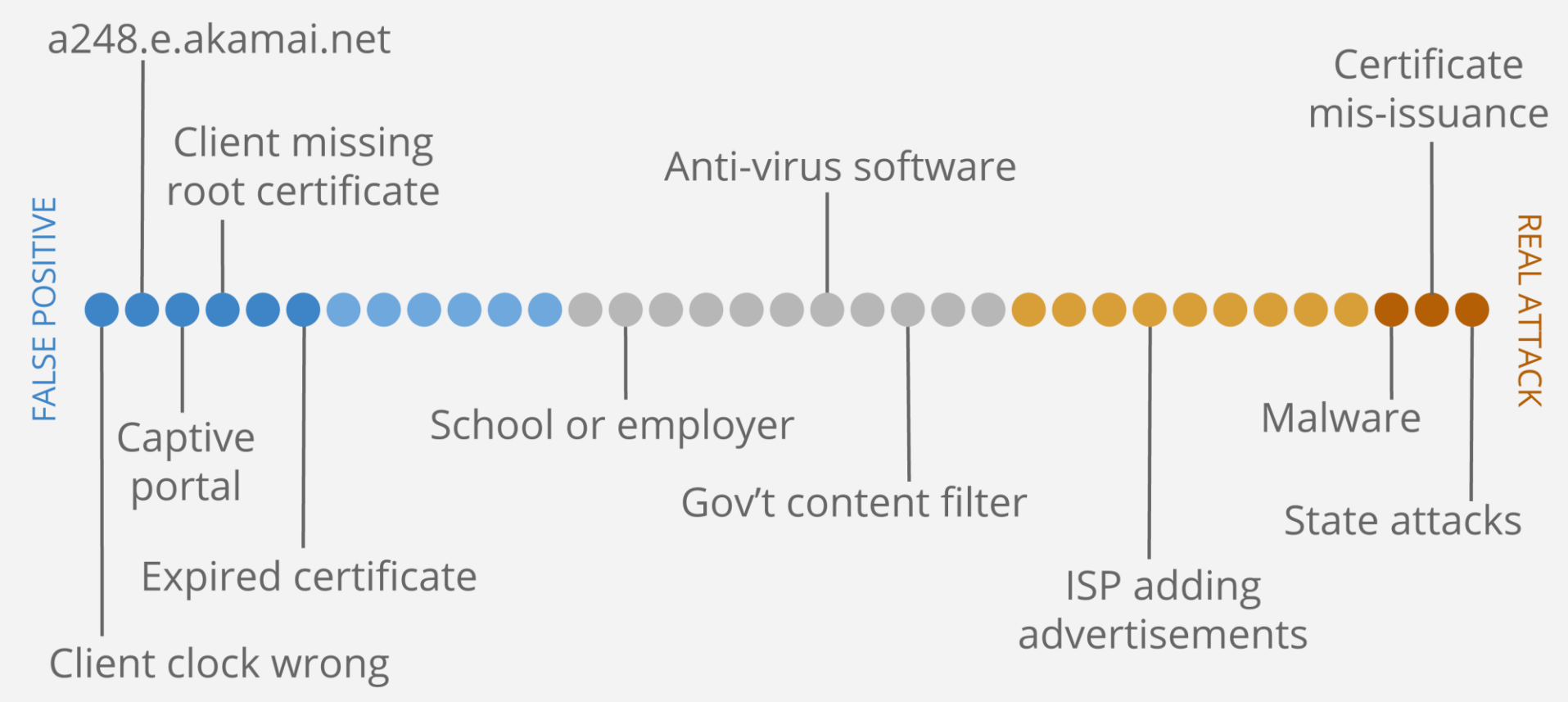
- **Design question 1:** How to indicate encrypted connections to users?
- **Design question 2:** How to alert the user if a site's SSL certificate is untrusted?
  - You discussed this in section a couple weeks ago
  - Recall: Opinionated design



[Felt et al.]

Challenge: Meaningful Warnings

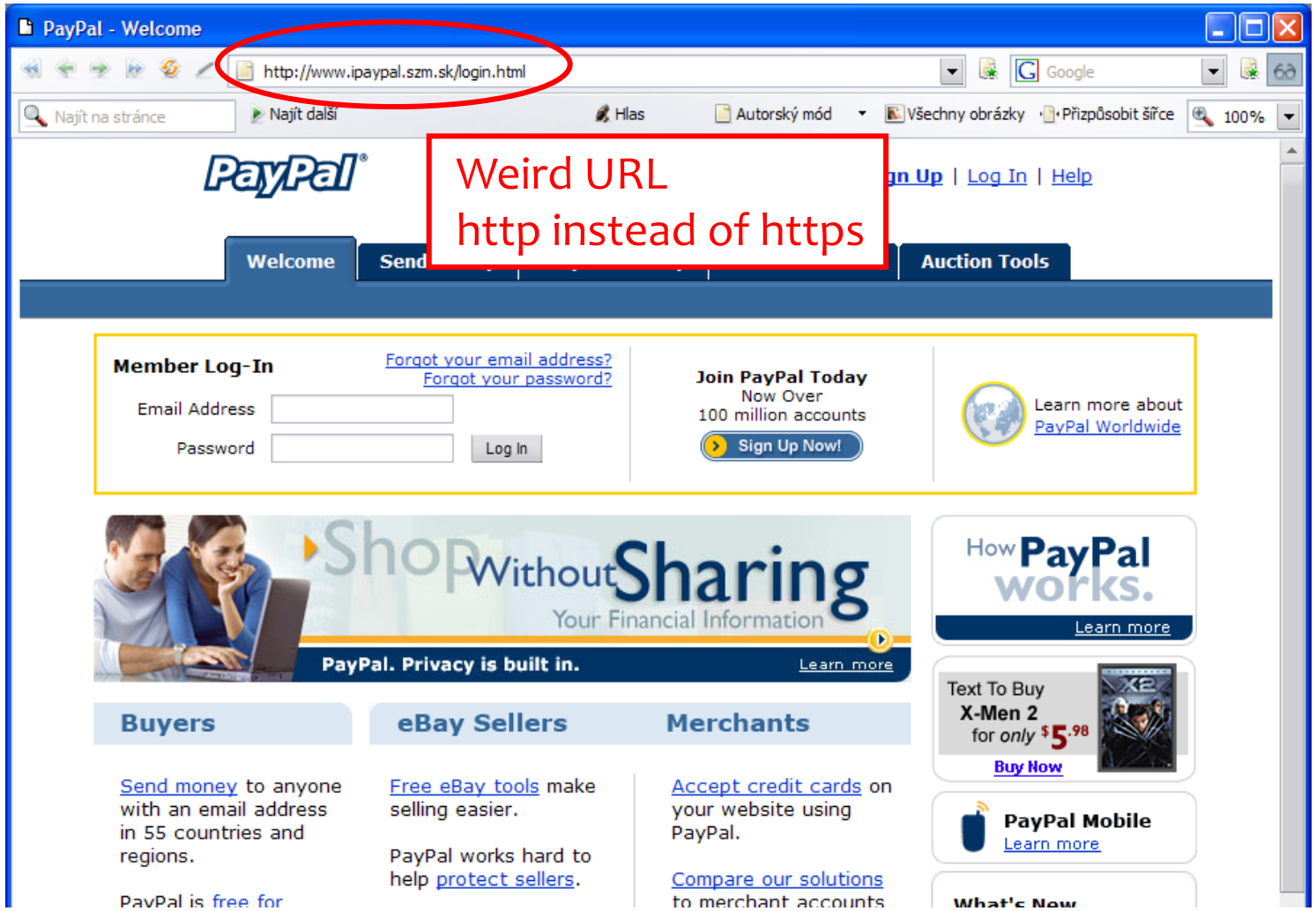


See current designs for different conditions at https://badssl.com/.

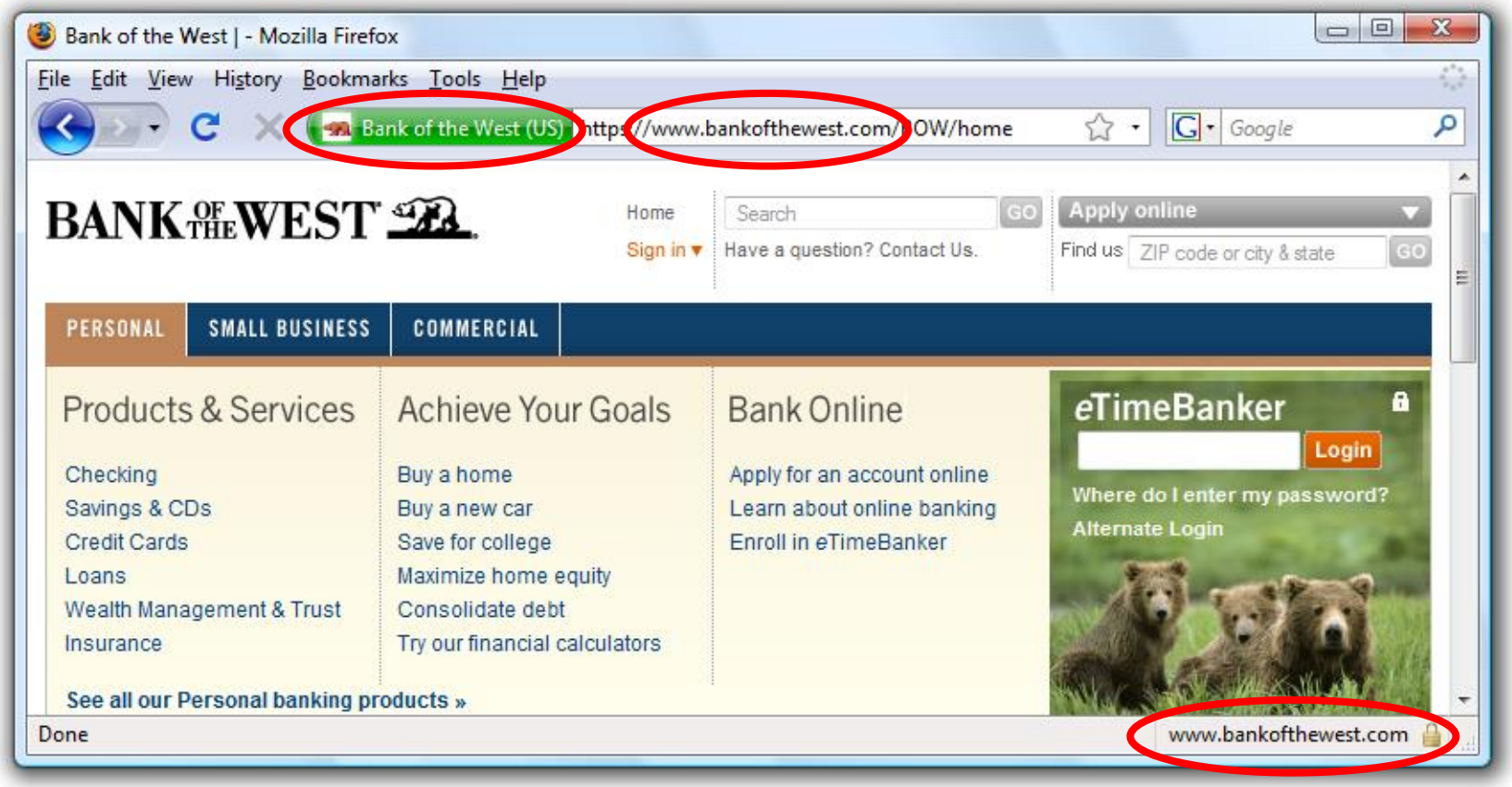
Case Study #2: Phishing

- **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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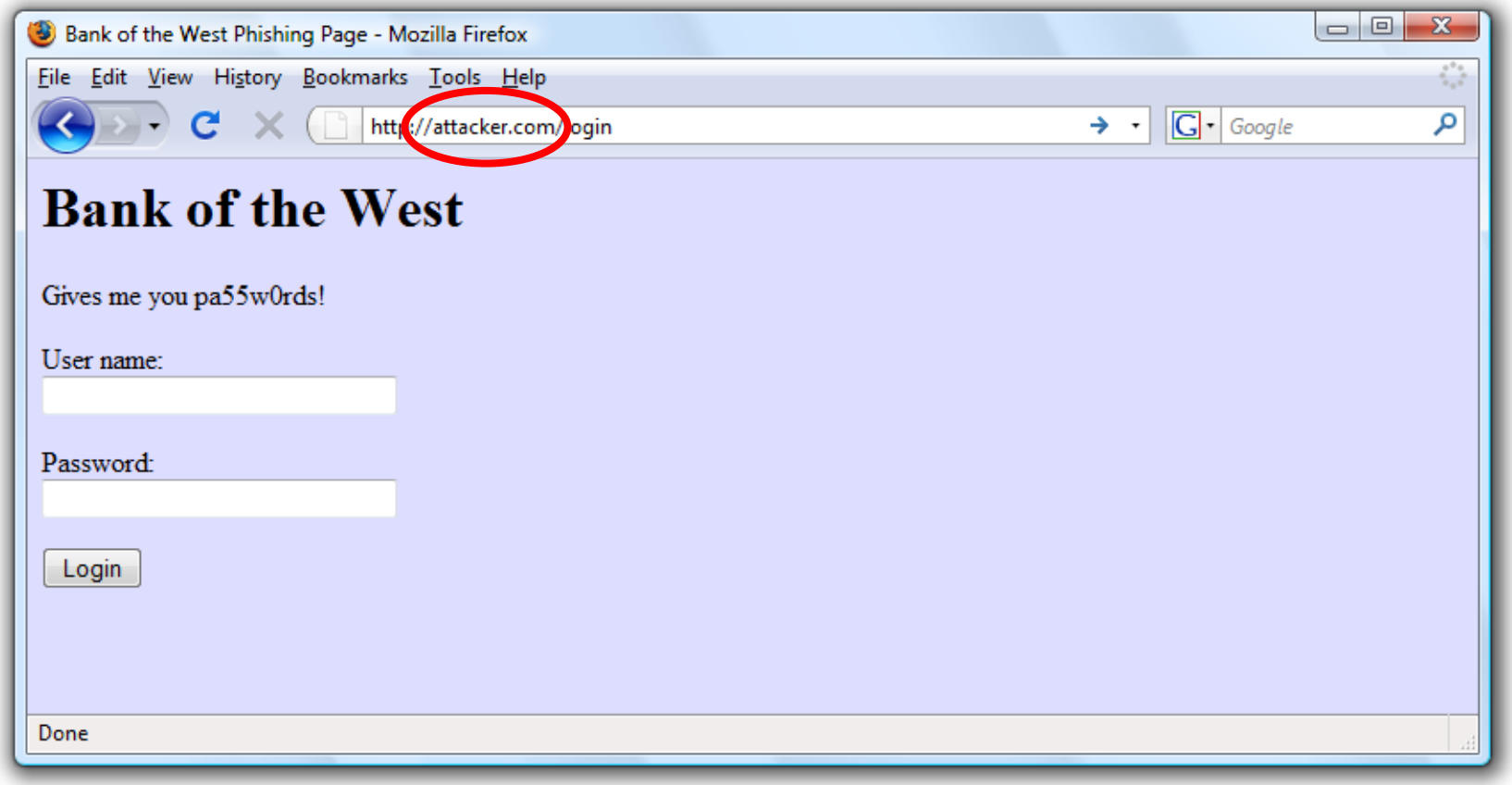

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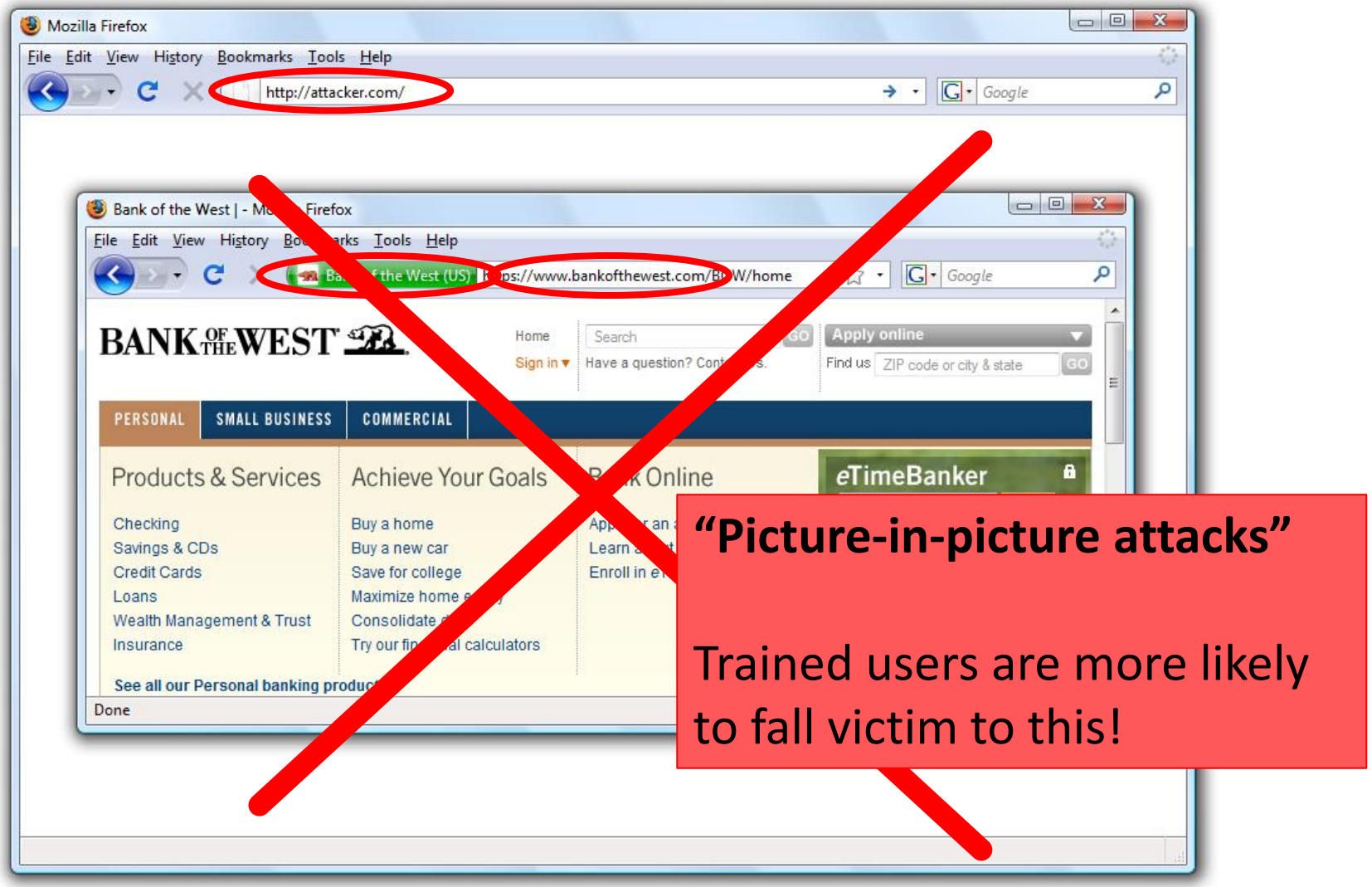
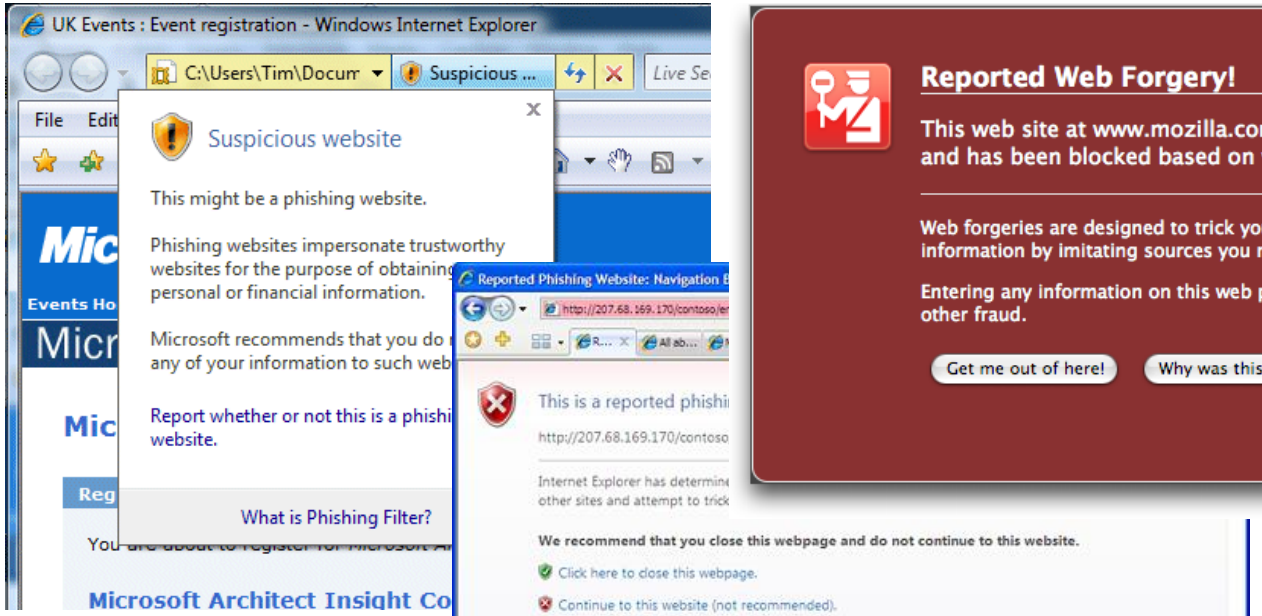
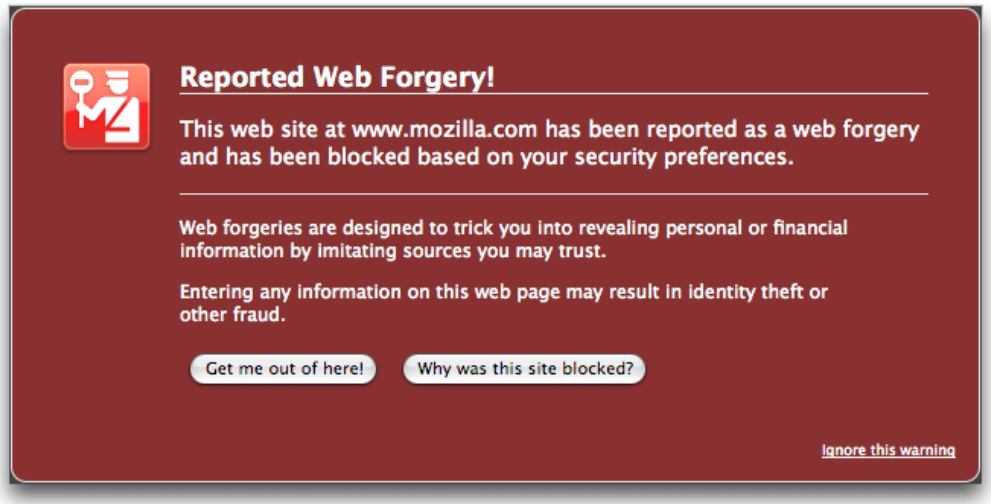


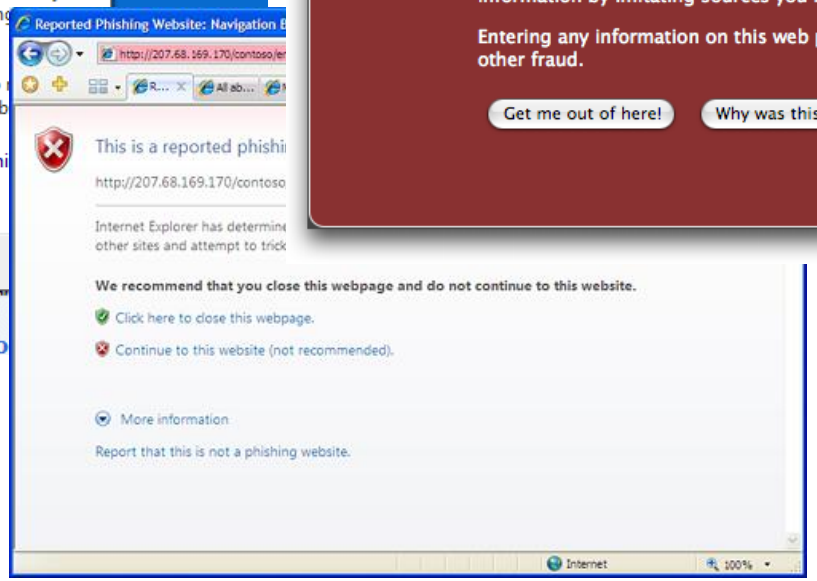
Phishing Warnings (2008)



Passive (IE)



Active (Firefox)

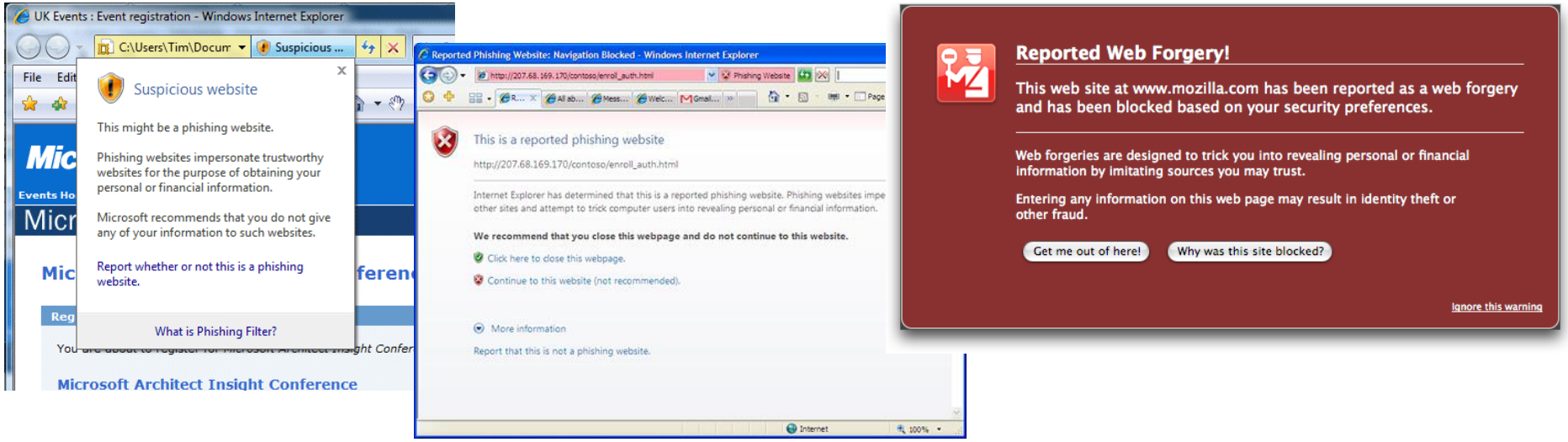


Active (IE)

[Egelman et al.]

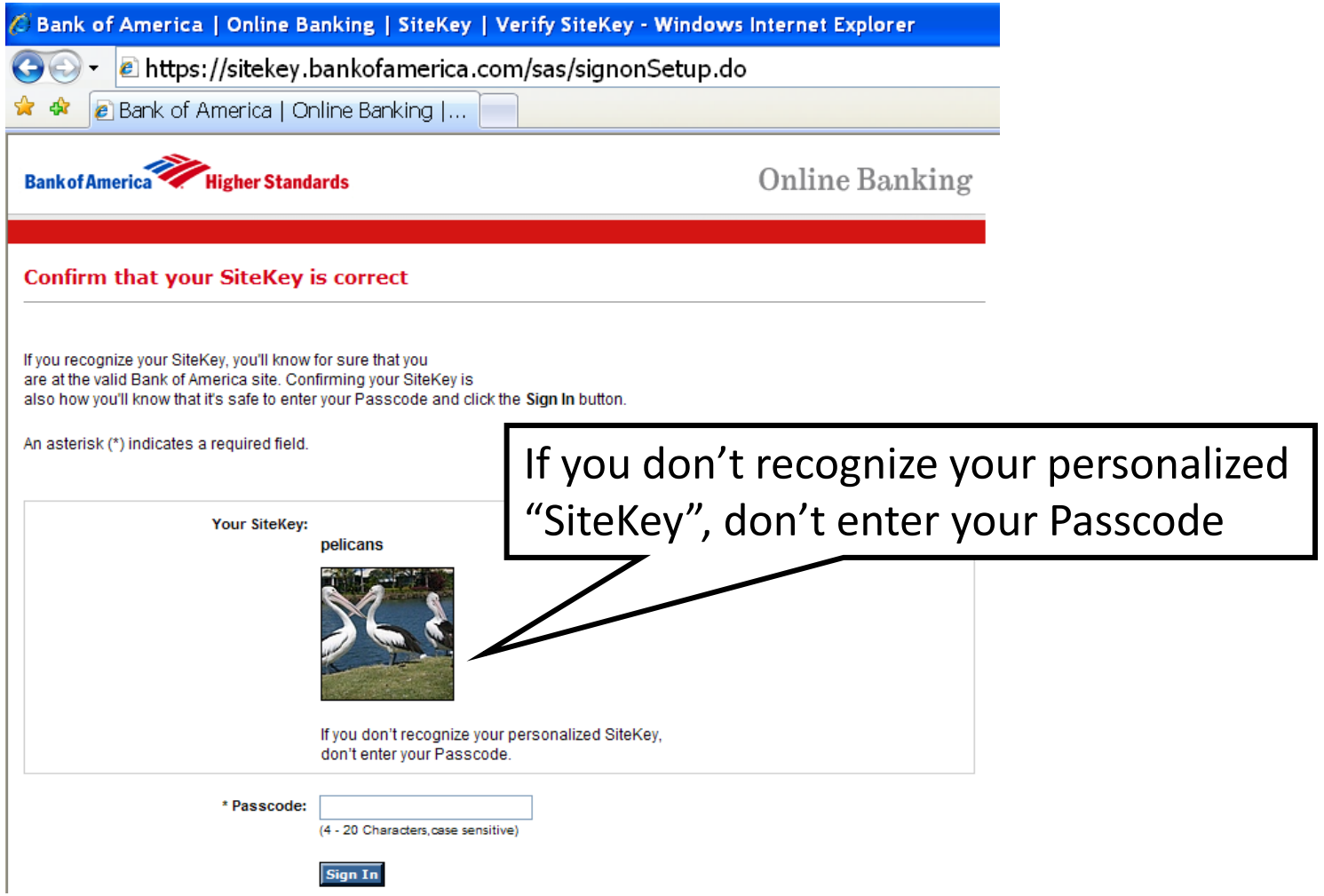
Active vs. Passive Warnings

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



Passive (IE) Active (IE) Active (Firefox)

FYI: Site Authentication Image



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

Root Causes? How to Improve?

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
- …?

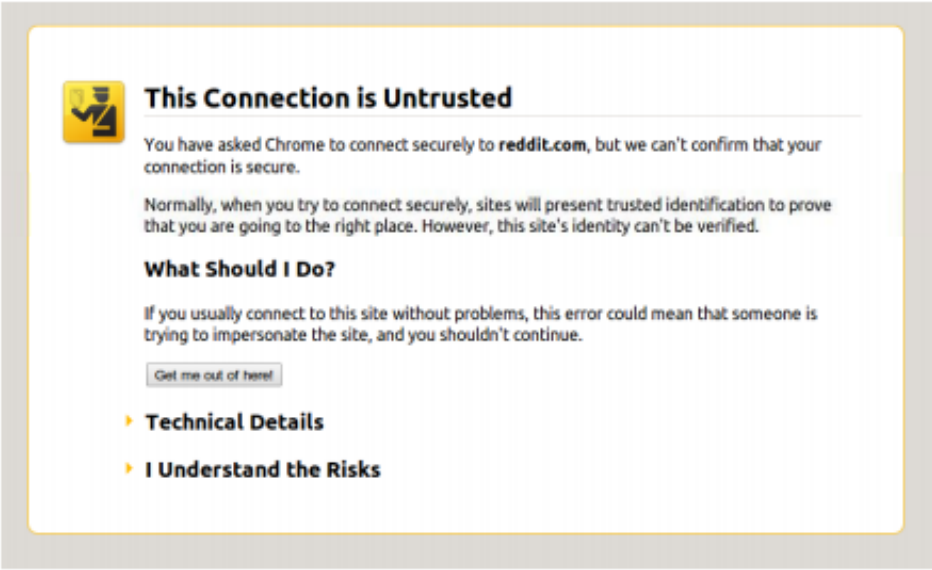
Beyond Specific Tools: Different User Groups

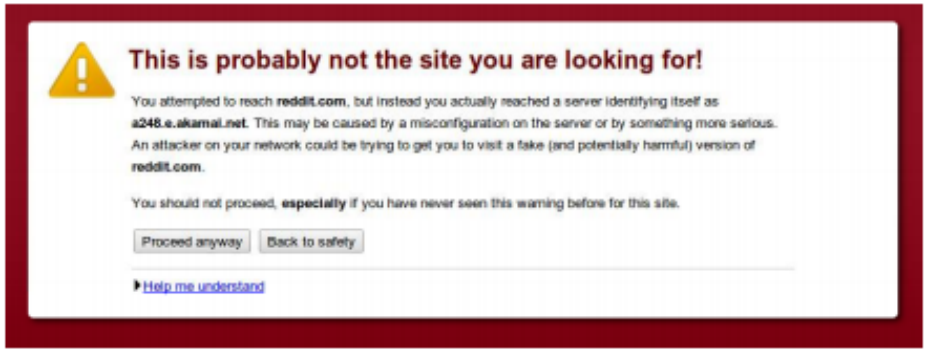
- Not all users are the same!
- Designing for one group of users, or "generic" users, may leads to dangerous failures or reasons that people will not use security tools
- Examples from (qualitative) research at UW:
  - Journalists (most sources are not like Snowden!)
  - Refugees in US (security measures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

[Felt et al.]

Firefox vs. Chrome Warning

33% vs. 70% clickthrough rate





[Felt et al.]

Experimenting w/ Warning Design

#	Condition	CTR	N
1	Control (default Chrome warning)		
2	Chrome warning with policeman		
3	Chrome warning with criminal		
4	Chrome warning with traffic light		
5	Mock Firefox		
6	Mock Firefox, no image		
7	Mock Firefox with corporate styling		

Table 1. Click-through rates and sample size for conditions.

[Felt et al.]

Experimenting w/ Warning Design

#	Condition	CTR	N
1	Control (default Chrome warning)	67.9%	17,479
2	Chrome warning with policeman		
3	Chrome warning with criminal		
4	Chrome warning with traffic light		
5	Mock Firefox		
6	Mock Firefox, no image		
7	Mock Firefox with corporate styling		

Table 1. Click-through rates and sample size for conditions.

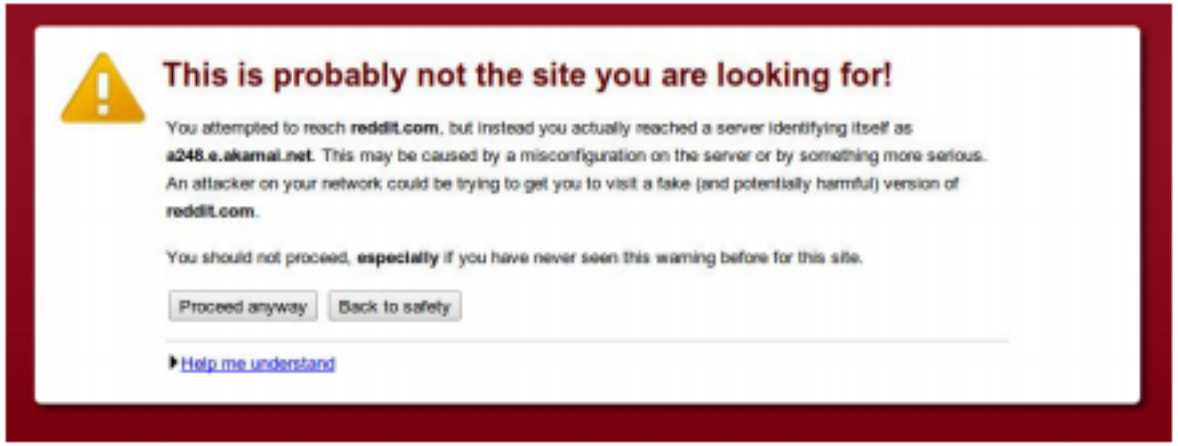


Figure 1. The default Chrome SSL warning (Condition 1).

[Felt et al.]

Experimenting w/ Warning Design

#	Condition	CTR	N
1	Control (default Chrome warning)	67.9%	17,479
2	Chrome warning with policeman	68.9%	17,977
3	Chrome warning with criminal	66.5%	18,049
4	Chrome warning with traffic light	68.8%	18,084
5	Mock Firefox		
6	Mock Firefox, no image		
7	Mock Firefox with corporate styling		

Table 1. Click-through rates and sample size for conditions.

Figure 4. The three images used in Conditions 2-4.

Figure 1. The default Chrome SSL warning (Condition 1).

[Felt et al.]

Experimenting w/ Warning Design

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1	Control (default Chrome warning)	67.9%	17,479
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5	Mock Firefox	56.1%	20,023
6	Mock Firefox, no image	55.9%	19.297
7	Mock Firefox with corporate styling		

Table 1. Click-through rates and sample size for conditions.

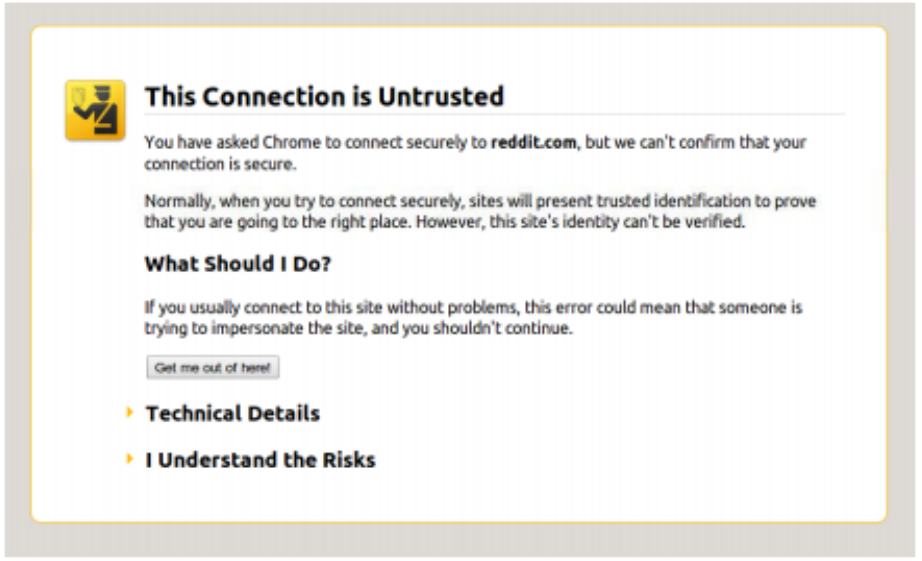

Figure 2. The mock Firefox SSL warning (Condition 5).

[Felt et al.]

Experimenting w/ Warning Design

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6	Mock Firefox, no image	55.9%	19,297
7	Mock Firefox with corporate styling	55.8%	19,845

Table 1. Click-through rates and sample size for conditions.

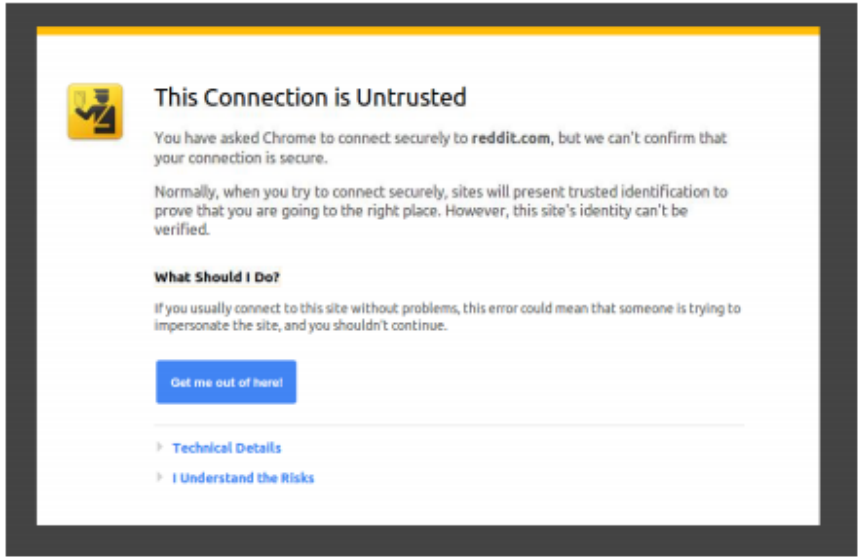
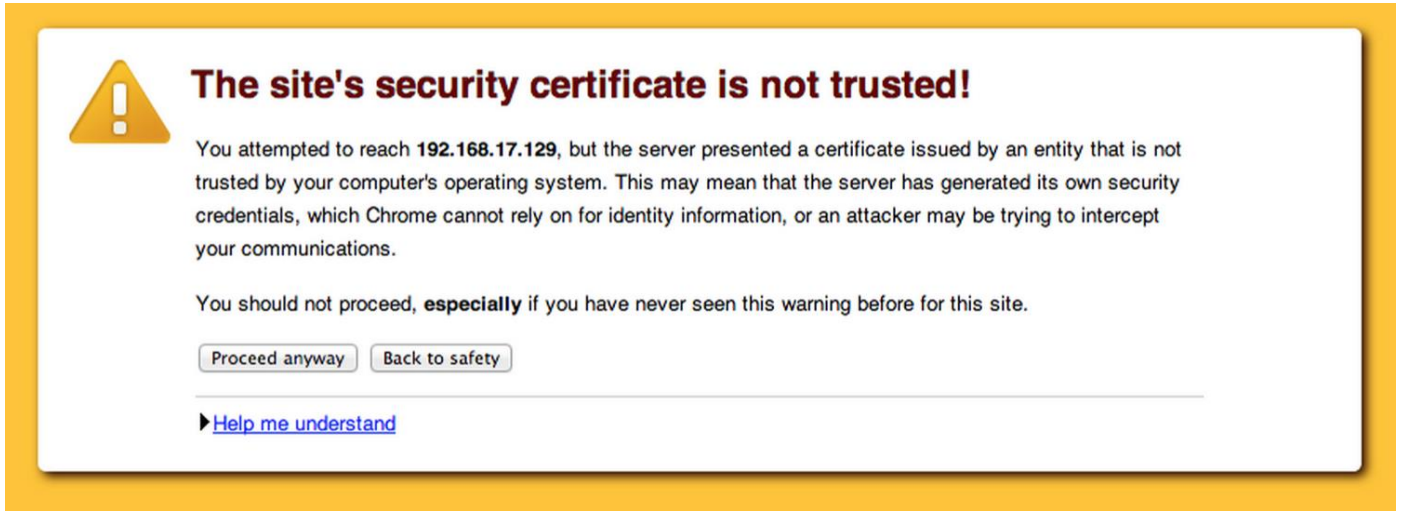


Figure 3. The Firefox SSL warning with Google styling (Condition 7).

[Felt et al.]

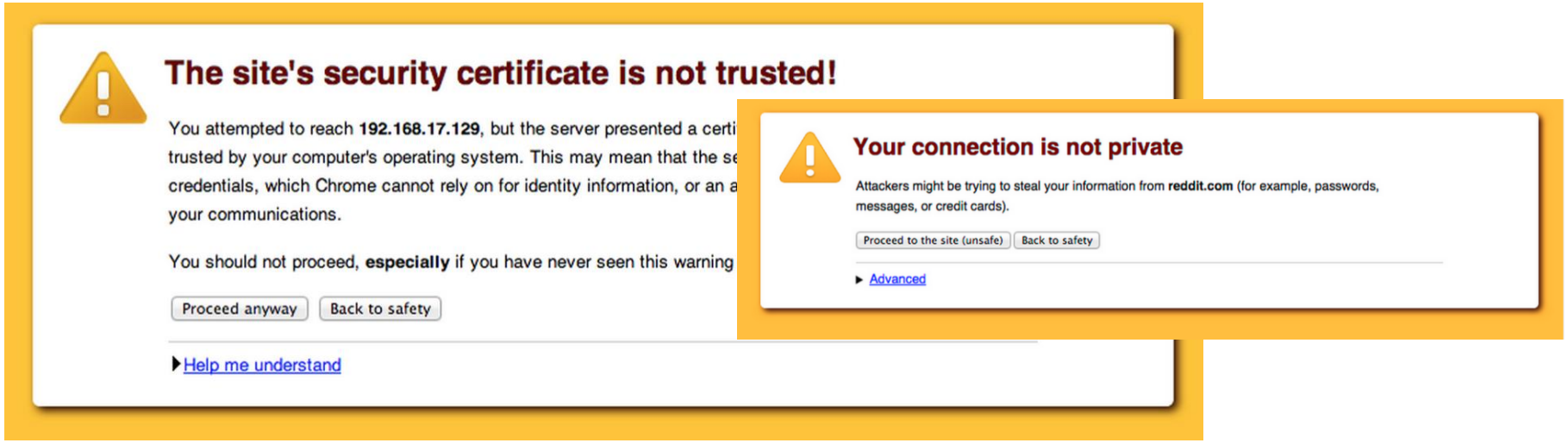
Opinionated Design Helps!

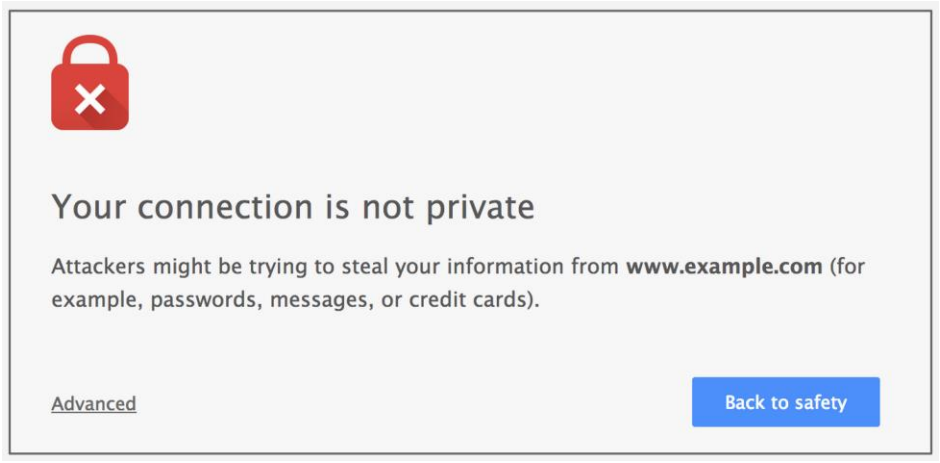


Adherence	N
30.9%	4,551

[Felt et al.]

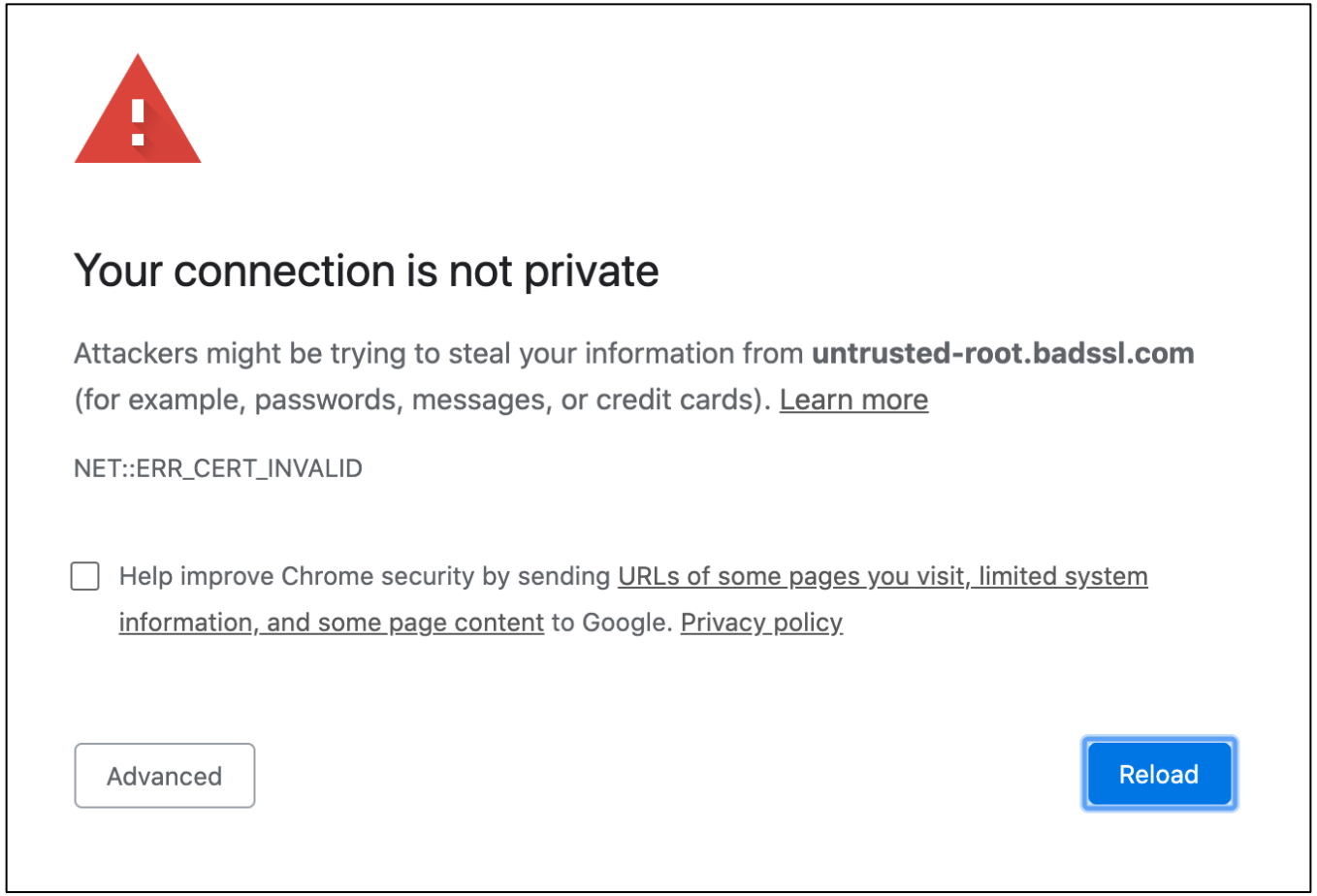
Opinionated Design Helps!





Adherence	N
30.9%	4,551
32.1%	4,075
58.3%	**4,644**

Today's Warning



Which warning is ‘better’?

- For user security?
- For user agency?
- For user understanding?
- For… what?