

CSE 490K Lecture 9

Authentication and Human Aspects to Computer Security

Tadayoshi Kohno

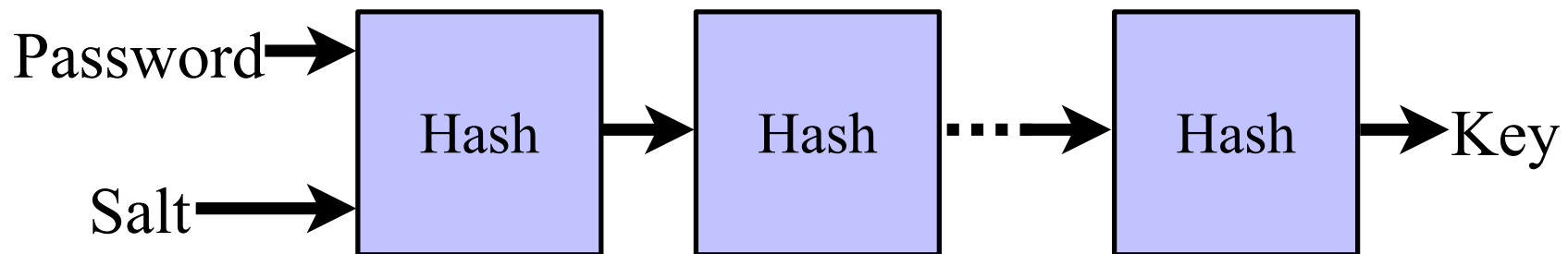
Some slides derived from Vitaly Shmatikov's and Dan Simon's

PBKDF

◆ Problem:

- Wish to encrypt file on local system using a password
- User remembers password (e.g, a 16 character passphrase)
- File encrypted with a symmetric cryptographic key (e.g., a 128 bit random key)

◆ Solution: Password-based key derivation

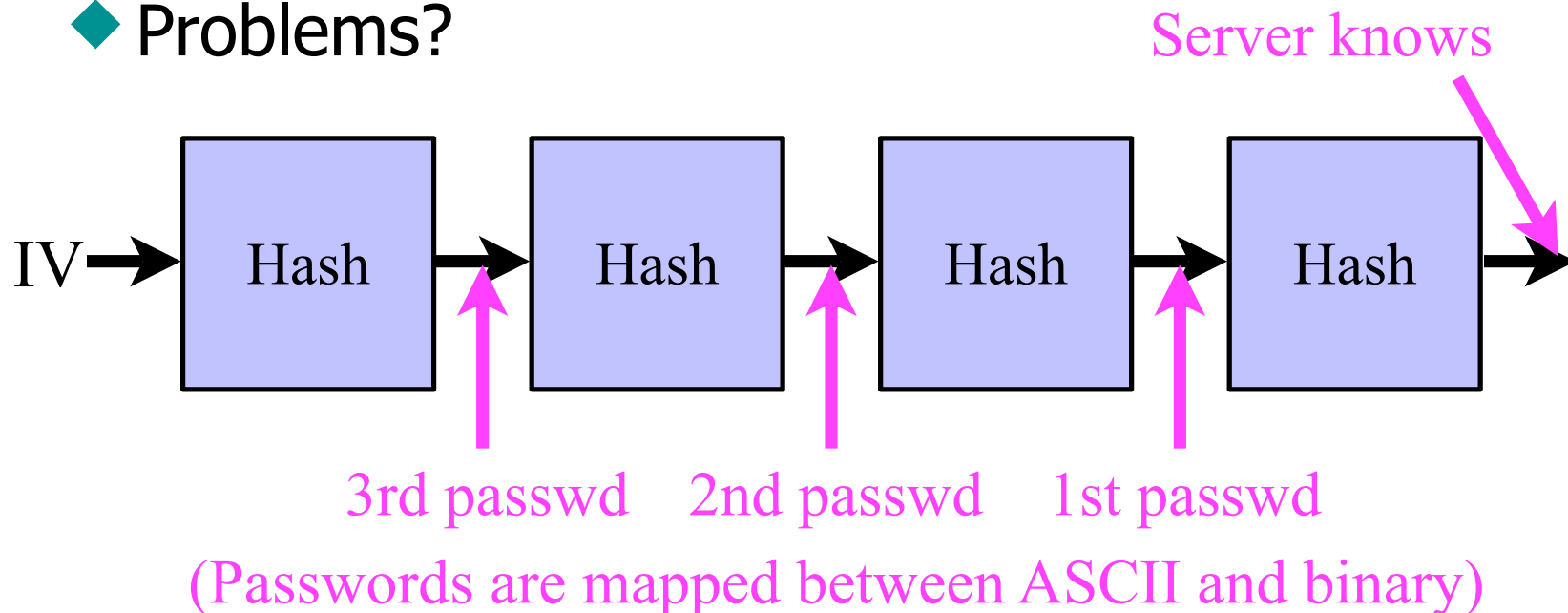


SKeys

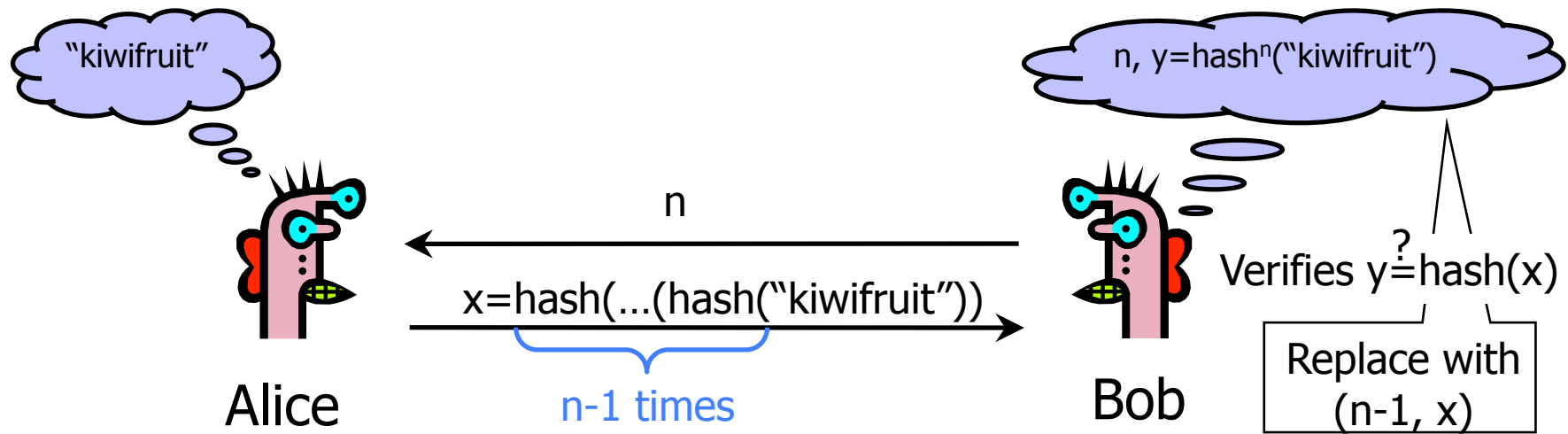
◆ One time “passwords”

- Easy for server to check
- Hard for adversary who captures token to figure out the next one
- User keeps list of passwords

◆ Problems?

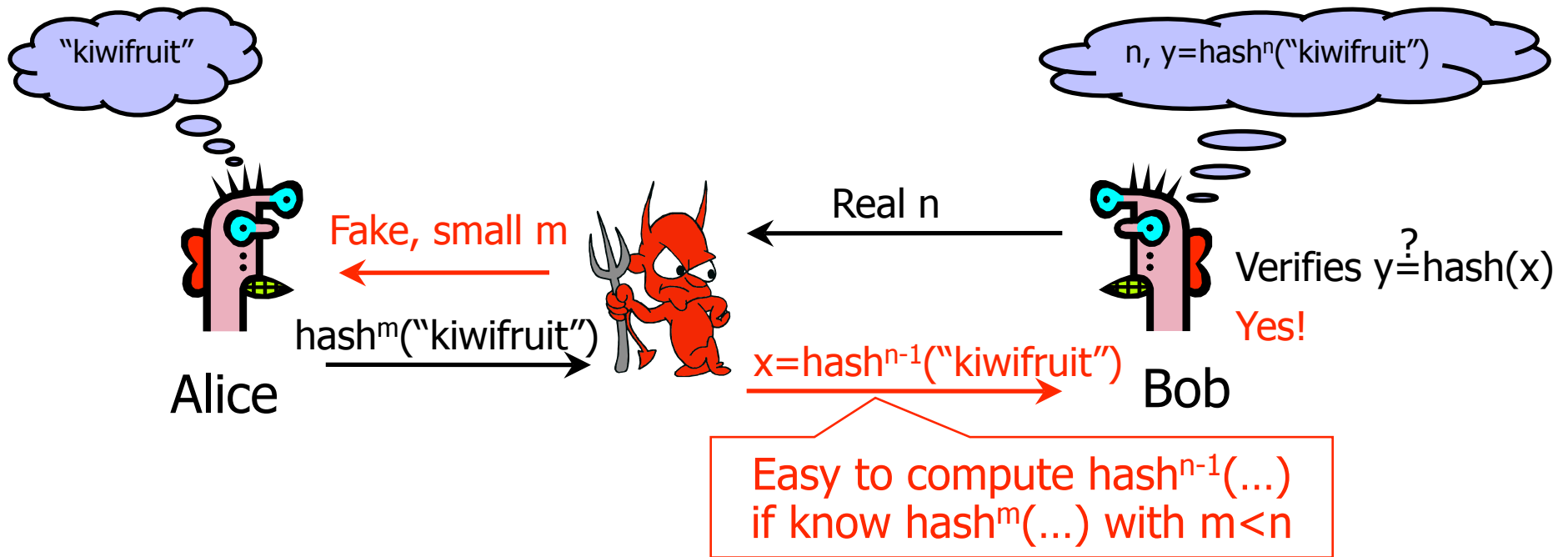


Lamport's Hash



- ◆ Main idea: "hash stalk"
 - Moving up the stalk (computing the next hash) is easy, moving down the stalk (inverting the hash) is hard
 - n should be large (can only use it for n authentications)
- ◆ For verification, only need the tip of the stalk

"Small n" Attack



- ◆ First message from Bob is not authenticated!
- ◆ Alice should remember current value of n

Two-factor authentication

◆ Authentication

- What you know
- Who you are
- What you are

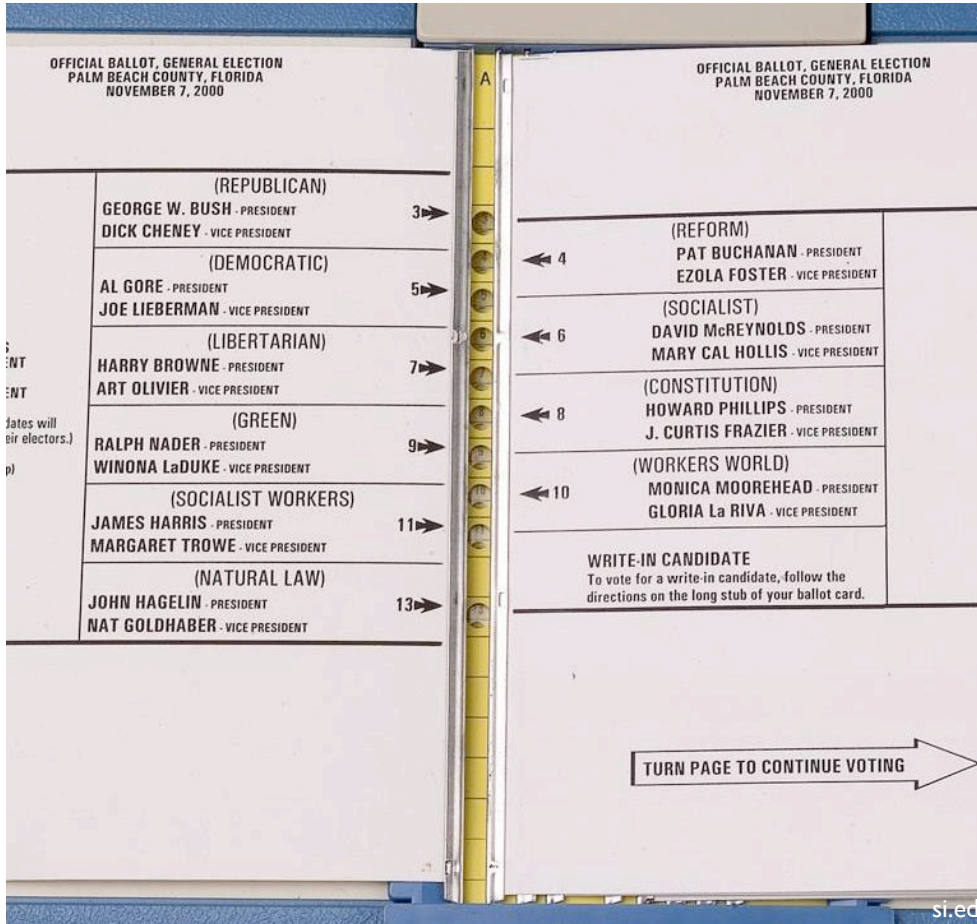
◆ Idea: More is better

- Authenticate with two factors
- ATM cards
 - Physical card - something you have
 - PIN - something you know

Authentication Adversaries

- ◆ Eavesdropper
- ◆ Pretend to be Bob and accept connections from Alice
- ◆ Initiate conversation pretending to be Alice
- ◆ Read Alice's database
- ◆ Read Bob's database
- ◆ Modify messages in transit between Alice and Bob
- ◆ Any combination of the above

Poor Usability Causes Problems



si.ed

AP

Importance

◆ Why is usability important?

- People are the critical element of any computer system
 - People are the real 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

◆ Today

- Challenges with security and usability
- Key design principles
- New trends and directions

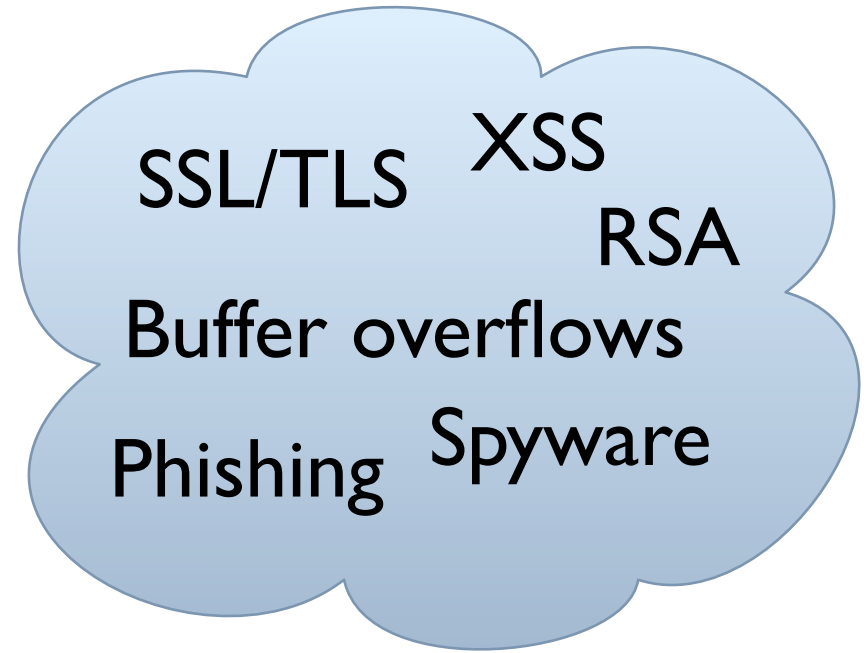
Issue #1: Complexities, Lack of Intuition

Real World



We can see, understand, relate to.

Electronic World



Too complex, hidden, no intuition.

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Issue #1: Complexities, Lack of Intuition

- ◆ Mismatch between perception of technology and what really happens
 - Public keys?
 - Signatures?
 - Encryption?
 - Message integrity?
 - Chosen-plaintext attacks?
 - Chosen-ciphertext attacks?
 - Password management?
 - ...

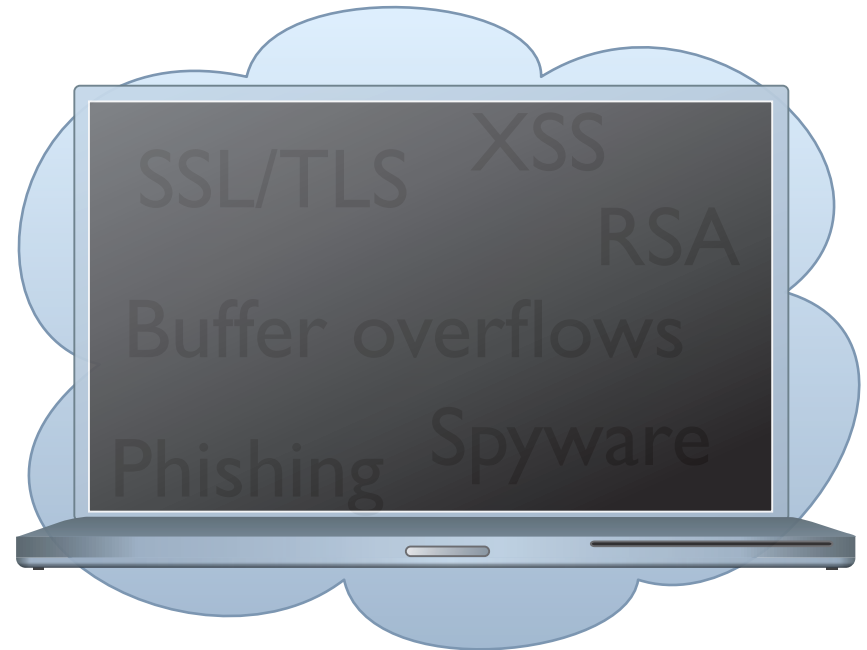
Issue #2: Who's in Charge?

Real World



Complex, hidden, but
doctors manage

Electronic World



Complex, hidden, and
users manage

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Electronic World



Adversaries in the electronic world can be *intelligent, sneaky, and malicious.*

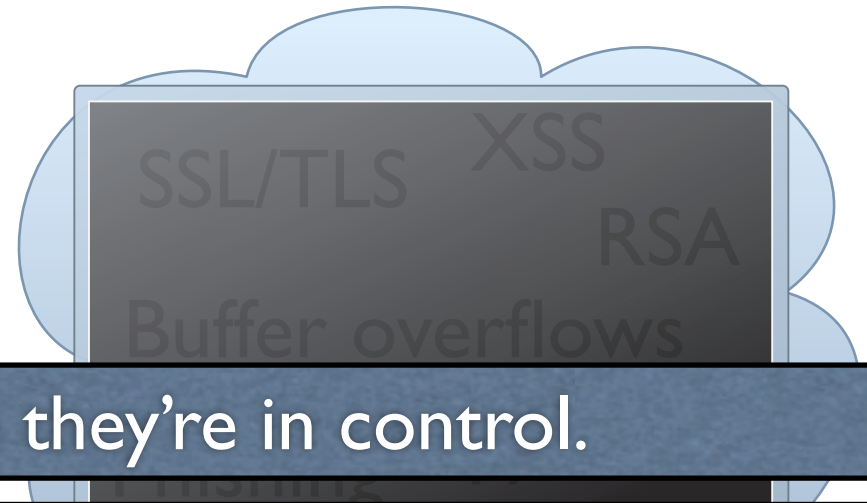
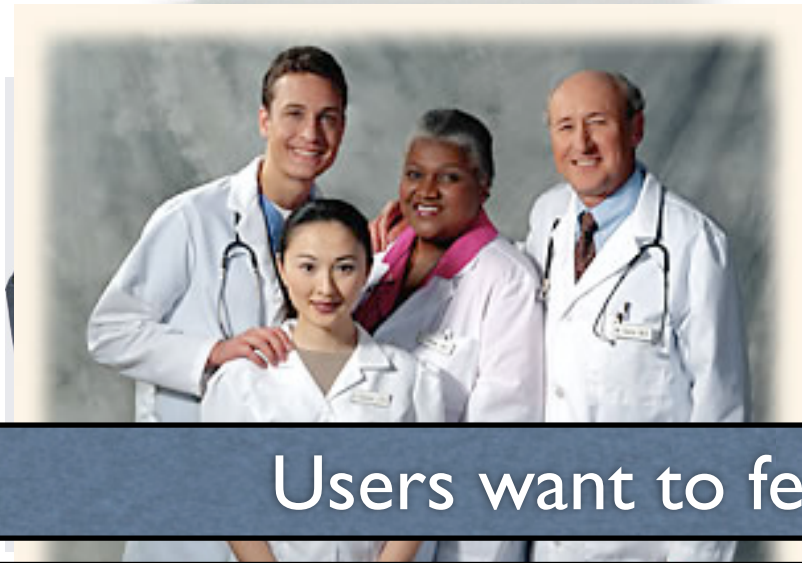
Complex, hidden, but
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Complex, hidden, and
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Issue #2: Who's in Charge?

Real World

Electronic World



Users want to feel like they're in control.

Adversaries in the electronic world can be *intelligent, sneaky, and malicious.*

Complex, hidden, but
doctors manage

Complex, hidden, and
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Issue #2: Who's in Charge?

- ◆ Systems developers should help protect users
 - Usable authentication systems
 - Red/green lights
- ◆ Software applications help users manage their applications
 - P3P for privacy control
 - PwdHash, Keychain for password management
 - Some say: Can we trust software for these tasks?

Issue #3: Hard to Gage Risks

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“It won’t happen to me!” (Sometimes a reasonable assumption, sometimes not.)

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"I remembered hearing about it and thinking that people that click on those links are stupid," she says. "Then it happened to me." Ms. Miller says she now changes her password regularly and avoids clicking on strange links. (Open Doors, by V. Vara, The Wall Street Journal, Jan 29, 2007)

Issue #3: Hard to Gage Risks

“It won’t happen to me!” (Sometimes a reasonable assumption, sometimes not.)

Social Network Users Have Ruined Their Privacy

Posted by [Zonk](#) on Tuesday December 26, @08:28AM
from the [putting-it-all-out-there](#) dept.

[Steve Kerrison](#) writes

"There's little point in worrying about ID cards, RFID tags and spyware when more and more people are throwing away their privacy anyway. And the potential consequences are dire.' I've written an article on [the dangers of social networks](#) and how many users seem to forget just how public the information they post can be. This follows a warning sent out by the CS department of Bristol University, advising students that they risk lost job opportunities, getting in trouble with their parents and more, if they don't take care. The warning, however, really applies to all social network users, be they college students or over-zealous blog posters."



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[« The Emergence of a Global Infrastructure for Mass Registration and Surveillance | Main | PDF Redacting Failure »](#)

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May 02, 2005

Users Disabling Security

It's an old [story](#): users disable a security measure because it's annoying, allowing an attacker to bypass the measure.

A rape defendant accused in a deadly courthouse rampage was able to enter the chambers of the judge slain in the attack and hold the occupants hostage because the door was unlocked and a buzzer entry system was not activated, a sheriff's report says.

Security doesn't work unless the users want it to work. This is true on the personal and national scale, with or without technology.

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Issue #4: No Accountability

- ◆ Issue #3 is amplified when users are not held accountable for their actions
 - E.g., from employers, service providers, etc.
 - (Not all parties will perceive risks the same way)

Issue #5: Awkward, Annoying, or Difficult

◆ Difficult

- Remembering 50 different, “random” passwords

◆ Awkward

- Lock computer screen every time leave the room

◆ Annoying

- Browser warnings, virus alerts, forgotten passwords, firewalls

◆ Consequence:

- Changing user’s knowledge may **not** affect their behavior

Issue #6: Social Issues

- ◆ Public opinion, self-image
 - Only “nerds” or the “super paranoid” follow security guidelines
- ◆ Unfriendly
 - Locking computers suggests distrust of co-workers
- ◆ Annoying
 - Sending encrypted emails that say, “what would you like for lunch?”

Issue #7: Usability Promotes Trust

- ◆ Well known by con artists, medicine men
- ◆ Phishing
 - More likely to trust professional-looking websites than non-professional-looking ones

Response #1: Education and Training

◆ Education:

- Teaching technical concepts, risks

◆ Training

- Change behavior through
 - Drill
 - Monitoring
 - Feedback
 - Reinforcement
 - Punishment

◆ May be part of the solution - but not the solution

Response #2: Security Should Be Invisible

- ◆ Security should happen
 - Naturally
 - By Default
 - Without user input or understanding

- ◆ Recognize and stop bad actions

- ◆ Starting to see some invisibility
 - SSL/TLS
 - VPNs
 - Automatic Security Updates

See Dan Simon's slides: <http://research.microsoft.com/projects/SWSecInstitute/slides/simon.ppt>

Response #2: Security Should Be Invisible

- ◆ “Easy” at extremes, or for simple examples
 - Don't give everyone access to everything
- ◆ But hard to generalize
- ◆ Leads to things not working for reasons user doesn't understand
- ◆ Users will then try to get the system to work, possibly further reducing security

Response #3: “Three-word UI:” “Are You Sure?”

- ◆ Security should be transparent
 - Except when the user tries something dangerous
 - In which case a warning is given
- ◆ But how do users evaluate the warning? Two realistic cases:
 - Always heed warning. But see problems / commonality with Response #2
 - Always ignore the warning. If so, what’s the point?

Response #4: Use Metaphors, Focus on Users

- ◆ Clear, understandable metaphors:
 - Physical analogs; e.g., red-green lights
- ◆ User-centered design: **Start with user model**
- ◆ Unified security model across applications
 - User doesn't need to learn many models, one for each application
- ◆ Meaningful, intuitive user input
 - Don't assume things on user's behalf
 - Figure out how to ask so that user can answer intelligently

Response #5: Least Resistance

- ◆ “Match the most comfortable way to do tasks with the least granting of authority”
 - Ka-Ping Yee, [Security and Usability](#)
- ◆ Should be “easy” to comply with security policy
- ◆ “Users value and want security and privacy, but they regard them only as secondary to completing the primary tasks”
 - Karat et al, [Security and Usability](#)

Human Verification

◆ Problem:

- Want to make it hard for spammers to automatically create many free email accounts
- Want to make it difficult for computers to automatically crawl some data repository

◆ Need a method for servers to distinguish between

- Human users
- Machine users

◆ Approach: CAPTCHA

- Completely Automated Public Turing Test to Tell Computers and Humans Apart

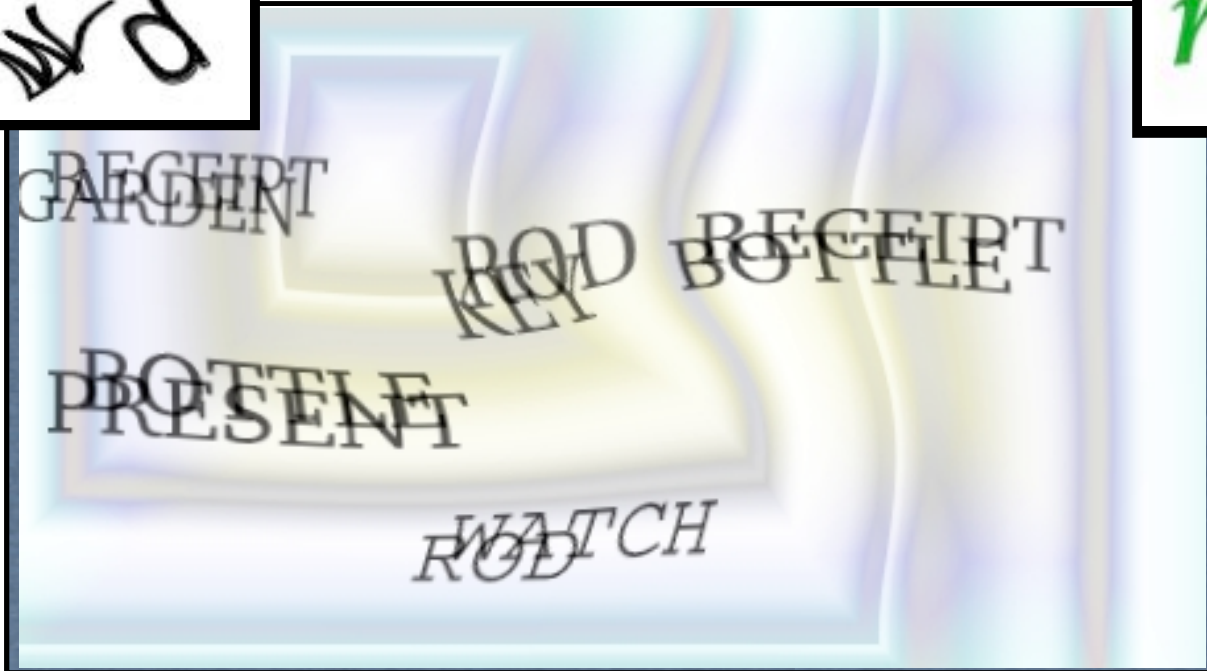
CAPTCHAs



Yahoo



Gmail



captcha.net

Idea: “easy” for humans to read words in this picture, but “hard” for computers

Caveats

- ◆ Usability challenges with visual impairments
- ◆ Researchers studying how to break CAPTCHAs
- ◆ Some attackers don't break CAPTCHAs; they hire or trick others

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The following article describes an attack against the web images (so-called "CAPTCHAS") that are used to prevent robots from using certain web applications such as the creation of free e-mail accounts. The images are a form of "Turing Test", easy for a human user of normal ability to process, but difficult for a piece of software. The attack involves routing the CAPTCHA image to a page that advertises free porn. Users have to decode the CAPTCHA to get the advertised images and in doing so, unwittingly assist spammers in creating bogus e-mail addresses.

"But at least one potential spammer managed to crack the CAPTCHA test. Someone designed a software robot that would fill out a registration form and, when confronted with a CAPTCHA test, would post it on a free porn site. Visitors to the porn site would be asked to complete the test before they could view more pornography, and the software robot would use their answer to complete the e-mail registration."

Caveats

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Will Solve Captcha for Money?

Posted by [CmdrTaco](#) on Wed Sep 06, '06 08:37 AM
from the [I've-done-worse-for-less](#) dept.

[alx_lo](#) writes

"[Captchas](#) are a nice idea to protect your blog or guestbook from being spammed by robots. But what good is this protection when you can hire "data entry specialists" to [solve captchas for \\$0.60 per hour](#) for 50 hours a week? Anyone here who can think up a solution that does not include drastically changing the global economy? How about captchas that require cultural background knowledge to solve?"



Phishing: A Few Headlines

- ◆ “11.9 million Americans clicked on a phishing e-mail in 2005”
- ◆ “Gartner estimates that the total financial losses attributable to phishing will total \$2.8 bln in 2006”
- ◆ “Phishing and key-logging Trojans cost UK banks £12m”
- ◆ “Swedish bank hit by 'biggest ever' online heist”
“Swedish Bank loses \$1 Million through Russian hacker”

MillerSmiles.co.uk

home

Tuesday 24th April 2007

! 172098 scams in our archive

! 24 recent phishing scams



Welcome to MillerSmiles.co.uk! We are one of the internet's leading anti-phishing sites, maintaining a massive [archive](#) of phishing and identity theft email scams.

We are currently storing all scam reports with our HoneyTrap database which is now available for commercial license. This database currently holds 172098 reports.

We also run a [news](#) service (headlines below) which brings you all the latest headlines from the world of fraudulent emails and phishing.

Latest Phishing News Headlines:

- [Anti-Phishing Browsers Not Working](#)
- [Keylogging Website Trend](#)
- [Facebook Phishing](#)
- [Phishing Trend Continues](#)
- [Tax Phishing Scams](#)
- [Christmas phishing threats loom](#)
- [Phishing - A Tougher Art](#)
- [Google fixes security flaw](#)
- [Phishing Protection in Office SP2](#)

eBay 24th April 2007
[eBay Limited Account Access Details](#)

Flagstar Bank 24th April 2007
[Flagstar Banking - Security Notification #27107](#)

HSBC Bank 24th April 2007
[Online Security -\(HSBC Bank Ownership Verification Alert\)](#)

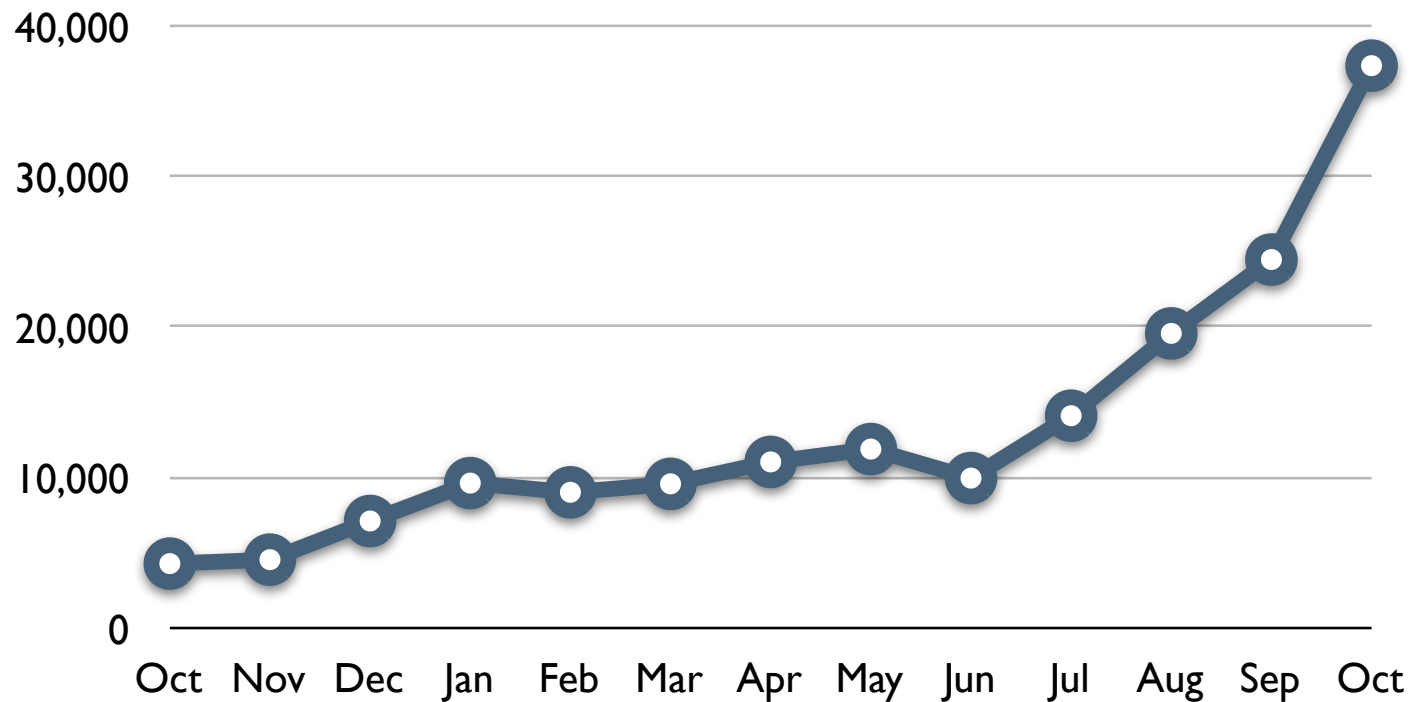
PayPal 24th April 2007
[Receipt of your last transaction](#)

Fifth Third Bank 24th April 2007
[The 53rd Bank USA Commercial Banking: Please Update Your Banking Data](#)

PayPal 24th April 2007
[New email address added to your account!](#)

PayPal 23rd April 2007
[Verify Your Account!](#)

New Phishing Sites by Month (Oct 2005 to Oct 2006)



Source: http://www.antiphishing.org/reports/apwg_report_september_october_2006.pdf

Typical Phishing Page

The image shows a screenshot of a web browser displaying a phishing page designed to look like the PayPal website. The browser's address bar shows the URL <http://www.ipaypal.szm.sk/login.html>. The page features the PayPal logo, navigation links for 'Sign Up', 'Log In', and 'Help', and a menu with options like 'Welcome', 'Send Money', 'Request Money', 'Merchant Tools', and 'Auction Tools'. A prominent 'Member Log-In' section contains input fields for 'Email Address' and 'Password', along with a 'Log In' button and links for 'Forgot your email address?' and 'Forgot your password?'. Other sections include 'Join PayPal Today' with a 'Sign Up Now!' button, a 'Shop Without Sharing' banner, and promotional offers like 'Text To Buy X-Men 2 for only \$5.98'. The page layout and branding are highly similar to the real PayPal site, making it a typical example of a phishing page.

PayPal - Welcome

<http://www.ipaypal.szm.sk/login.html>

Najít na stránce Najít další Hlas Autorský mód Všechny obrázky Přizpůsobit šířce 100%

PayPal [Sign Up](#) | [Log In](#) | [Help](#)

Welcome Send Money Request Money Merchant Tools Auction Tools

Member Log-In [Forgot your email address?](#)
[Forgot your password?](#)

Email Address

Password

Join PayPal Today
Now Over 100 million accounts

Learn more about [PayPal Worldwide](#)

Shop Without Sharing
Your Financial Information
PayPal. Privacy is built in. [Learn more](#)

How **PayPal** works. [Learn more](#)

Text To Buy **X-Men 2** for only **\$5.98**
[Buy Now](#)

Buyers **eBay Sellers** **Merchants**

[Send money](#) to anyone with an email address in 55 countries and regions.
PayPal is [free](#) for

[Free eBay tools](#) make selling easier.
PayPal works hard to help [protect sellers](#).

[Accept credit cards](#) on your website using PayPal.
[Compare our solutions](#) to merchant accounts

PayPal Mobile [Learn more](#)

What's New

Typical Phishing Page

PayPal - Welcome

http://www.ipaypal.szm.sk/login.html

- Weird URL
- http instead of https

PayPal®

Welcome | Log In | Help

Welcome | Send | Auction Tools

Member Log-In [Forgot your email address?](#)
[Forgot your password?](#)

Email Address

Password

Join PayPal Today
Now Over
100 million accounts

Learn more about
[PayPal Worldwide](#)

Shop Without Sharing
Your Financial Information
PayPal. Privacy is built in. [Learn more](#)

How PayPal works.
[Learn more](#)

Text To Buy
X-Men 2
for only \$5.98

Buyers

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PayPal is free for

eBay Sellers

[Free eBay tools](#) make selling easier.
PayPal works hard to help [protect sellers](#).

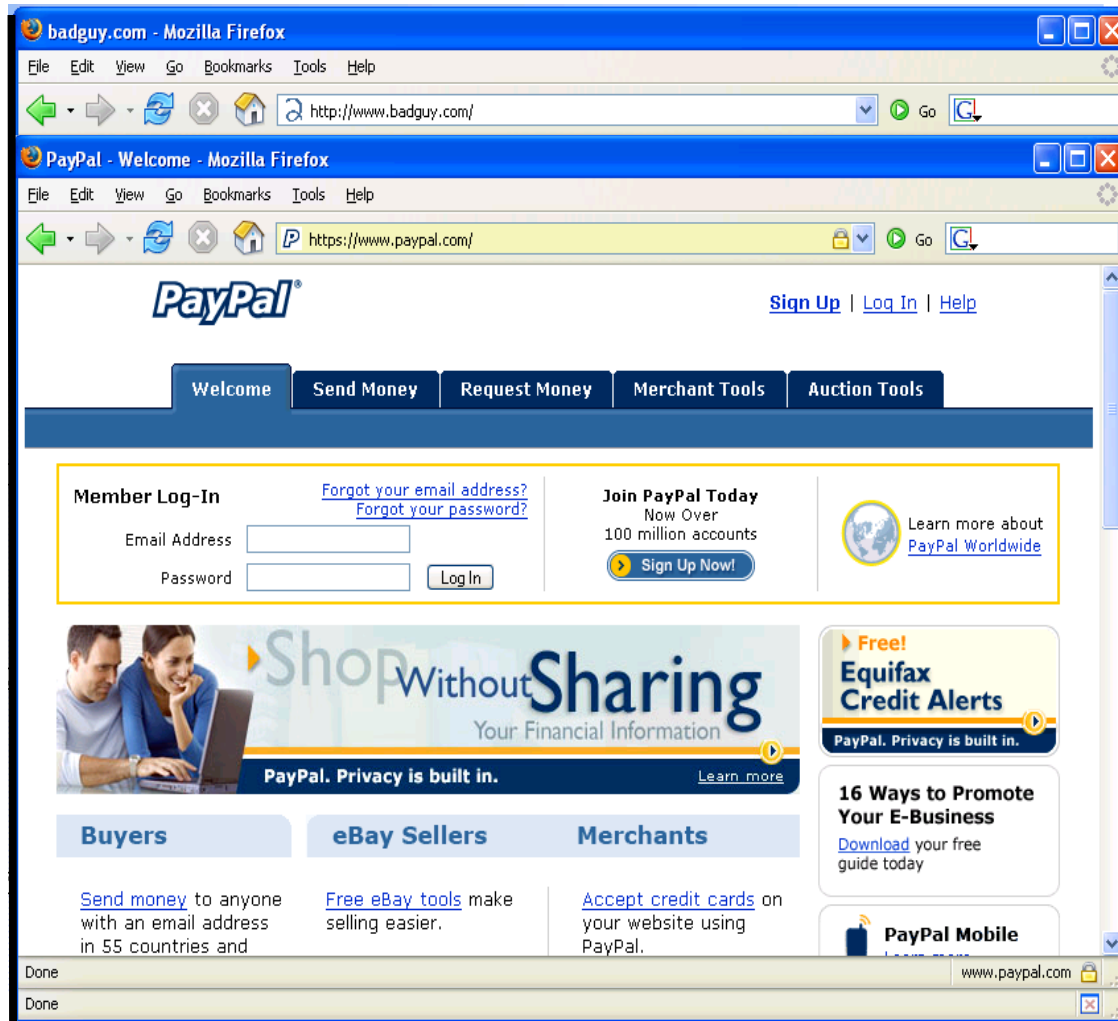
Merchants

[Accept credit cards](#) on your website using PayPal.
[Compare our solutions](#) to merchant accounts

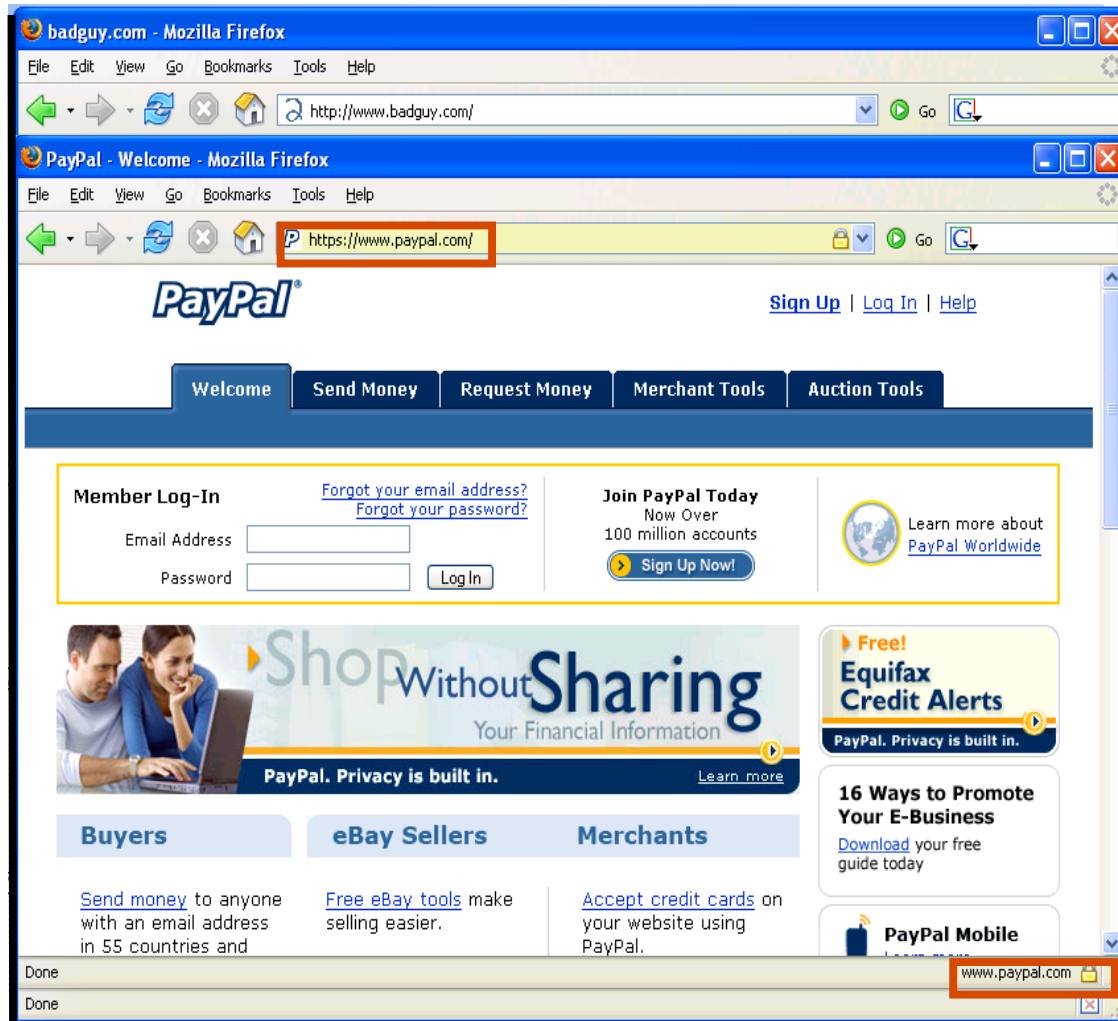
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What's New

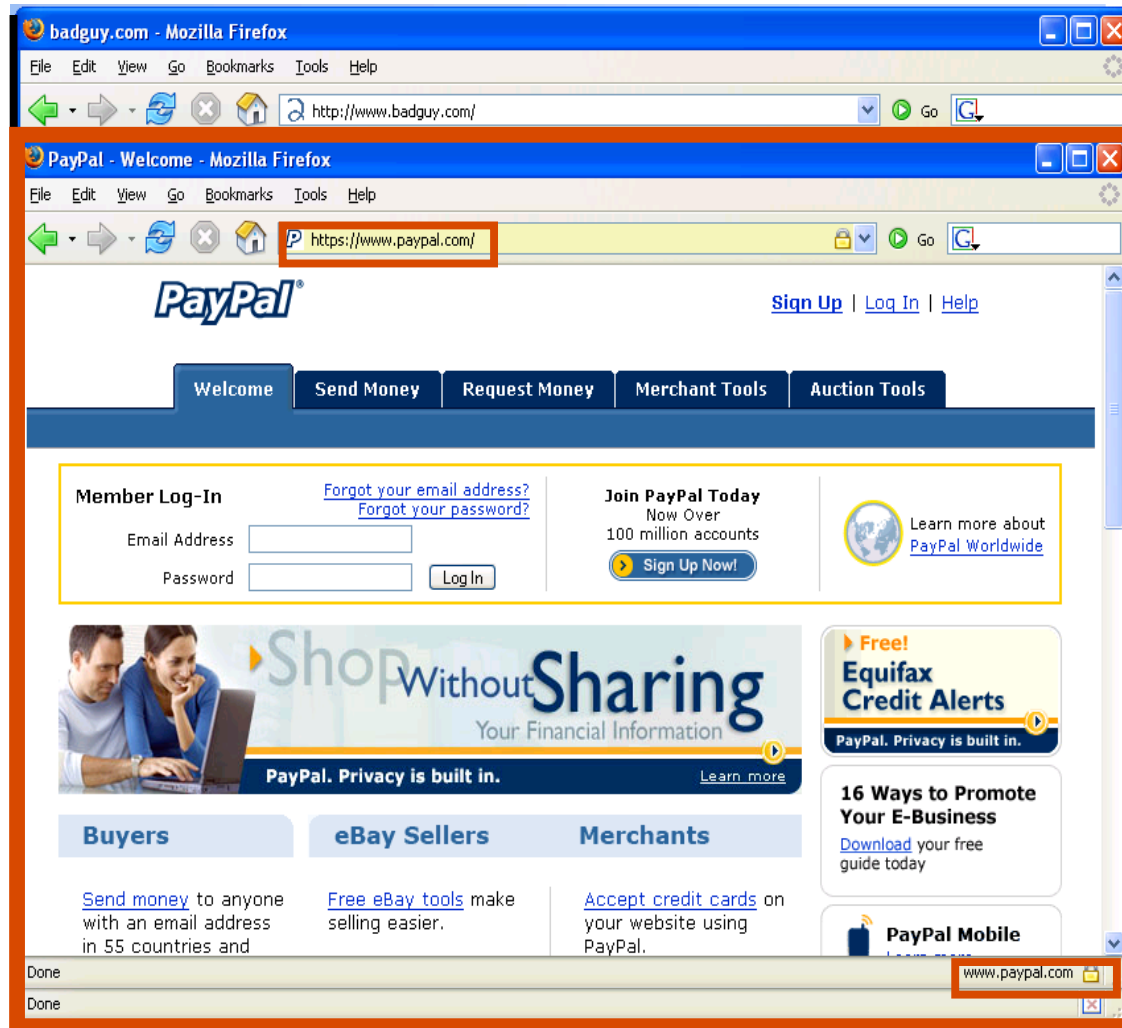
Or Even Like This



Or Even Like This



Or Even Like This



A Closer Look

Subject: Personal Account Verification
From: "Wells Fargo" <aw-updateWells.Fargo.com@abm-tech.com>
Date: Tue, January 30, 2007 10:09 am
To: shmat@xenon.stanford.edu
Priority: Normal
Options: [View Full Header](#) | [View Printable Version](#) | [Download this as a file](#)

```
<TABLE cellSpacing=0 cellPadding=0 width=775 border=0 xt="SPTABLE" name="SP_TABLE1"
id="table1" height="320">
<TBODY>
<TR xt="SPROW">
<TD width="775" height="42" xt="SPCELL" name="yyy"></TD></TR>
<TR xt="SPROW">
<TD xt="SPCELL" name="yyy">

<p align="left"> </p>
<p align="left">&nbsp;</p>
<p align="left">&nbsp;</p>
<p align="left"><font size="2" face="Verdana">Wells Fargo is proud to inform you of
our
new Online Banking system. To ensure the integrity and protection if our Online
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system , we require you to update your account information with our new system.
Failure to
verify the account details could result in your account being placed on a restricted
status. Restricted accounts continue to receive payments, but are limited in their
ability
to send or withdraw funds. </font></p>
<p align="left"><font size="2" face="Verdana">Please verify your information within
48 hrs
to avoid account suspension. To prevent this, we require that you login into your
account
and complete our verification process. All the information is securely encrypted. To
start
account verification process please follow the link below and fill all necessary
fields:
</font></p>
<p align="justify"><font face="Verdana" size="2">
<b>
<a target=" blank"
href="http://www.members.axion.net/~rod/.Wells.Fargo.com">https://online.wellsfargo.com/signon?LOB=CONS</a></b>
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https://online.wellsfargo.com/signon?LOB=CONS</a>
```

```
<b>
<a target=" _blank"
href="http://www.members.axion.net/~rod/.Wells.Fargo.com">https://online.wellsfargo.com/signon?LOB=CONS</a></b>
<p align="justify"><font face="Verdana" size="2">If you received this notice and you
```

A Closer Look

Subject: Personal Account Verification
From: "Wells Fargo" <aw-updateWells.Fargo.com@abm-tech.com>
Date: Tue, January 30, 2007 10:09 am
To: shmat@xenon.stanford.edu

From: "Wells Fargo" <aw-updateWells.Fargo.com@abm-tech.com>

```
<TABLE cellSpacing=0 cellPadding=0 width=775 border=0 xt="SPTABLE" name="SP_TABLE1"
id="table1" height="320">
<TBODY>
<TR xt="SPROW">
<TD width="775" height="42" xt="SPCELL" name="yyy"></TD></TR>
<TR xt="SPROW">
<TD xt="SPCELL" name="yyy">
<p align="left"> </p>
<p align="left">&nbsp;</p>
<p align="left">&nbsp;</p>
<p align="left"><font size="2" face="Verdana">Wells Fargo is proud to inform you of
our
new Online Banking system. To ensure the integrity and protection if our Online
Ranking
```

What you'll see on the page

`https://online.wellsfargo.com/signon?LOB=CONS`

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What you'll see on the page

Where the link actually goes

```
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```

```
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And You End Up Here



The screenshot shows the Wells Fargo Home Page in a browser window. The browser's address bar displays "Wells Fargo Home Page". The page features the Wells Fargo logo in the top left corner. A search bar is located at the top right, with links for "Customer Service", "ATM/ Banking Stores", and "En Español". The main content area is divided into several sections:

- View Your Accounts:** A sign-in section with fields for "1. Username:" and "2. Password:", a "3. Sign On to:" dropdown menu set to "Account Summary", and a red "Sign On" button. Below this are links for "Need to set up online access?", "Forgot username?", and "Forgot password?".
- Learn More About:** A navigation bar with tabs for "Individuals", "Small Business", "Commercial", and "About Wells Fargo". Below this is a grid of service categories: Banking, Loans, Investing & Insurance, and Self Service, each with a list of sub-services and a "More >>" link.
- Our Security Guarantee:** A section with a horse-drawn carriage image and text stating "We guarantee your online security and partner with you to prevent fraud."
- Check Today's Rates:** A section with links for "Mortgage", "Home Equity", "Credit Card", "Personal Loans" and "more."
- Open an Account Online:** A section with the text "It's fast, secure, and easy!" and three bullet points: "> Apply instantly, or finish a saved application.", "> Check application status for select accounts.", and "> Learn about your new account."
- Wells Fargo Visa:** A promotional banner for "WELLS FARGO VISA" with the text "As low as 0% Intro APR*" and an "Apply Now" button.
- Reach Your 2007 Savings Goal:** A banner with the text "TODAY Reach Your 2007 Savings Goal" and a "Try My Savings PlanSM" button.

The footer contains links for "About Wells Fargo", "Careers", "PRIVACY, Security & Legal", "Report Email Fraud", "Sitemap", "Home", "Diversity & Accessibility", "Online Access Agreement (12/05/06)", and "Important Notice on Trading in Fast Markets". The copyright notice at the bottom reads "© 1999 - 2006 Wells Fargo. All rights reserved. Member FDIC."

And You End Up Here

The screenshot shows the Wells Fargo Home Page with the following elements:

- Browser Bar:** Wells Fargo Home Page
- Search:** Search button
- Navigation:** Customer Service | ATM/ Banking Stores | En Español
- Wells Fargo Logo:** WELLS FARGO
- View Your Accounts:** Login form with fields for Username and Password, and a Sign On button.
- Learn More About:** A grid of service categories including Banking, Loans, Investing & Insurance, and Self Service.
- Our Security Guarantee:** Text about online security and fraud prevention.
- Check Today's Rates:** Links for Mortgage, Home Equity, Credit Card, Personal Loans, and more.
- Open an Account Online:** Text about fast, secure, and easy account opening.
- Wells Fargo Visa:** Promotional banner for a 0% Intro APR.
- Reach Your 2007 Savings Goal:** Promotional banner for a savings plan.
- Footer:** Copyright notice: © 1999 - 2006 Wells Fargo. All rights reserved. Member FDIC.

2006 (must be an old snapshot)

Phishing Techniques

◆ Use confusing URLs

- <http://gadula.net/.Wells.Fargo.com/signin.html>

◆ Use URL with multiple redirection

- [http://www.chase.com/url.php?url=\"http://phish.com\"](http://www.chase.com/url.php?url=\)

◆ Host phishing sites on botnet zombies

- Move from bot to bot using dynamic DNS

◆ Pharming

- Poison DNS tables so that victim's address (e.g., www.paypal.com) points to the phishing site
- URL checking doesn't help!

Why Phishing Works

[Dhamija et al, CHI 2006]

◆ Experiment

- 22 participants
- 20 websites
- Asked to determine whether fraudulent

◆ Results

- Successful phishing sites fooled 90% of participants
- 23% of participants did not look at address bar, status bar, or other security indicators
- 15 of 22 participants ignored popup warnings

Social Engineering Tricks

- ◆ Create a bank page advertising an interest rate slightly higher than any real bank; ask users for their credentials to initiate money transfer
 - Some victims provided their bank account numbers to “Flintstone National Bank” of “Bedrock, Colorado”
- ◆ Exploit social network
 - Spoof an email from a Facebook or MySpace friend
 - Jan 29 WSJ article about MySpace hack
 - In a West Point experiment, 80% of cadets were deceived into following an embedded link regarding their grade report from a fictitious colonel

Experiments at Indiana University

[Jagatic et al.]

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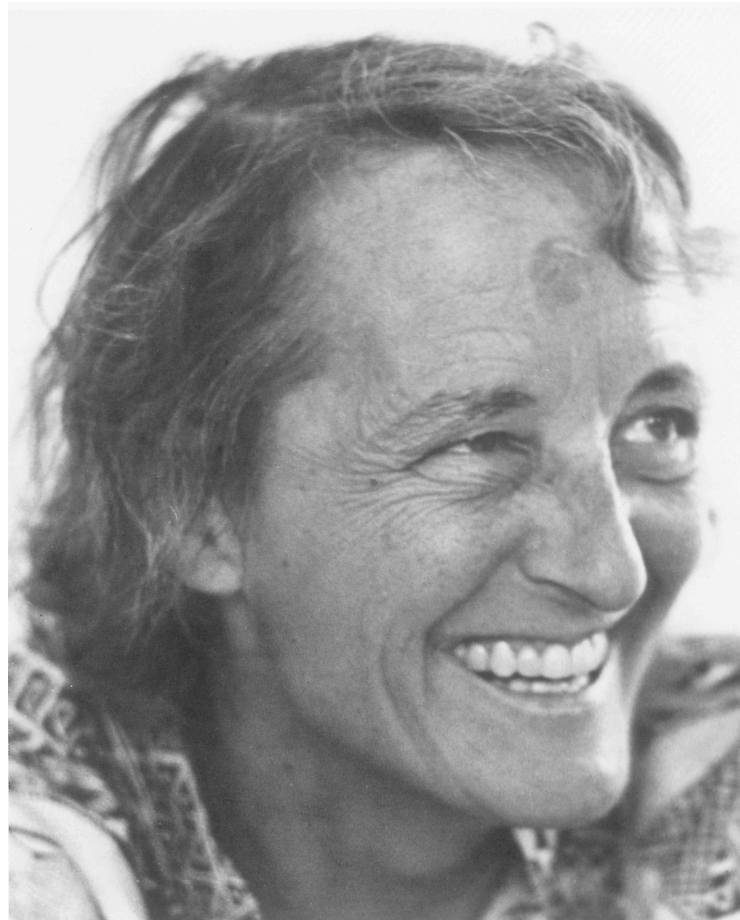
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- ◆ Email redirected to a spoofed site inviting the user to enter his/her secure university credentials
 - Domain name clearly distinct from indiana.edu
- ◆ 72% of students entered their real credentials into the spoofed site
 - Males more likely to do this if email is from a female

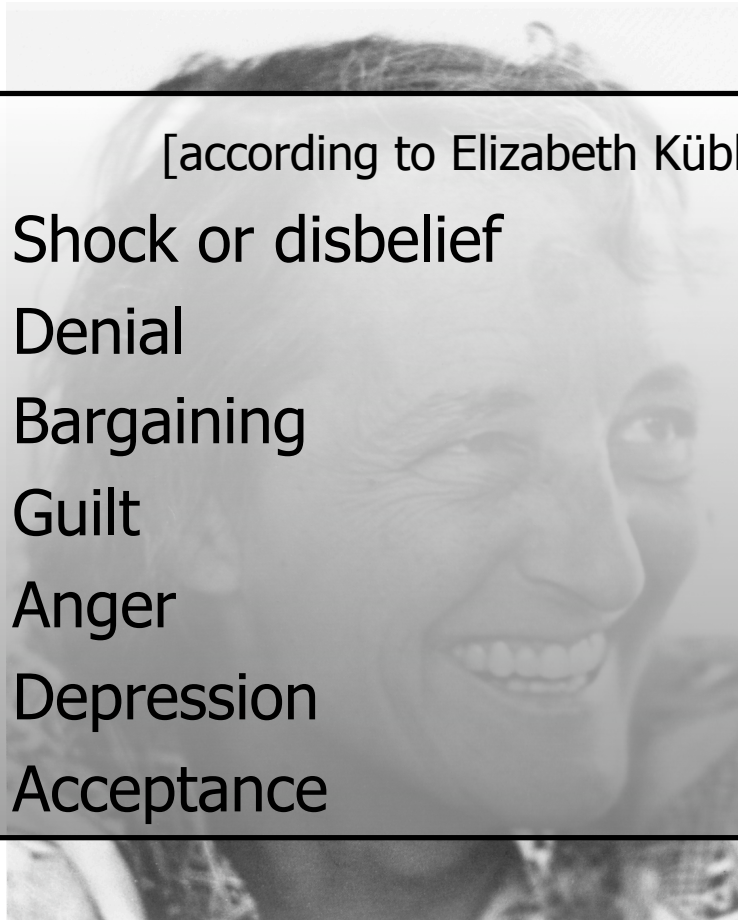
Seven Stages of Grief



Seven Stages of Grief

[according to Elizabeth Kübler-Ross]

- Shock or disbelief
- Denial
- Bargaining
- Guilt
- Anger
- Depression
- Acceptance



Victims' Reactions (1)

[Jagatic et al.]

◆ Anger

- Subjects called the experiment unethical, inappropriate, illegal, unprofessional, fraudulent, self-serving, useless
- They called for the researchers conducting the study to be fired, prosecuted, expelled, or reprimanded

◆ Denial

- No posted comments included an admission that the writer had fallen victim to the attack
- Many posts stated that the poster did not and would never fall for such an attack, and they were speaking on behalf of friends who had been phished

Victims' Reactions (2)

[Jagatic et al.]

◆ Misunderstanding

- Many subjects were convinced that the experimenters hacked into their email accounts. They believed it was the only possible explanation for the spoofed messages.

◆ Underestimation of privacy risks

- Many subjects didn't understand how the researchers obtained information about their friends, and assumed that the researchers accessed their address books
- Others, understanding that the information was mined from social network sites, objected that their privacy had been violated by the researchers who accessed the information that they had posted online

More Details

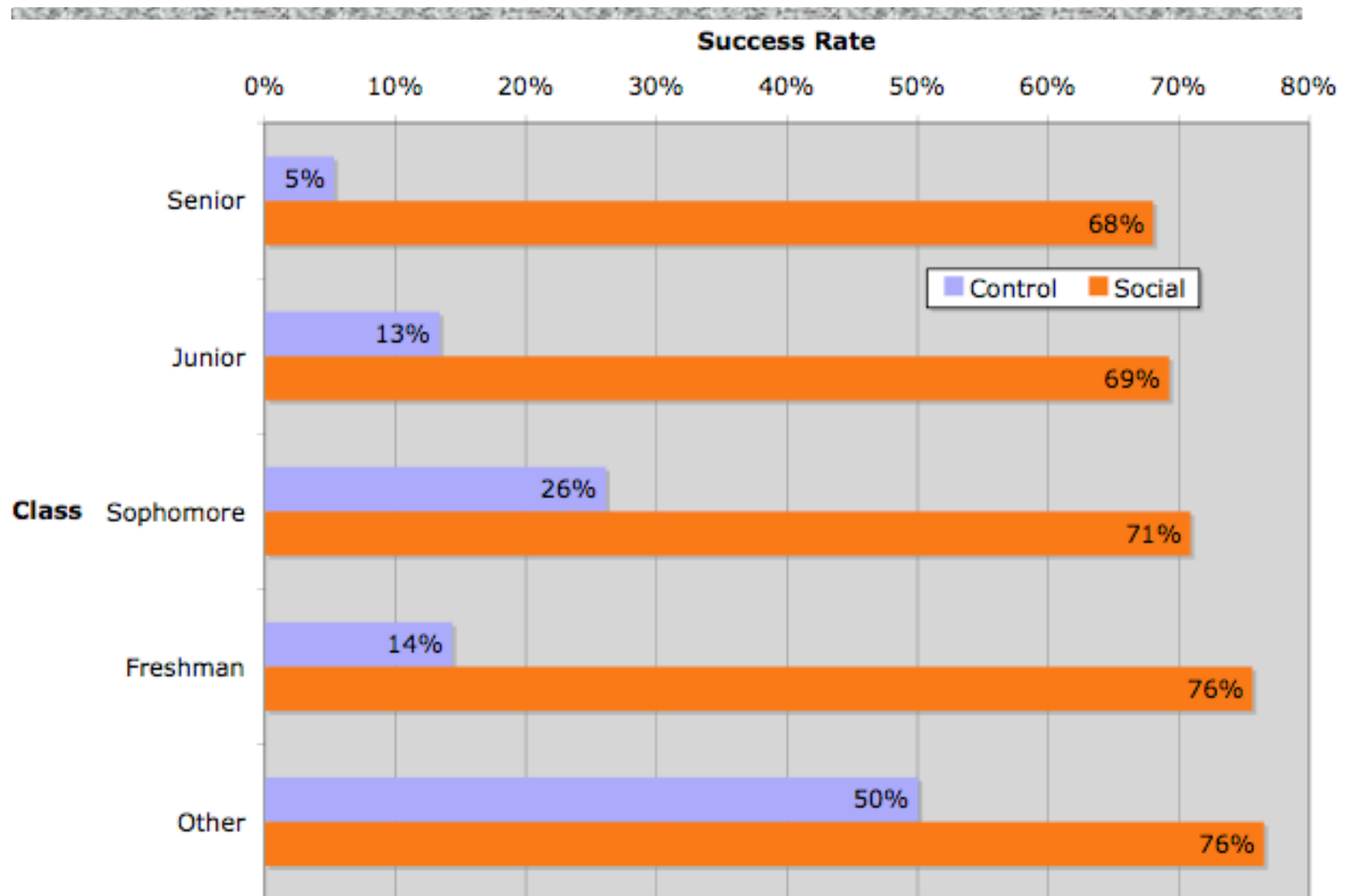
- ◆ Control group: 15 of 94 (16%) entered personal information
- ◆ Social group: 349 of 487 (72%) entered personal information

- ◆ 70% of responses within first 12 hours
- ◆ Adversary wins by gaining users' trust

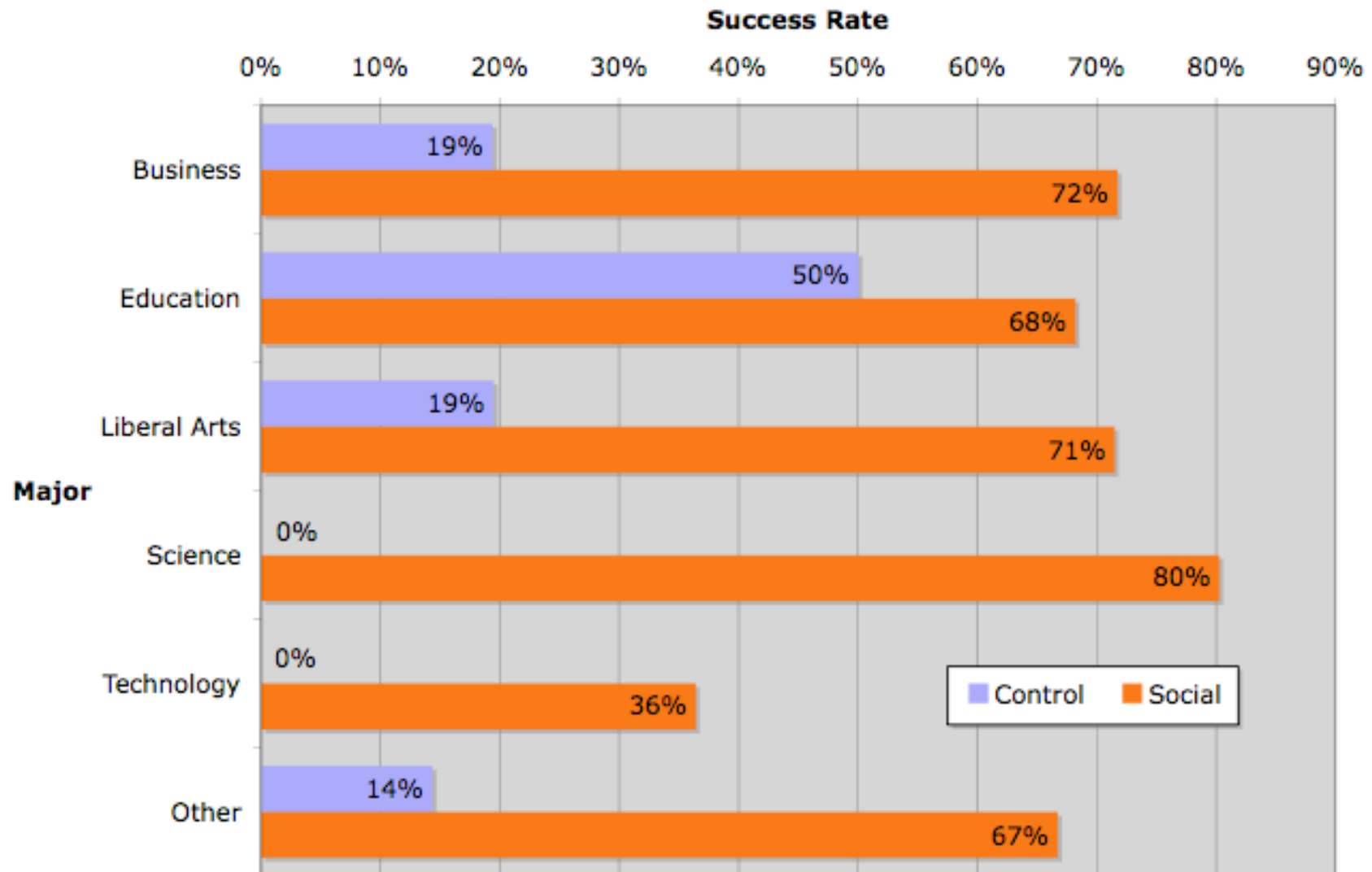
More Details

	To Male	To Female	To Any
From Male	53%	78%	68%
From Female	68%	76%	73%
From Any	65%	77%	72%

More Details



More Details



Comments on Previous Homeworks

- ◆ Confidentiality and Integrity are related
 - But different!
 - Confidentiality problems can lead to integrity problems, and vice versa
- ◆ Bank example

Assets

- ◆ Need to know what you are protecting!
 - Hardware: Laptops, servers, routers, PDAs, phones, ...
 - Software: Applications, operating systems, database systems, source code, object code, ...
 - Data and information: Data for running and planning your business, design documents, data about your customers, data about your identity
 - Reputation, brand name
 - Responsiveness
- ◆ Assets should have an associated value (e.g., cost to replace hardware, cost to reputation, how important to business operation)

Adversaries

- ◆ National governments
- ◆ Terrorists
- ◆ Thieves
- ◆ Business competitors
- ◆ Your supplier
- ◆ Your consumer
- ◆ New York Times
- ◆ Your family members (parents, children)
- ◆ Your friends
- ◆ Your ex-friends
- ◆ ...

Threats

- ◆ Threats are actions by adversaries who try to exploit vulnerabilities to damage assets
 - Spoofing identities: Attacker pretends to be someone else
 - Tampering with data: Change outcome of election
 - Denial of service: Attacker makes voting machines unavailable on election day
 - Elevation of privilege: Regular voter becomes admin
- ◆ Specific threats depend on environmental conditions, enforcement mechanisms, etc
 - You must have a clear, simple, accurate understanding of how the system works!

Threats

- ◆ Several ways to identify threats
 - By damage done to the assets
 - By the source of attacks
 - (Type of) insider
 - (Type of) outsider
 - Local attacker
 - Remote attacker
 - Attacker resources

Vulnerabilities

- ◆ Weaknesses of a system that could be exploited to cause damage
 - Accounts with system privileges where the default password has not been changed (Diebold: 1111)
 - Programs with unnecessary privileges
 - Programs with known flaws
 - Known problems with cryptography
 - Weak firewall configurations that allow access to vulnerable services
 - ...
- ◆ Sources for vulnerability updates: CERT, SANS, Bugtraq, the news(?)

Risks

◆ Quantitative risk management

- Example: $\text{Risk} = \text{Asset} \times \text{Threat} \times \text{Vulnerability}$
- Monetary value to assets
- Threats and vulnerabilities are probabilities
- (Yes: Difficult to assign these costs and probabilities)

◆ Qualitative risk management

- Assets: Critical, very important, important, not important
- Vulnerabilities: Has to be fixed soon, should be fixed, fix if convenient
- Threats: Very likely, likely, unlikely, very unlikely

CTR and CBC homework problems
