CSE 484 / CSE M 584: Computer Security and Privacy

# Usable Security

Autumn 2020

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Thanks to Dan Boneh, Dieter Gollmann, Dan Halperin, Yoshi Kohno, Ada Lerner, John Manferdelli, John Mitchell, Vitaly Shmatikov, Bennet Yee, and many others for sample slides and materials ...

# Admin

- Lab 2 due **today**
- Homework 3 out, due Dec 4
- There will be a Lab 3 (it is easier than 1+2)
  - Smart home security, more in section next week
- No class Wednesday or Friday this week (Thanksgiving)

# 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

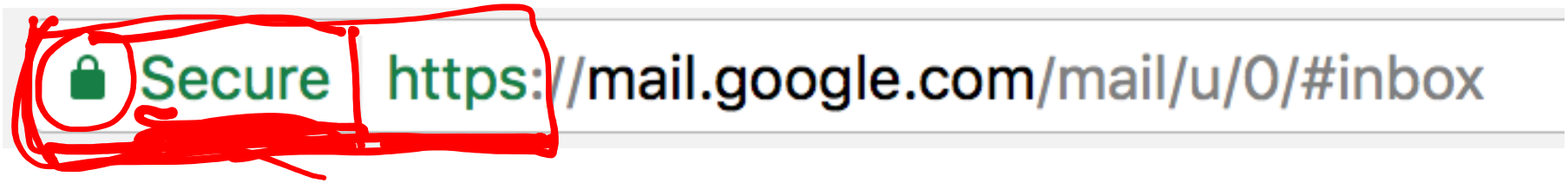
# Usable Security Roadmap

- 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

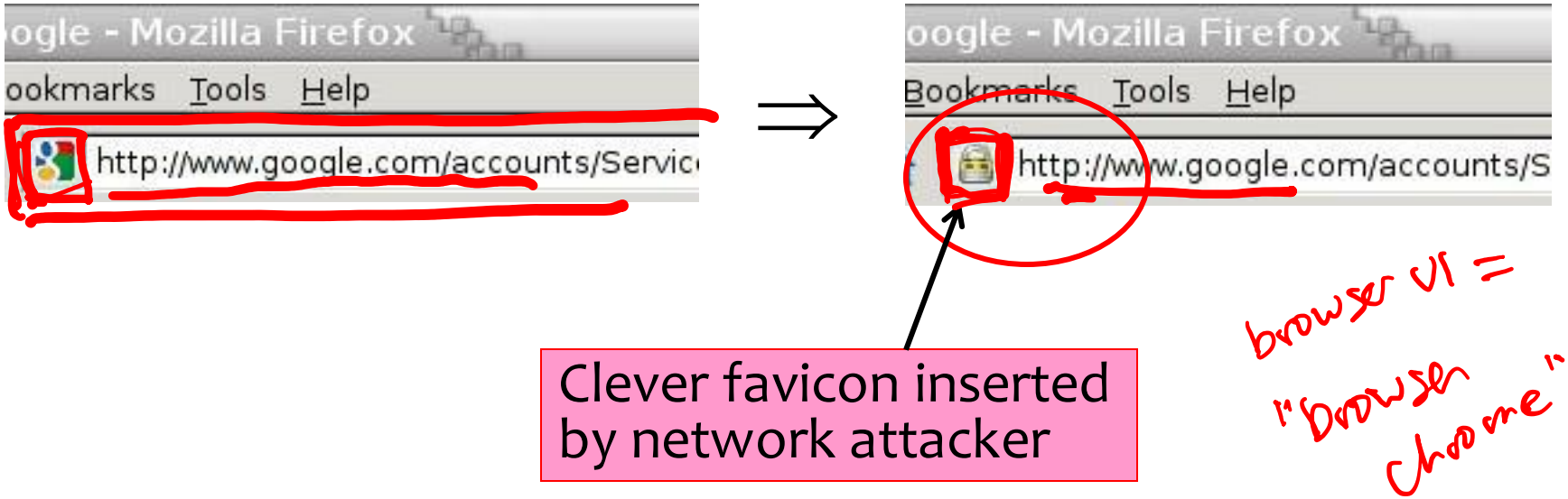
# The Lock Icon




- 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

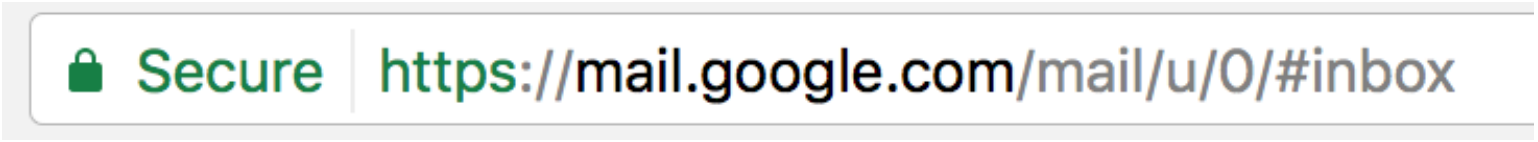
| | | Group | | | | |
|---|---|---|---|---|---|---|
| *Score* | *First chose* not *to enter password...* | *1* | *2* | *3* | *1 ∪ 2* | *Total* |
| *0* | upon noticing HTTPS absent | 0 0% | 0 0% | 0 0% | 0 0% | 0 0% |
| *1* | after site-authentication image removed | 0 0% | 0 0% | 2 9% | 0 0% | 2 4% |
| *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:**

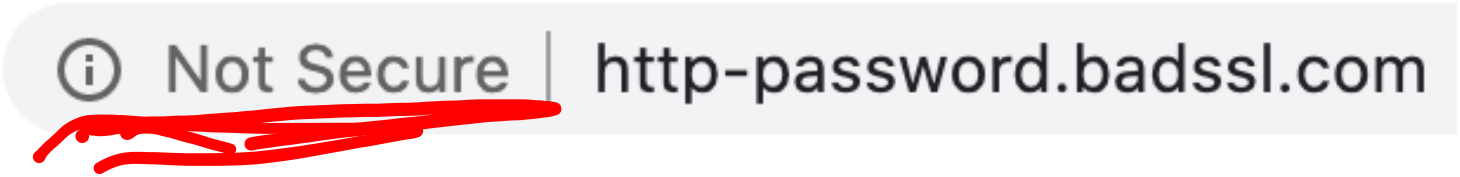
Users don't notice the **absence** of indicators!

# Newer Versions of Chrome

c. 2017

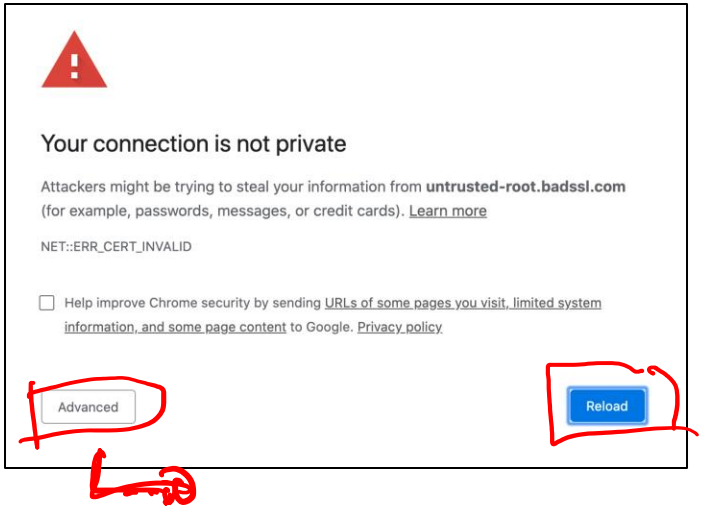



2020

# Case Study #1: Browser HTTPS Indicators

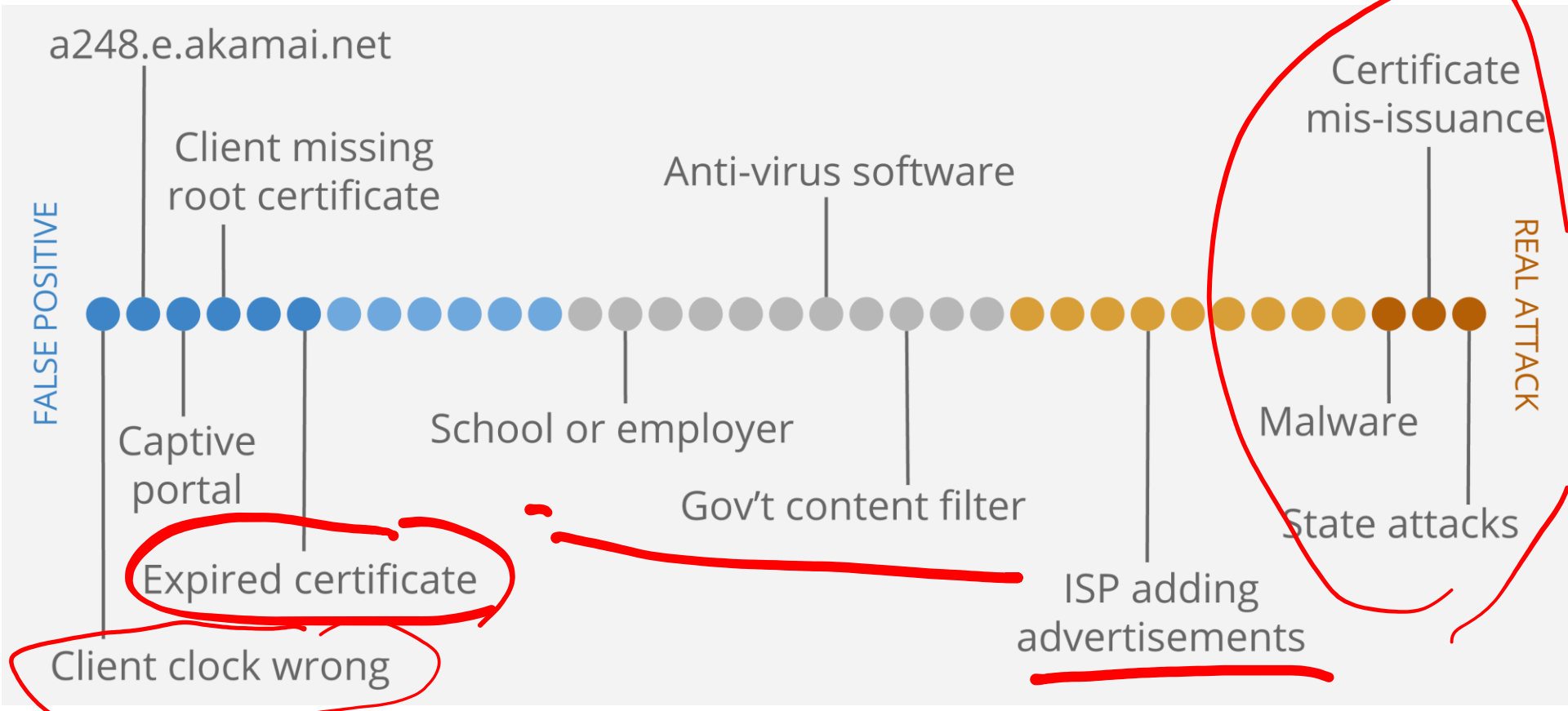
- **Design question 1:** How to indicate encrypted connections to users?
- **Design question 2:** How to alert the user if a site's SSL certificate is untrusted?
  - You discussed this in section a couple weeks ago
  - Recall: Opinionated design




"dark patterns"

[Felt et al.]

# Challenge: Meaningful Warnings



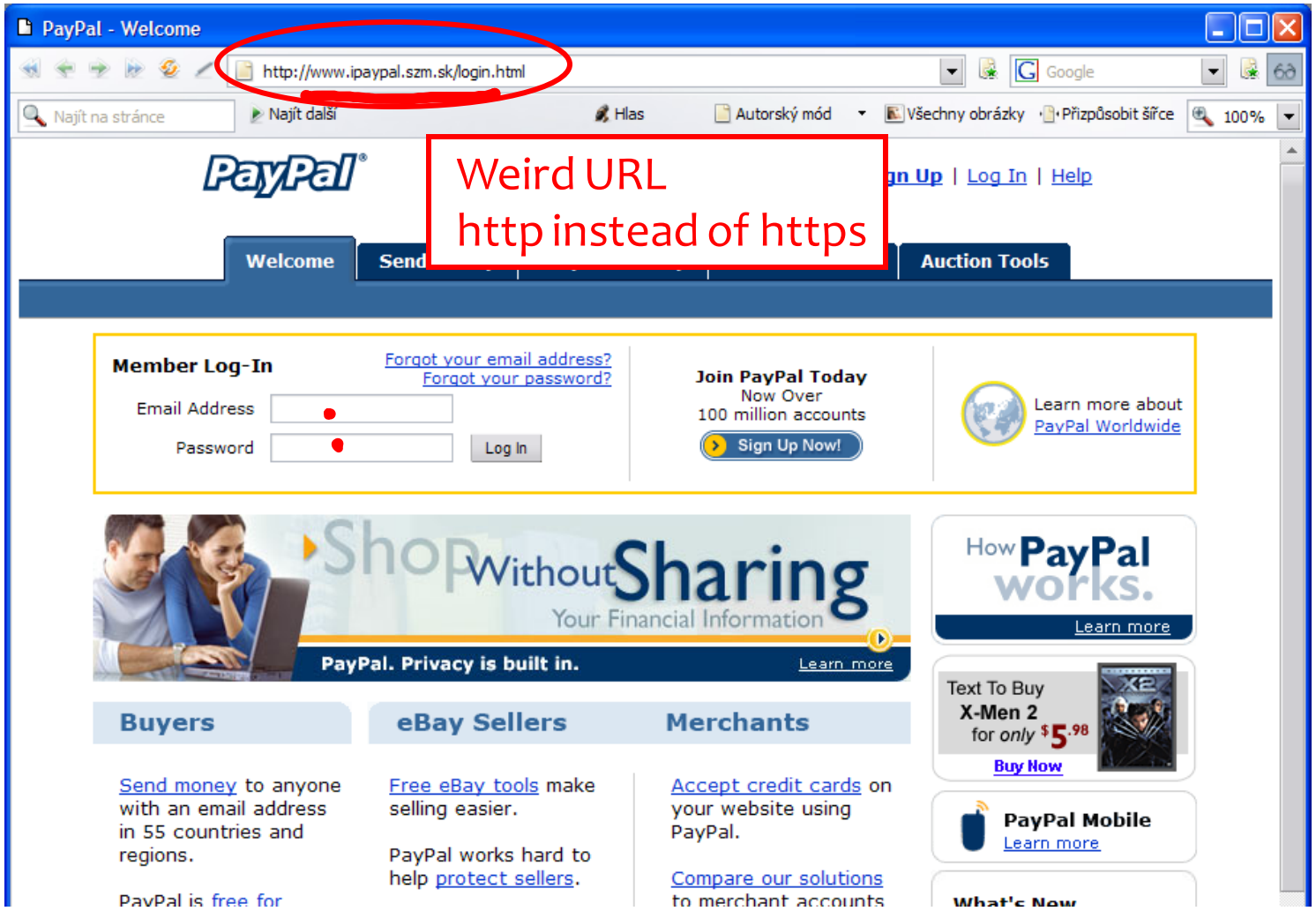

See current designs for different conditions at https://badssl.com/.

gmail.com

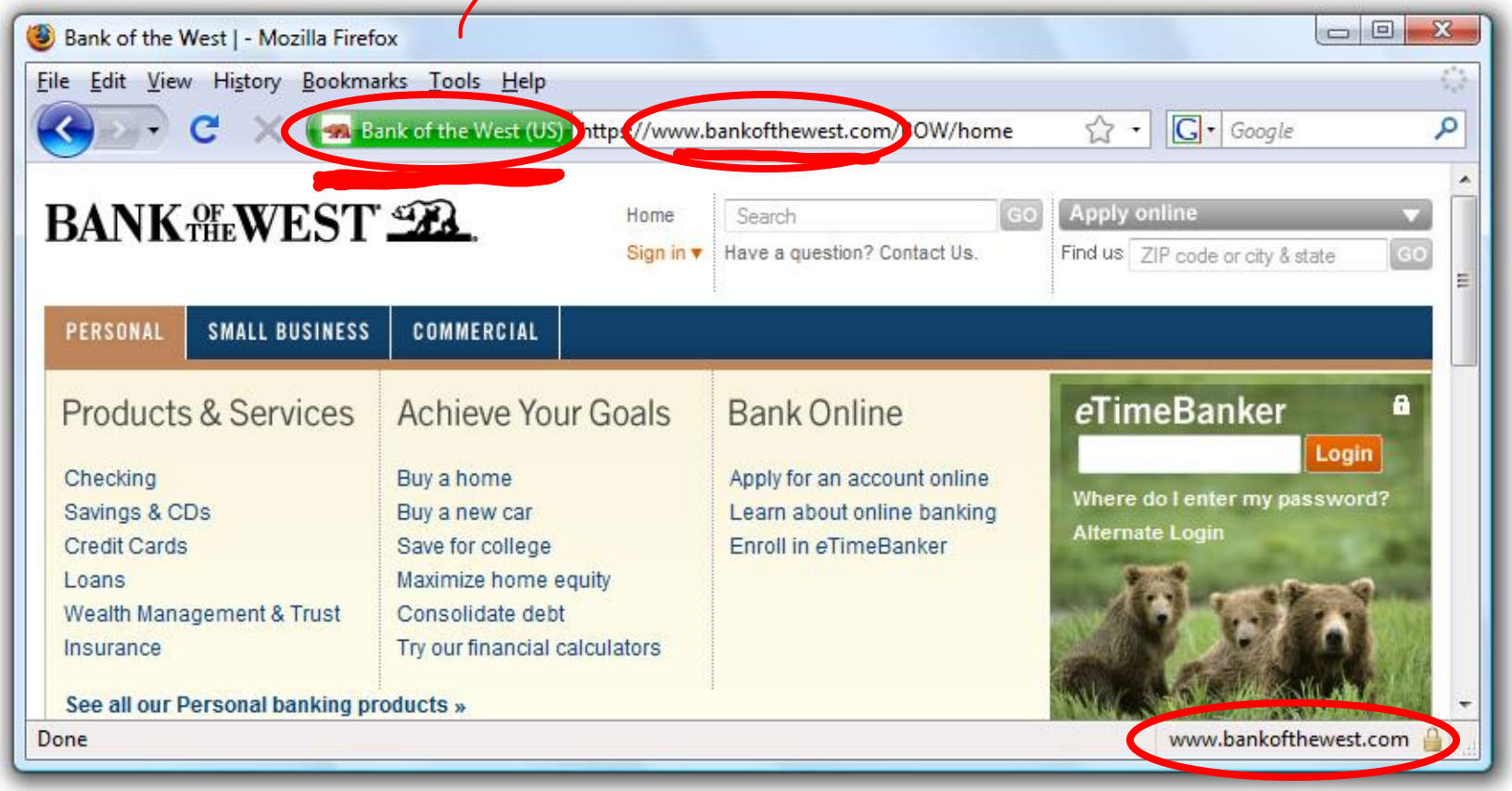
# Case Study #2: Phishing

- **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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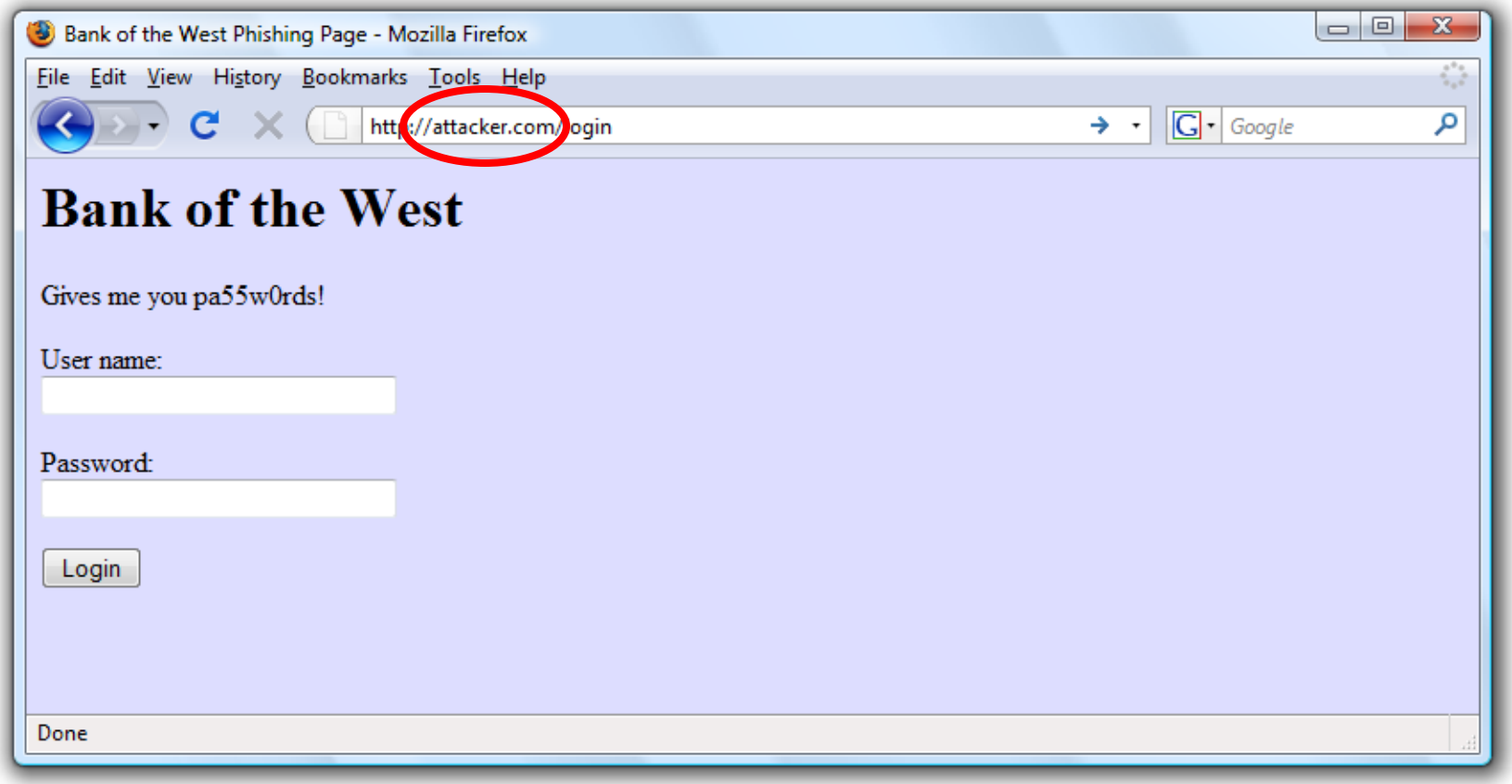

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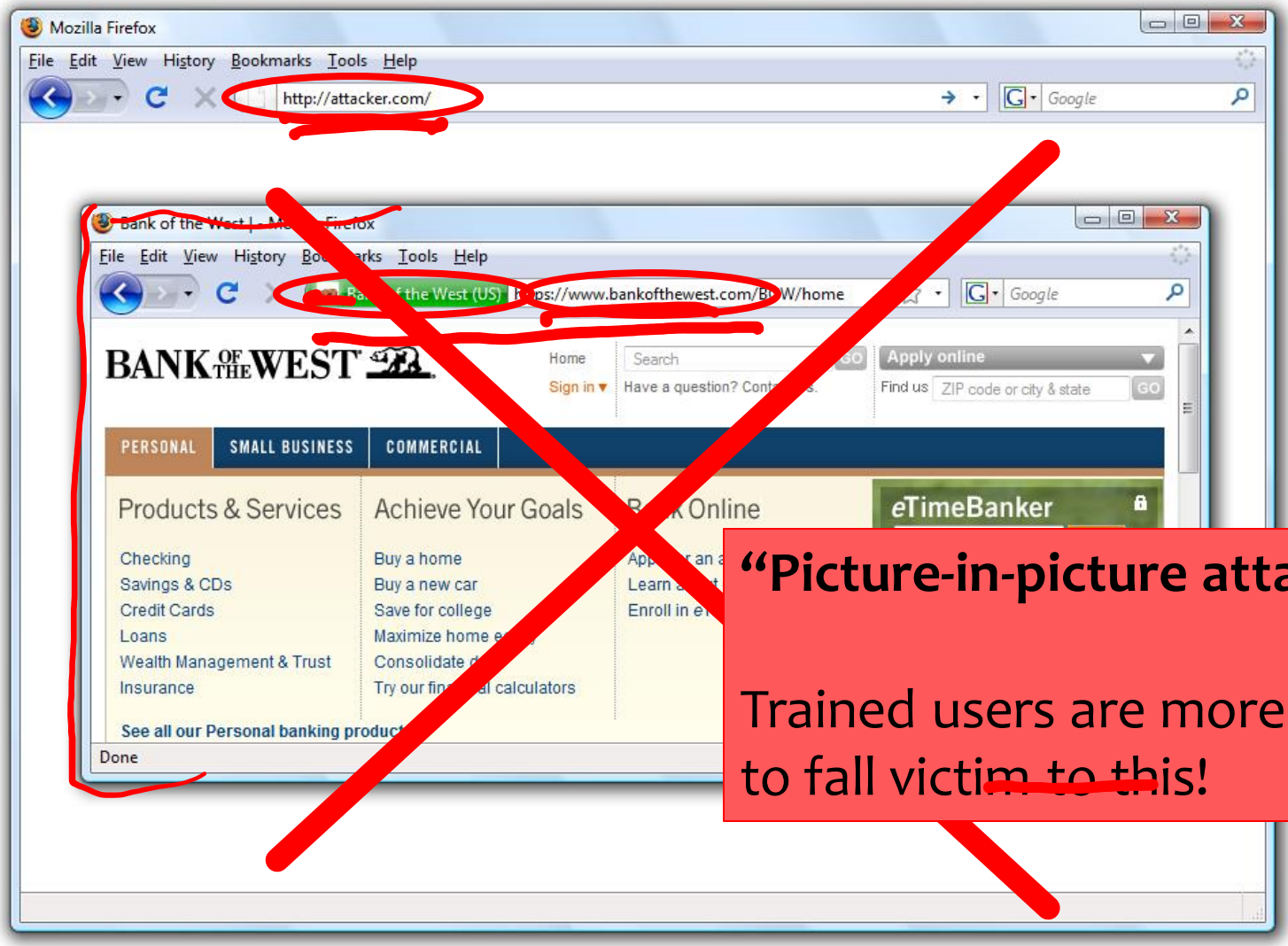
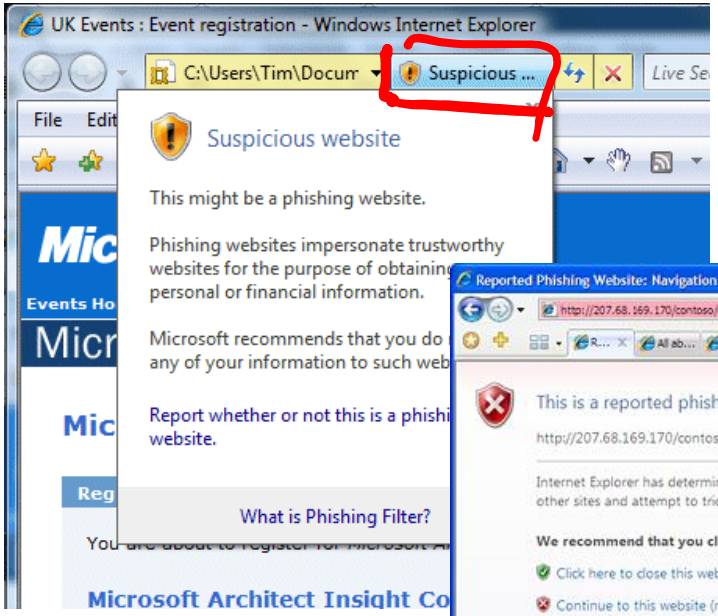


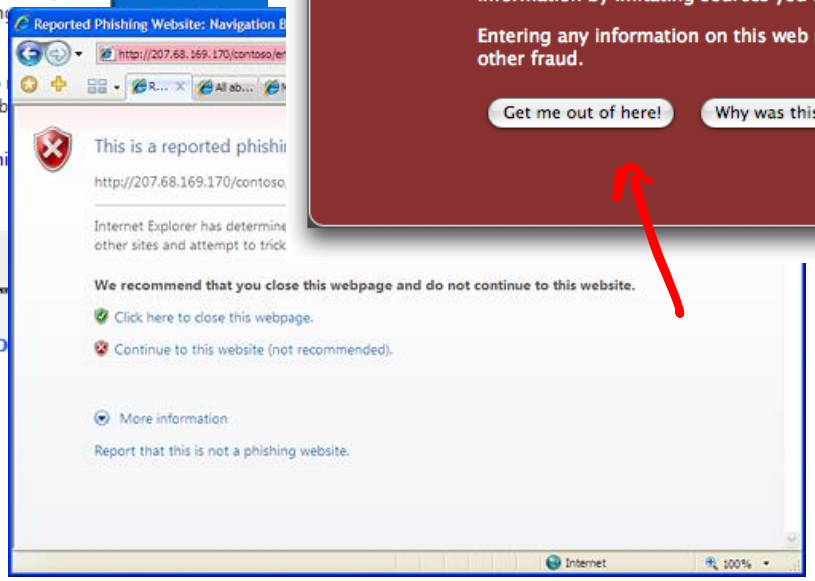

**"Picture-in-picture attacks"**

Trained users are more likely to fall victim to this!

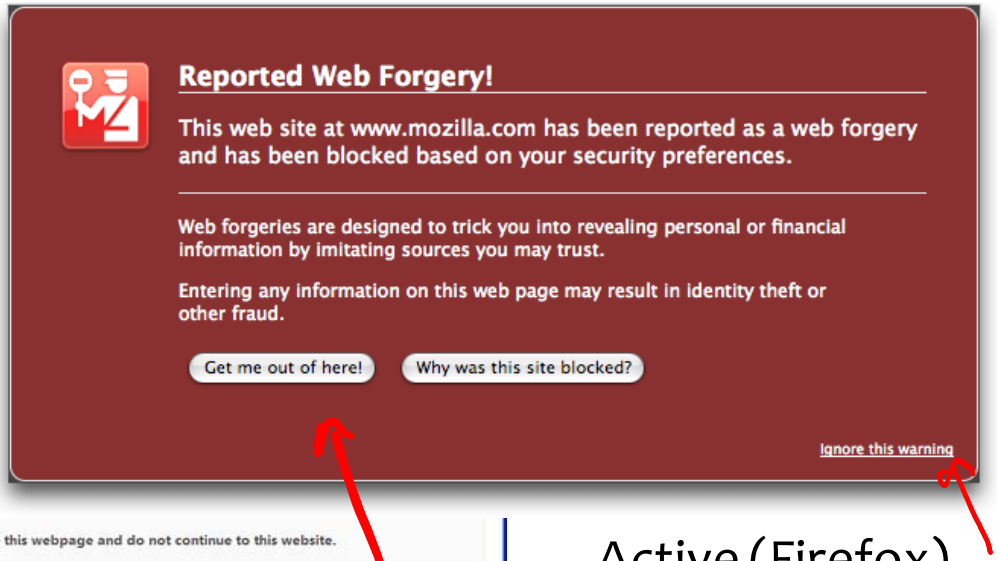
# Phishing Warnings (2008)




Passive (IE)




Active (IE)

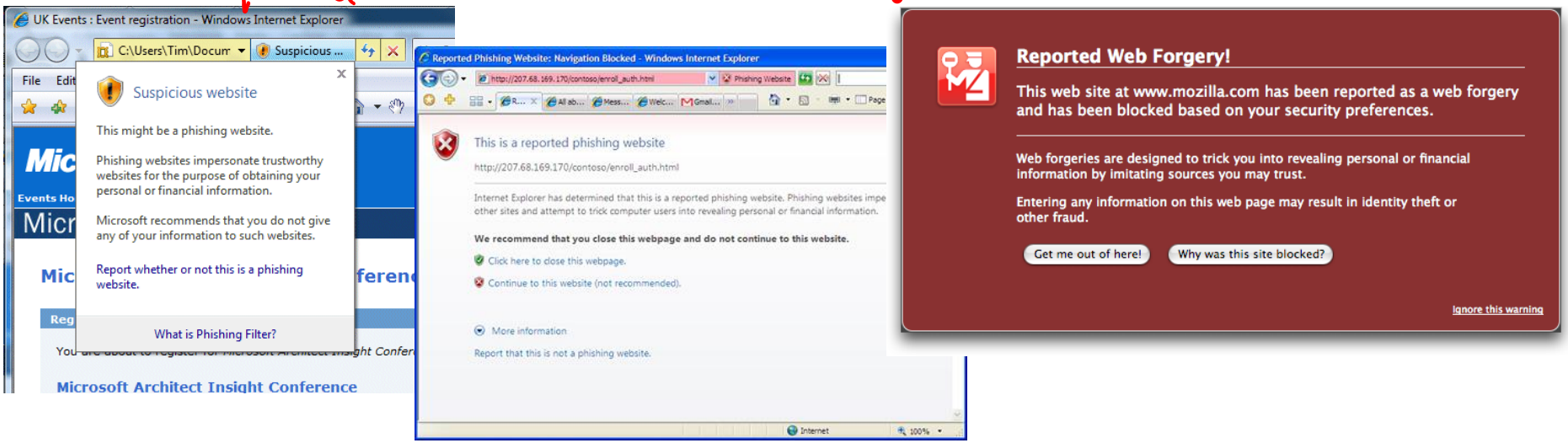



Active (Firefox)

[Egelman et al.]

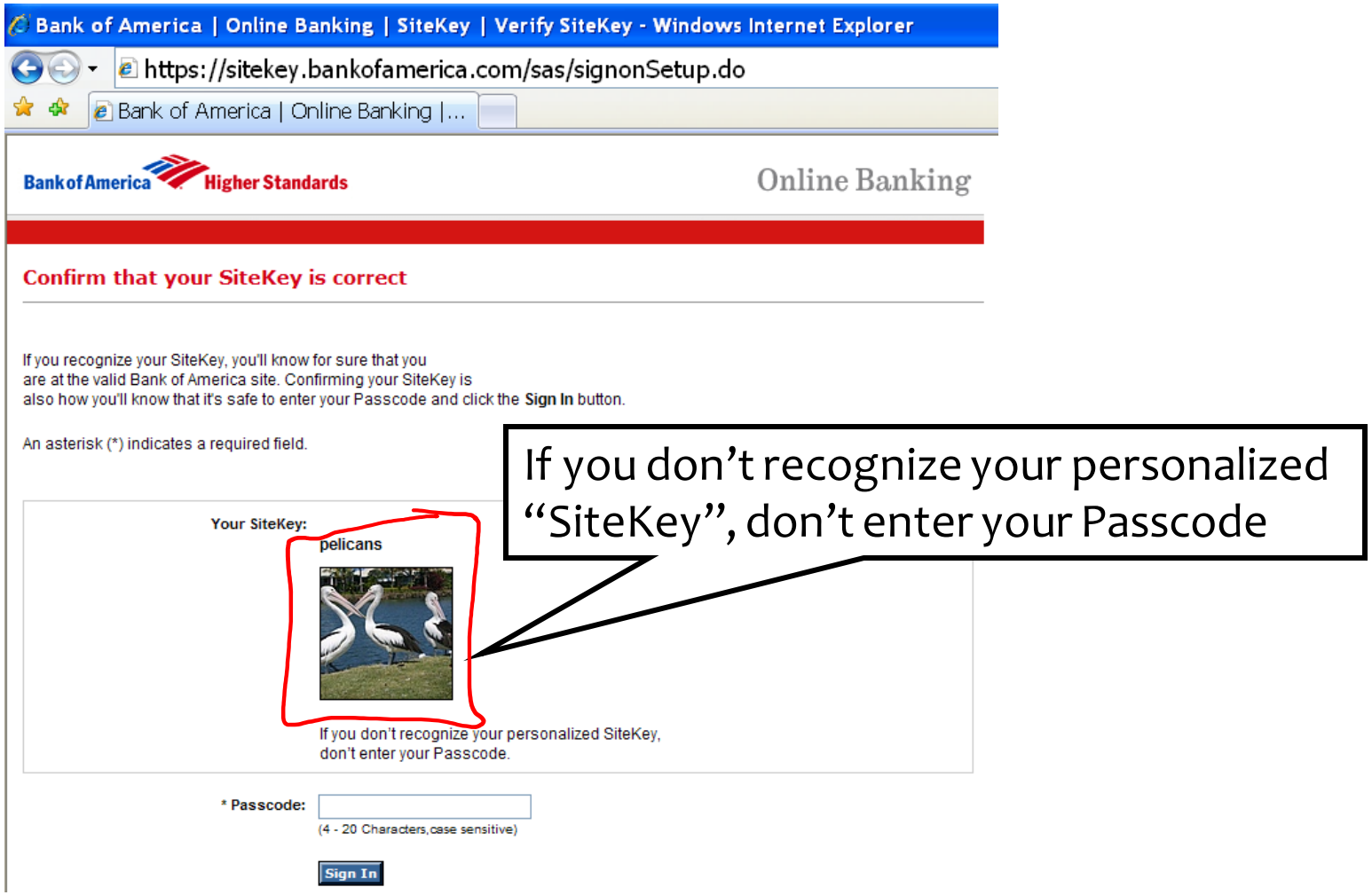
# Active vs. Passive Warnings

- 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?

- You aren't your user
- What assumptions?
- Security vs. convenience
- People want things to "just work" → design challenge
- Limited threat models
- Accessibility / not all users are the same

# 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!)