Reinforcing bad behaviour: the misuse of security indicators on popular websites

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Indiana University — April 26, 2011

How can users tell when a website is secure?

“secure” = “safe to enter personal information”

Welcome to Facebook

http://www.facebook.com/

facebook

Email

Password

Login

Keep me logged in

Forgot your password?

Facebook helps you connect and share with the people in your life.

Sign Up

It's free, and always will be.

First Name:

Last Name:

Your Email:

Re-enter Email:

New Password:

I am: Select Sex:

Birthday: Month: Day: Year:

Why do I need to provide this?

Sign Up

Create a Page for a celebrity, band or business.

English (US) Español Português (Brasil) Français (France) Deutsch Italiano العربية हिन्दी 中文(简体) 日本語 »

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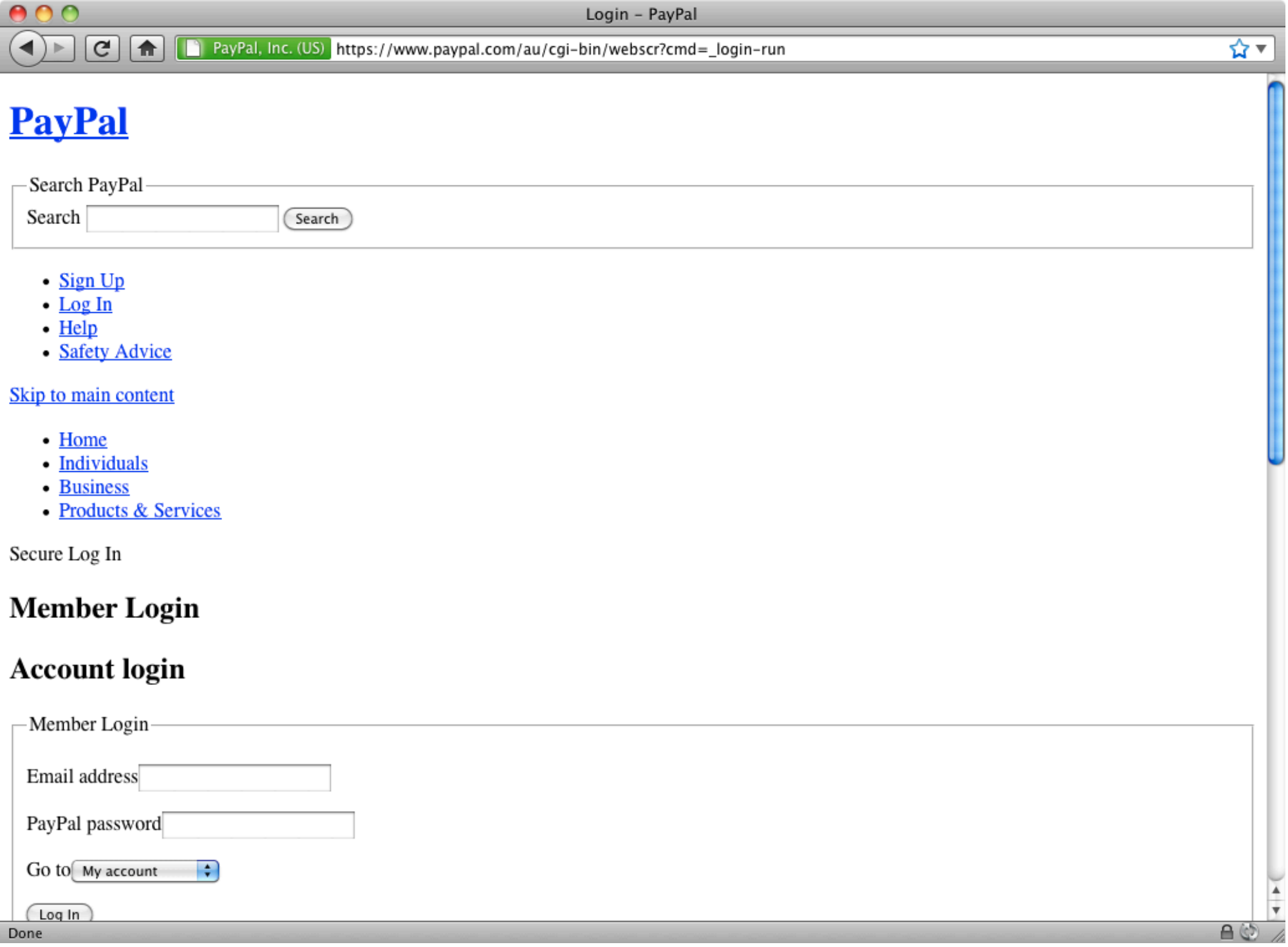
Done


Login - PayPal
PayPal, Inc. (US)
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PayPal
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Secure Log In
Member Login
Account login
Member Login
Email address
PayPal password
Go to
My account
Log In
Done

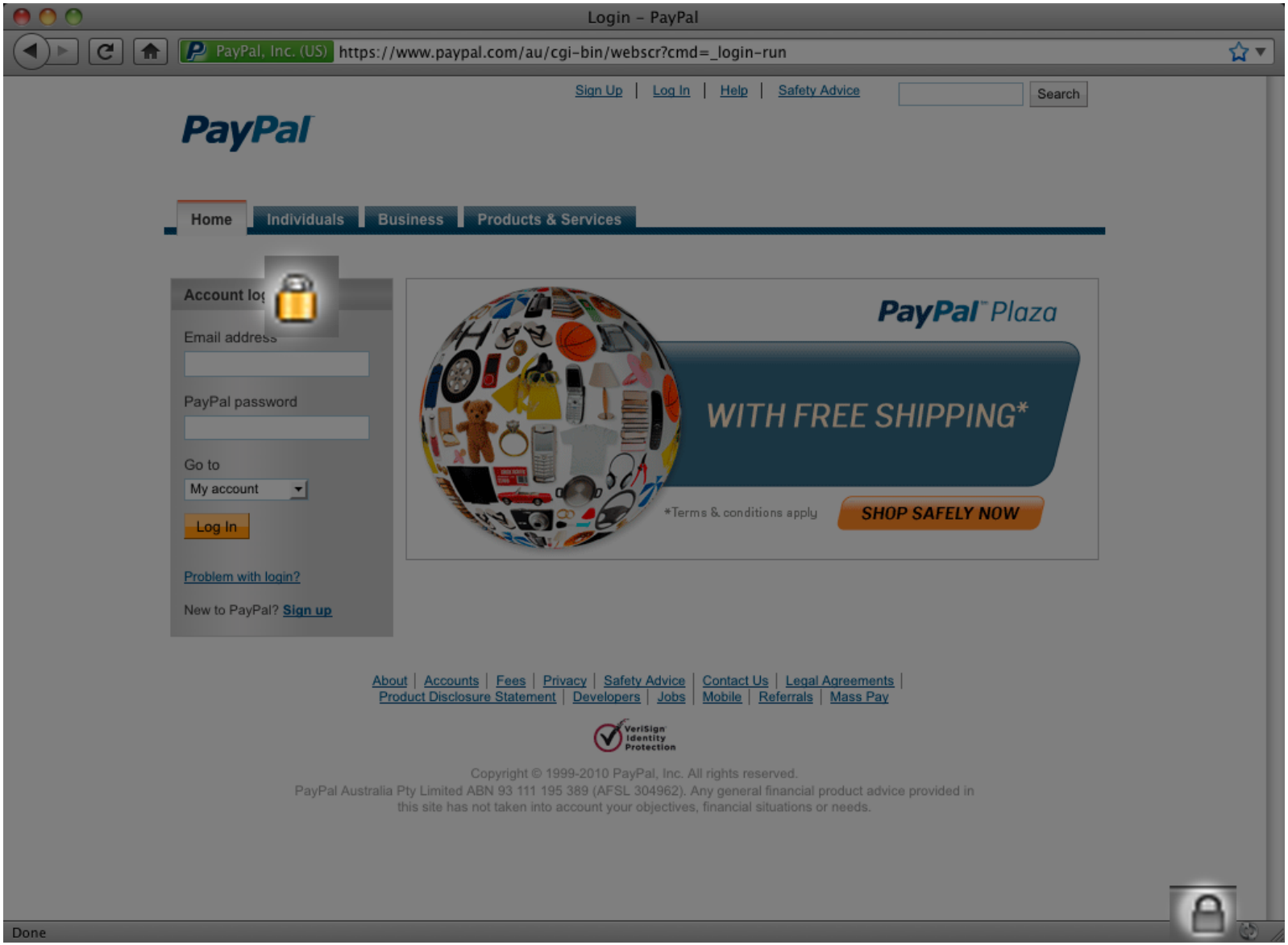
What criteria do people use to decide if a website is secure?

Consider criteria identified by Whalen and Inkpen[1] through eye-tracking and subject interviews.

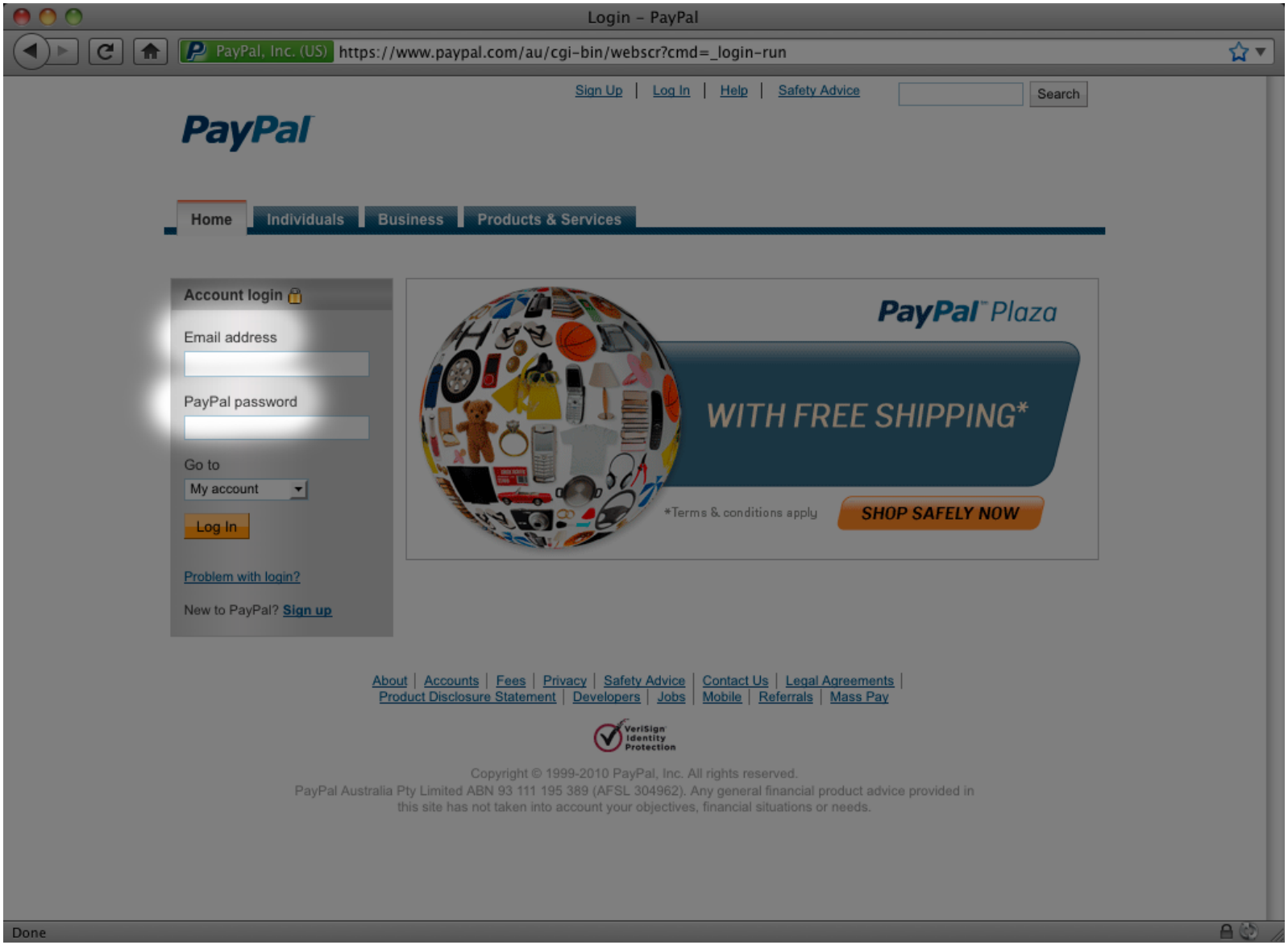
[1] Whalen, Inkpen. Gathering evidence: use of visual security cues in web browsers. *Graphics Interface*, 112:137–144 (2005)

“type of site” – 88%

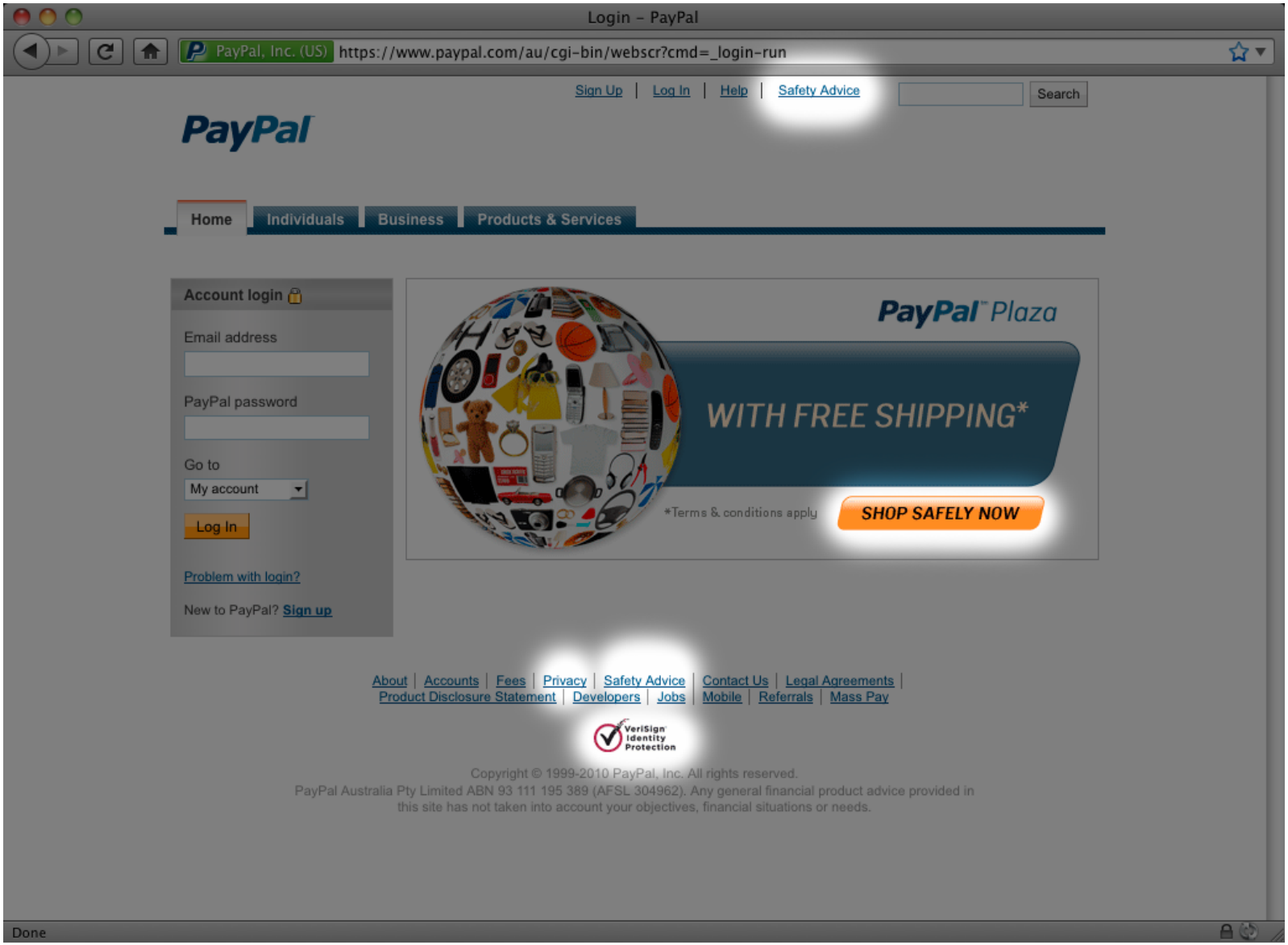
“lock or key icon” – 75%



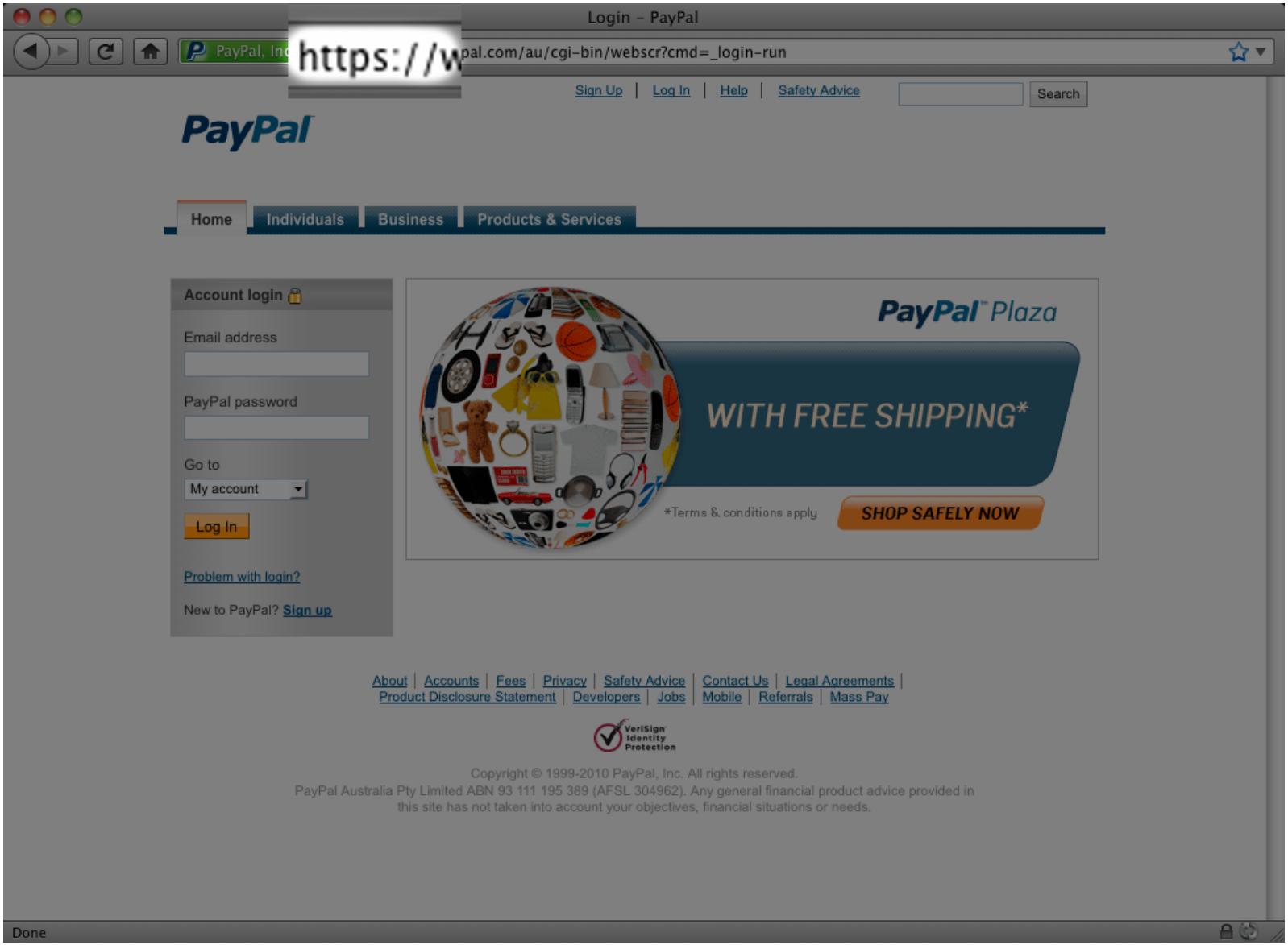
“type of information” – 69%



“site statements” – 50%



“https” – 50%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pal.com/au/cgi-bin/webscr?cmd=_login-run
Sign Up | Log In | Help | Safety Advice
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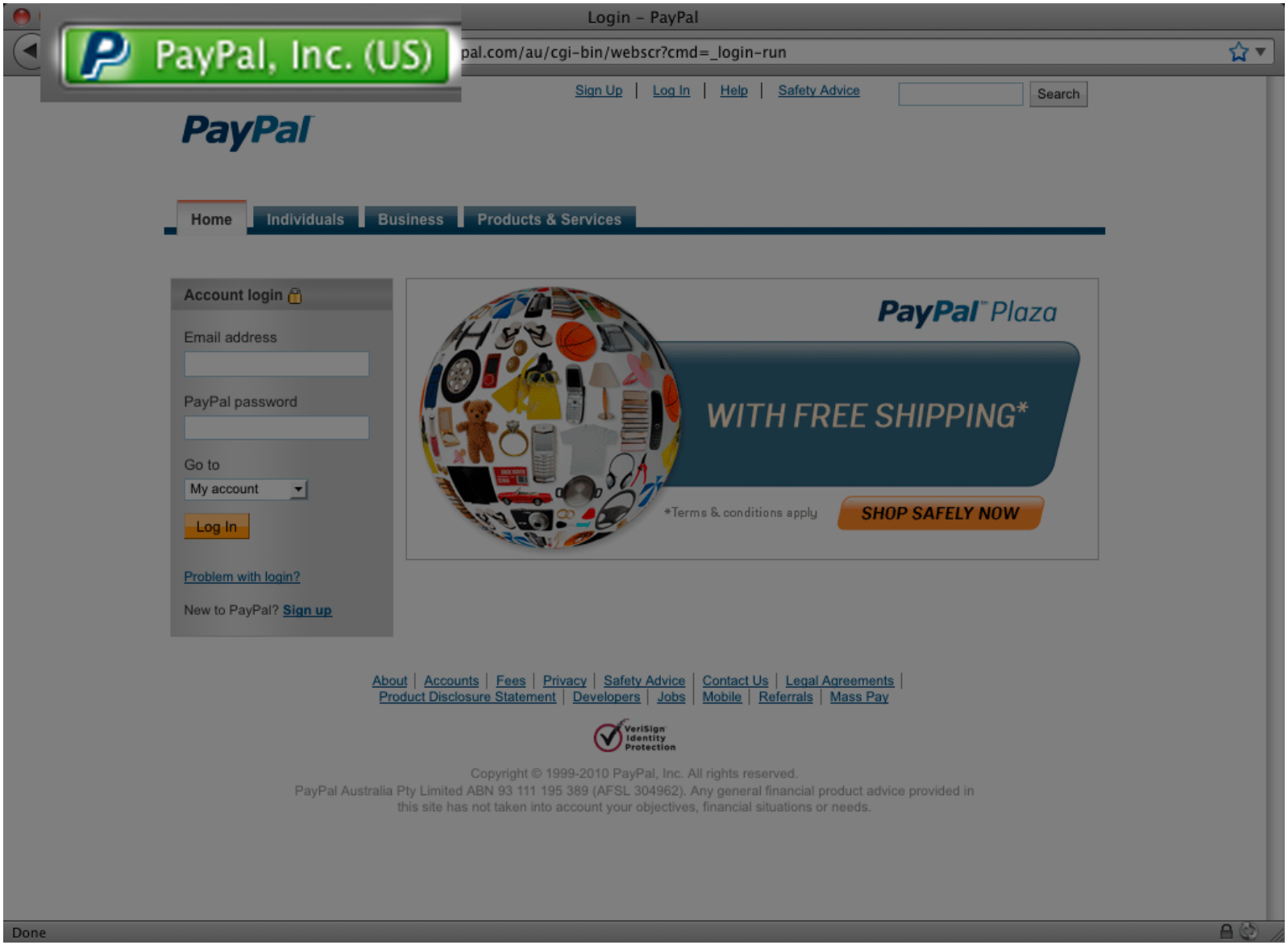
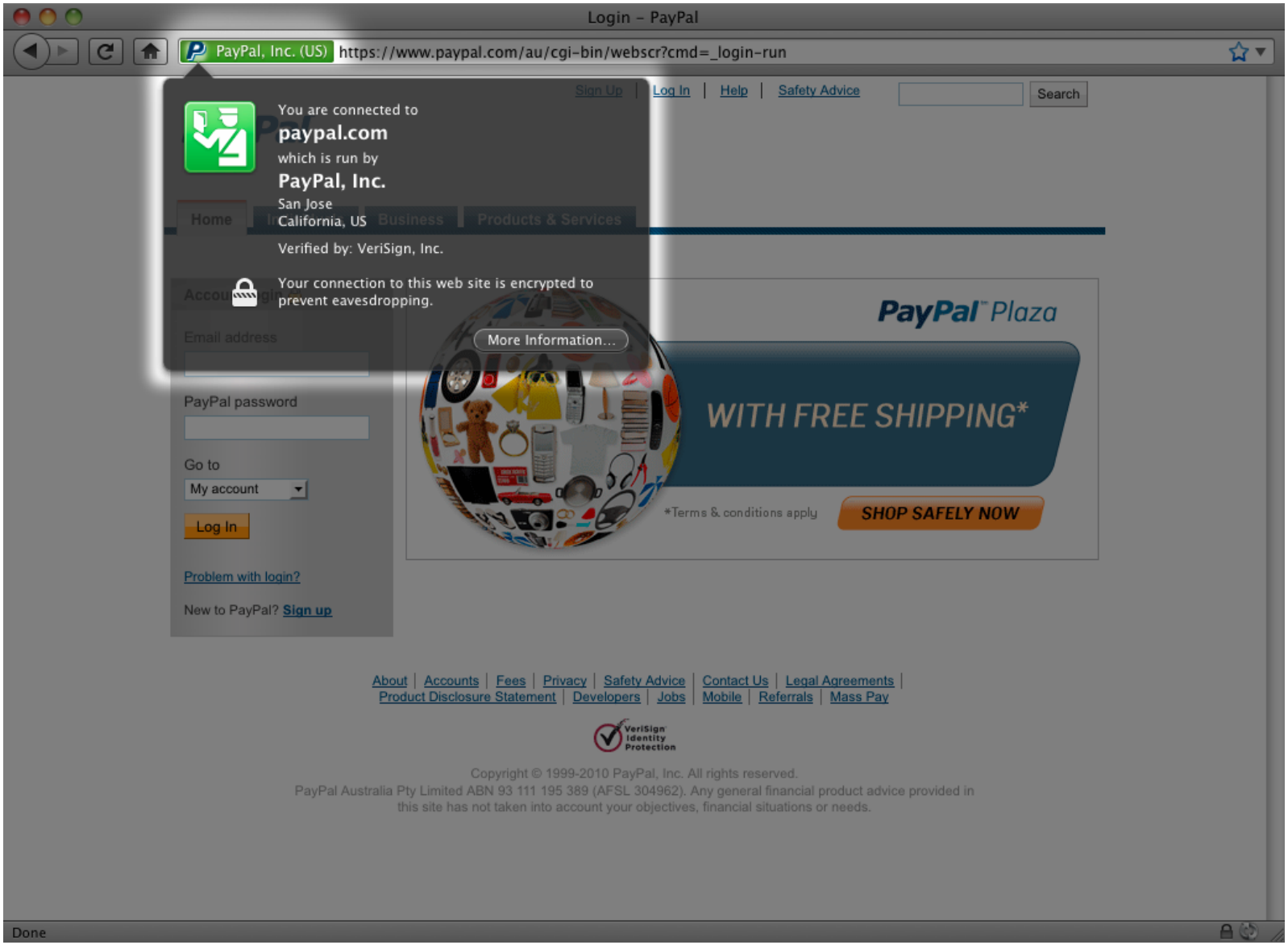
Copyright © 1999-2010 PayPal, Inc. All rights reserved.
PayPal Australia Pty Limited ABN 93 111 195 389 (AFSL 304962). Any general financial product advice provided in this site has not taken into account your objectives, financial situations or needs.
Done

“certificate” – 19%



“certificate” – 19%



What criteria *should* people use to decide if a website is secure?

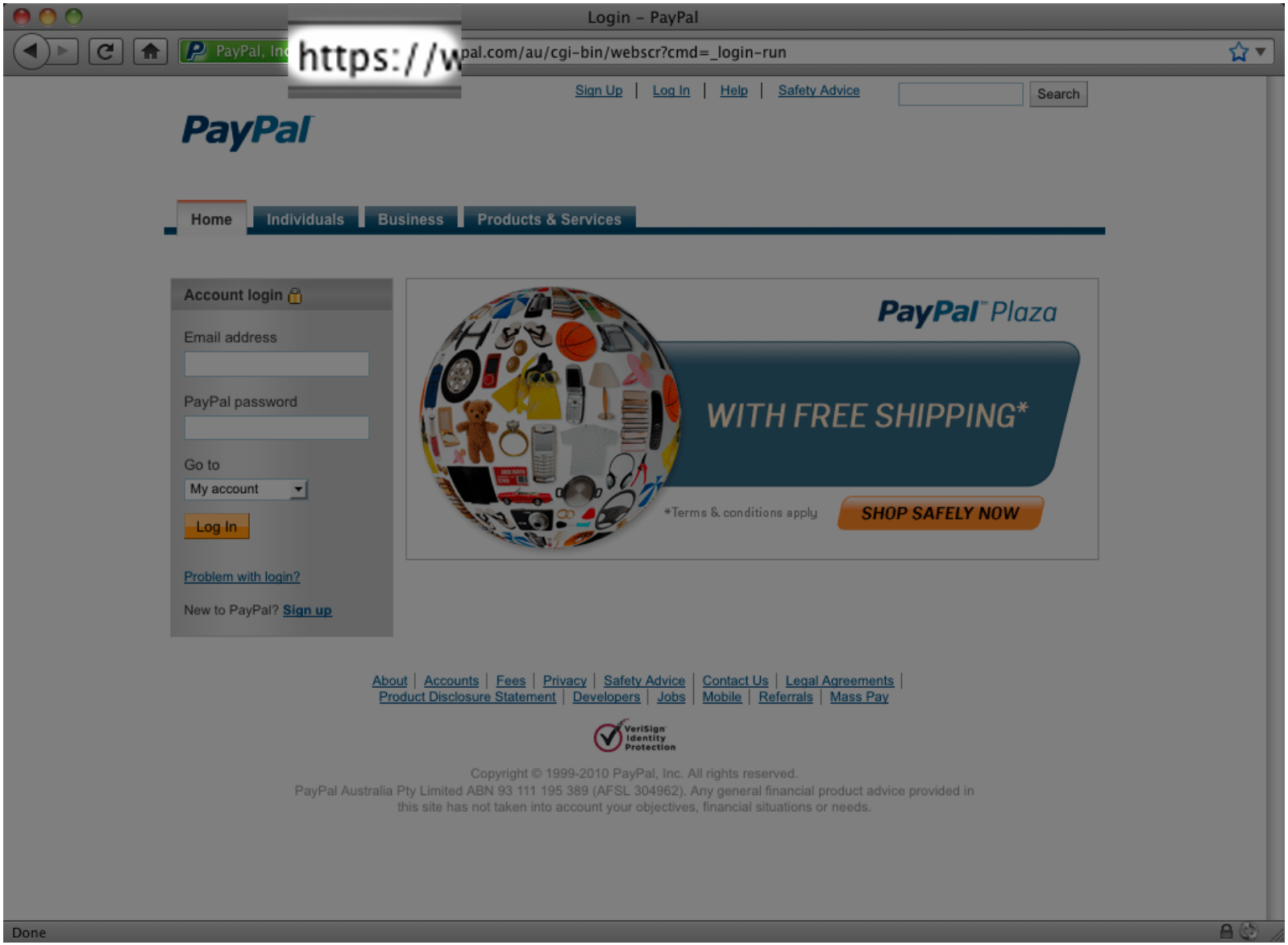
Narrow focus from a cryptographer's perspective:

- What criteria accurately convey the known security properties of the connection?
  - Use of the SSL / HTTPS protocol which encrypts all data and gives server-to-client authentication.

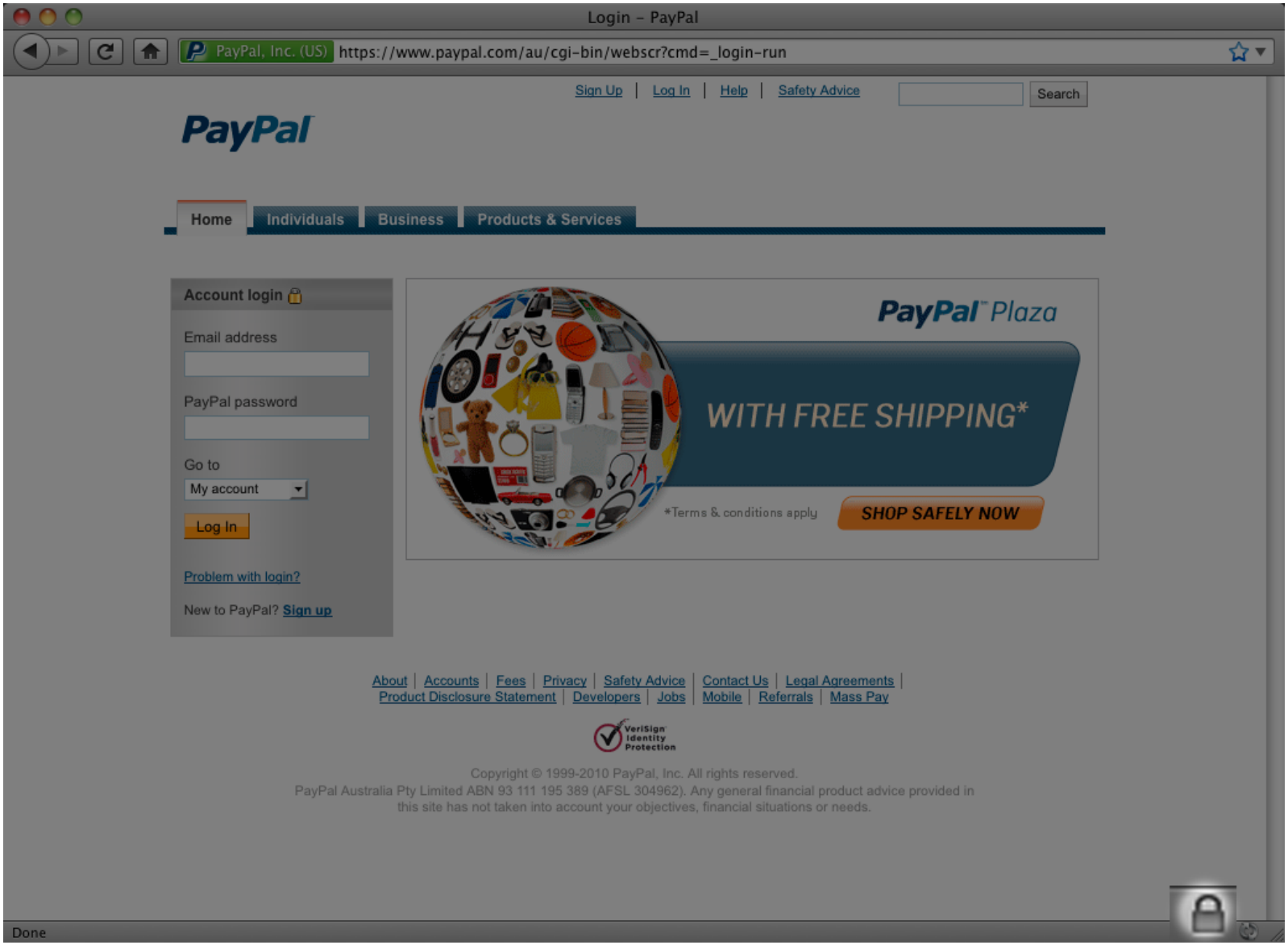
We can't trust anything provided by the server

We can't trust anything provided by the server

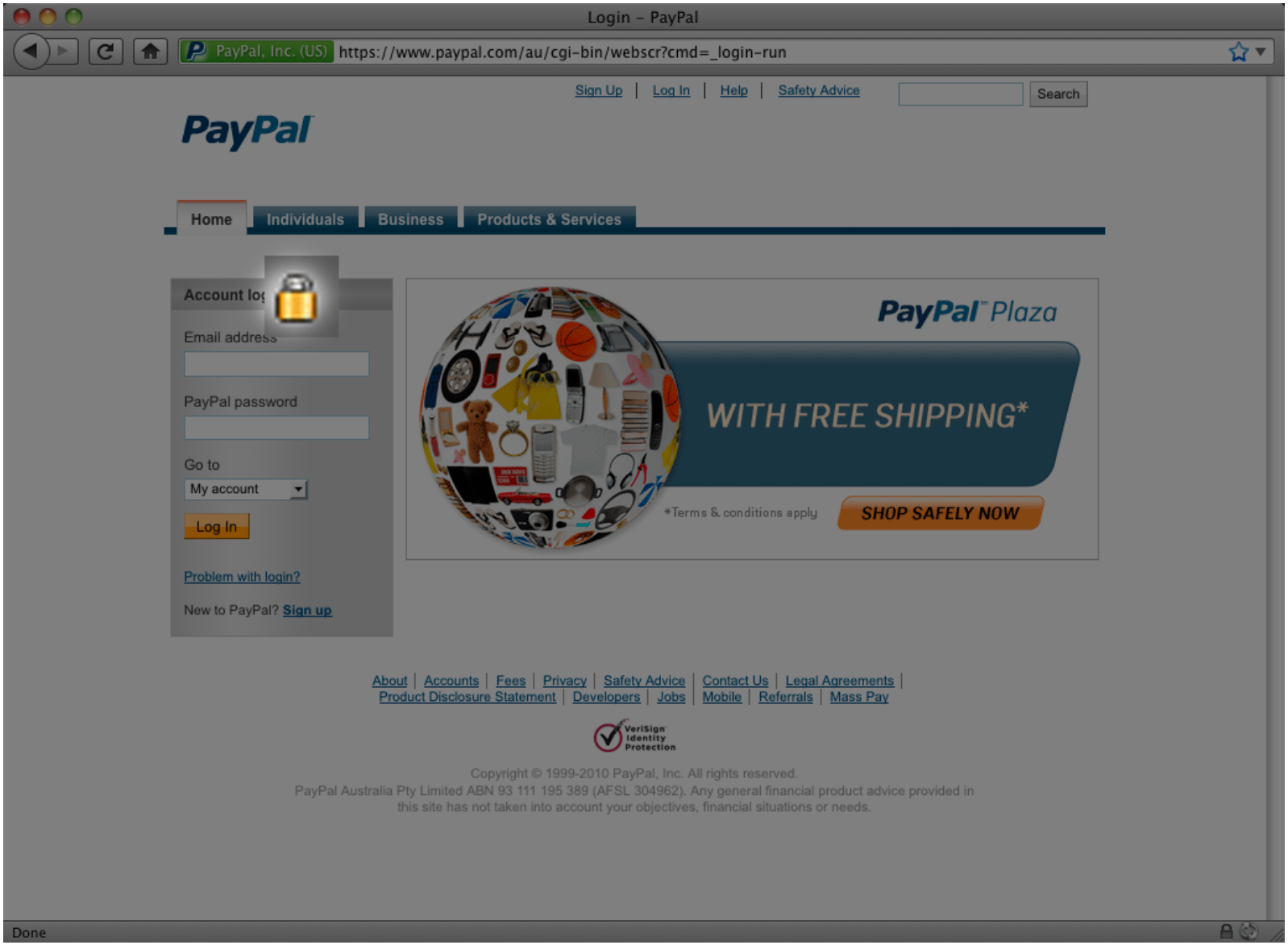
Security indicator: “https” in location bar



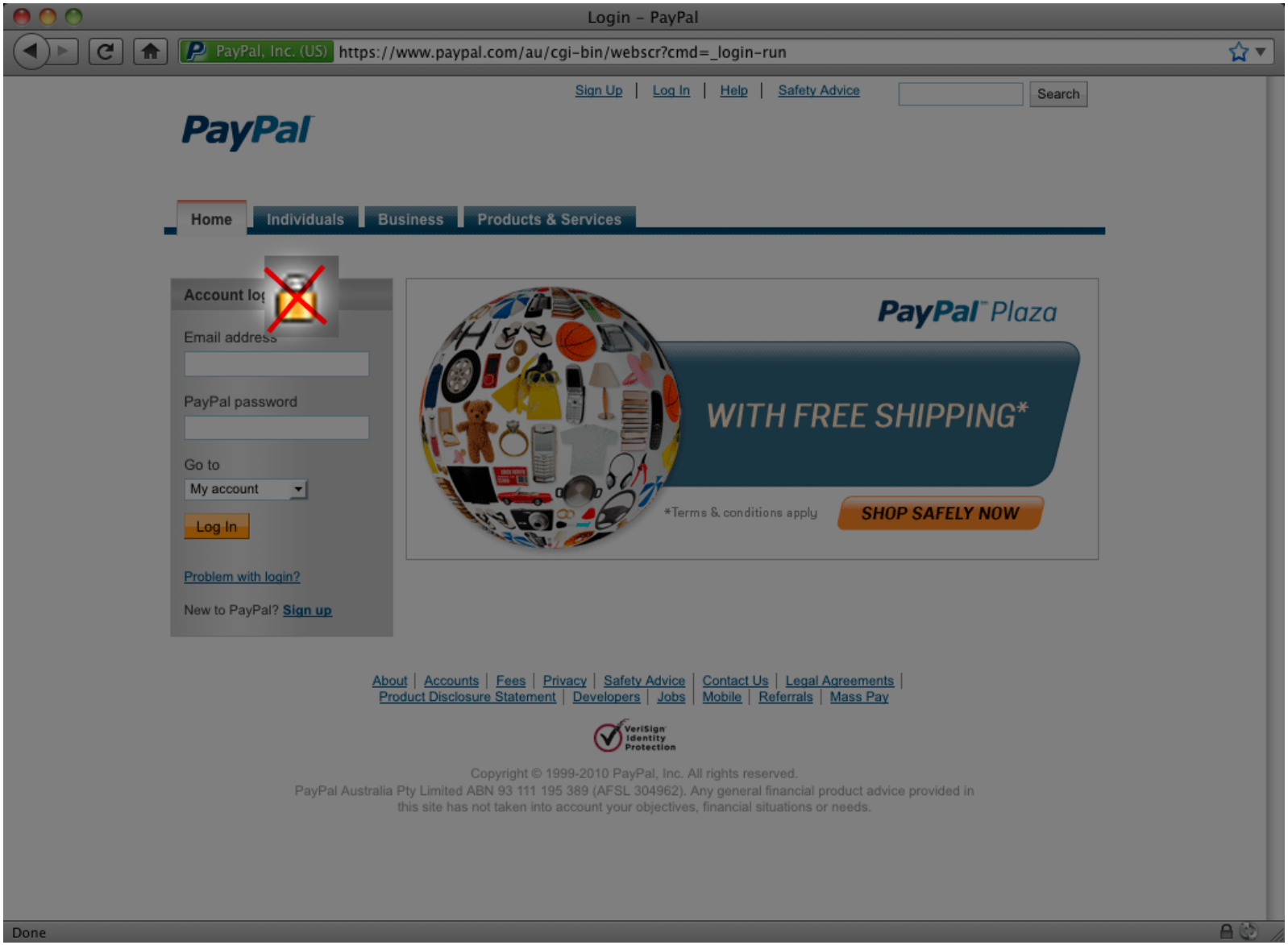
Security indicator: lock icon in browser chrome



Security indicator: lock icon in browser chrome

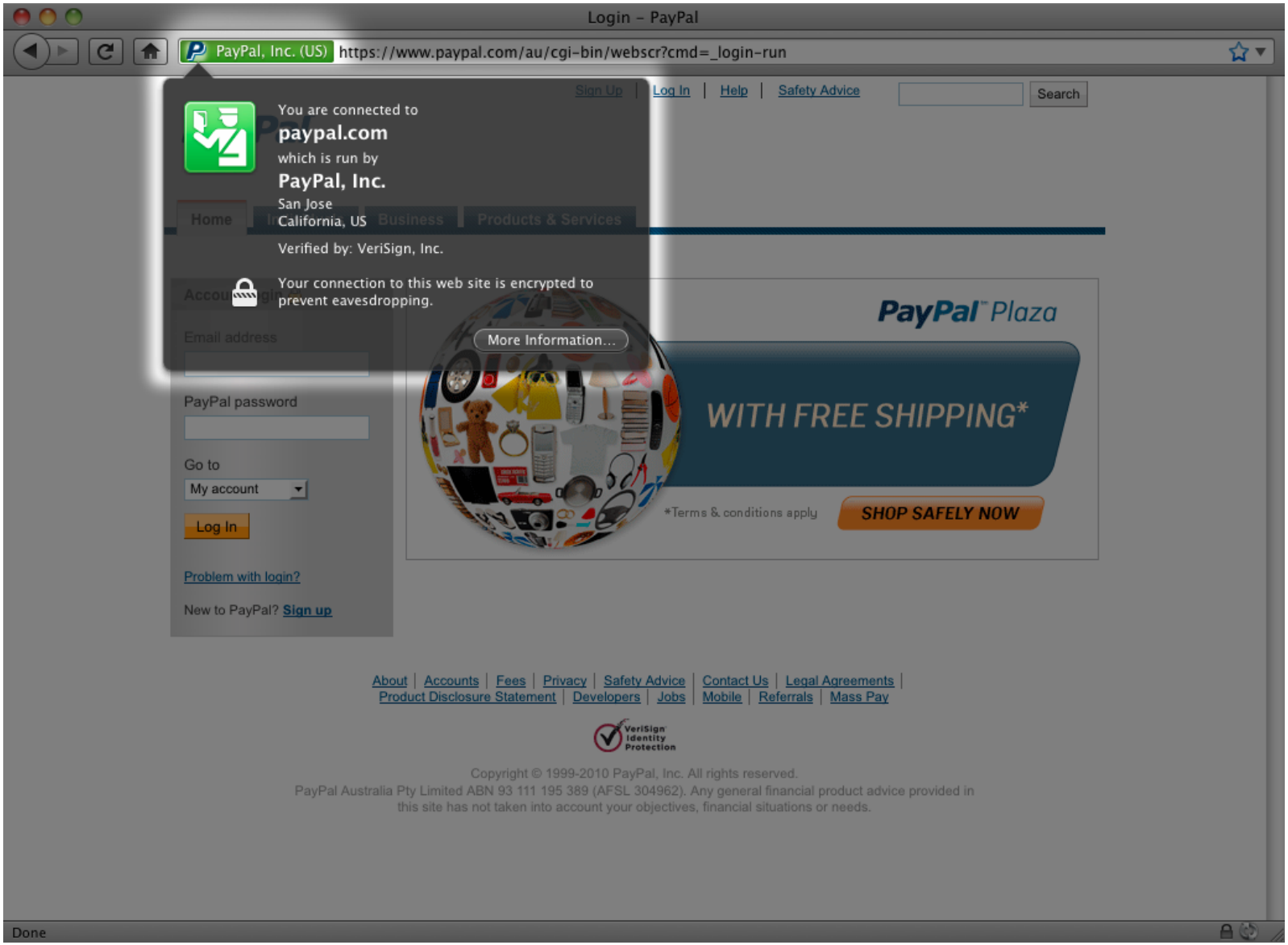


Security indicator: lock icon in browser chrome



Security indicator: domain name correct

Security indicator: extended validation certificate



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- Individuals
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Secure Log In

Member Login

Account login

Member Login

Email address [ ]

PayPal password [ ]

Go to [My account]

Log In

Done

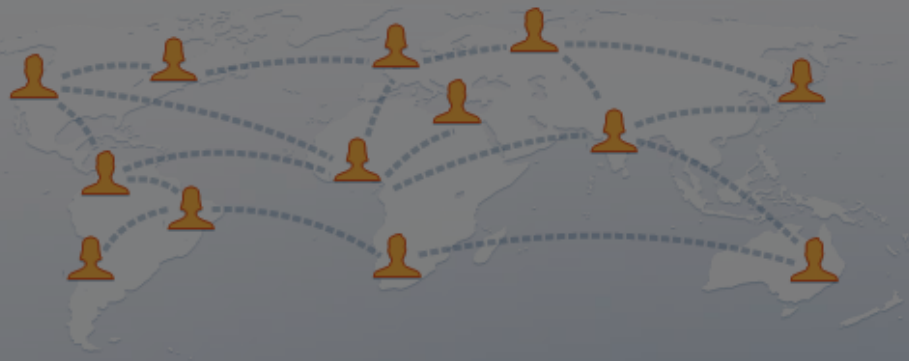
http://www.facebook.com/

facebook

Email Password Login

Keep me logged in Forgot your password?

Facebook helps you connect and share with the people in your life.



Sign Up

It's free, and always will be.

First Name:

Last Name:

Your Email:

Re-enter Email:

New Password:

I am: Select Sex:

Birthday: Month: Day: Year:

Why do I need to provide this?

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Create a Page for a celebrity, band or business.

English (US) Español Português (Brasil) Français (France) Deutsch Italiano العربية हिन्दी 中文(简体) 日本語 »

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Security indicators

S1. Does the URL in the location bar begin with https?

S2. Is the domain name of the URL in the location bar correct?

S3. Is the lock icon displayed somewhere in the browser chrome?

S4. Are there indicators present for an extended validation certificate?

Do people use security indicators?

Use of security indicators: Whalen and Inkpen[2]

Methodology: eye-tracking, subject interviews.

- "type of site" – 88%
- "lock or key icon" – 75%
- "type of information" – 69%
- "site statements" – 50%
- "https" – 44%
- "certificate" – 19%

[2] Whalen, Inkpen. Gathering evidence: use of visual security cues in web browsers. *Graphics Interface*, 112:137–144 (2005)

Use of security indicators: Schechter et al.[3]

Absence of security indicators: Examined user behaviour when logging in to financial websites. All 67 subjects continued logging in even when no security indicators were present.

Site authentication images: Users were more willing to ignore browser warnings and security indicators when site-authentication images were used.

[3] Schechter, Damija, Ozment, Fischer. The emperor's new security indicators: An evaluation of website authentication and the effect of role playing on usability studies. *Proc. IEEE S&P 2007*, 51–65.

Use of security indicators: Sobey et al.[4]

Methodology: eye-tracking

- Eye-tracking data showed that extended validation interface was not originally noticed by users.
- Once trained, users show a willingness to adopt these features.

[4] Sobey, Biddle, van Oorschot, Patrick. Exploring user reactions to new browser cues for extended validation certificates. *Proc. ESORICS 2008*, LNCS 5283, 411–427.

Why do people ignore security indicators?

[5] Whitten, Tygar. Why Johnny can't encrypt: A usability evaluation of PGP 5.0 *Proc. USENIX 1999*.

[6] Dhamija, Tygar, Hearst. Why phishing works. *Proc. CHI 2006*.

Why do people ignore security indicators?

1. "the unmotivated user property" [5]
2. lack of knowledge of security and security indicators
3. lack of attention to security indicators
4. lack of attention to **absence** of security indicators [6]

[5] Whitten, Tygar. Why Johnny can't encrypt: A usability evaluation of PGP 5.0 *Proc. USENIX 1999*.

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3. lack of attention to security indicators
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Our hypothesis: users are habituated to ignoring security indicators because many websites don't use them properly.

[5] Whitten, Tygar. Why Johnny can't encrypt: A usability evaluation of PGP 5.0 *Proc. USENIX 1999*.

[6] Dhamija, Tygar, Hearst. Why phishing works. *Proc. CHI 2006*.

To what extent are security criteria and indicators misused on websites?

Widespread misuse of security criteria and indicators suggests users will become habituated to making bad security decisions.

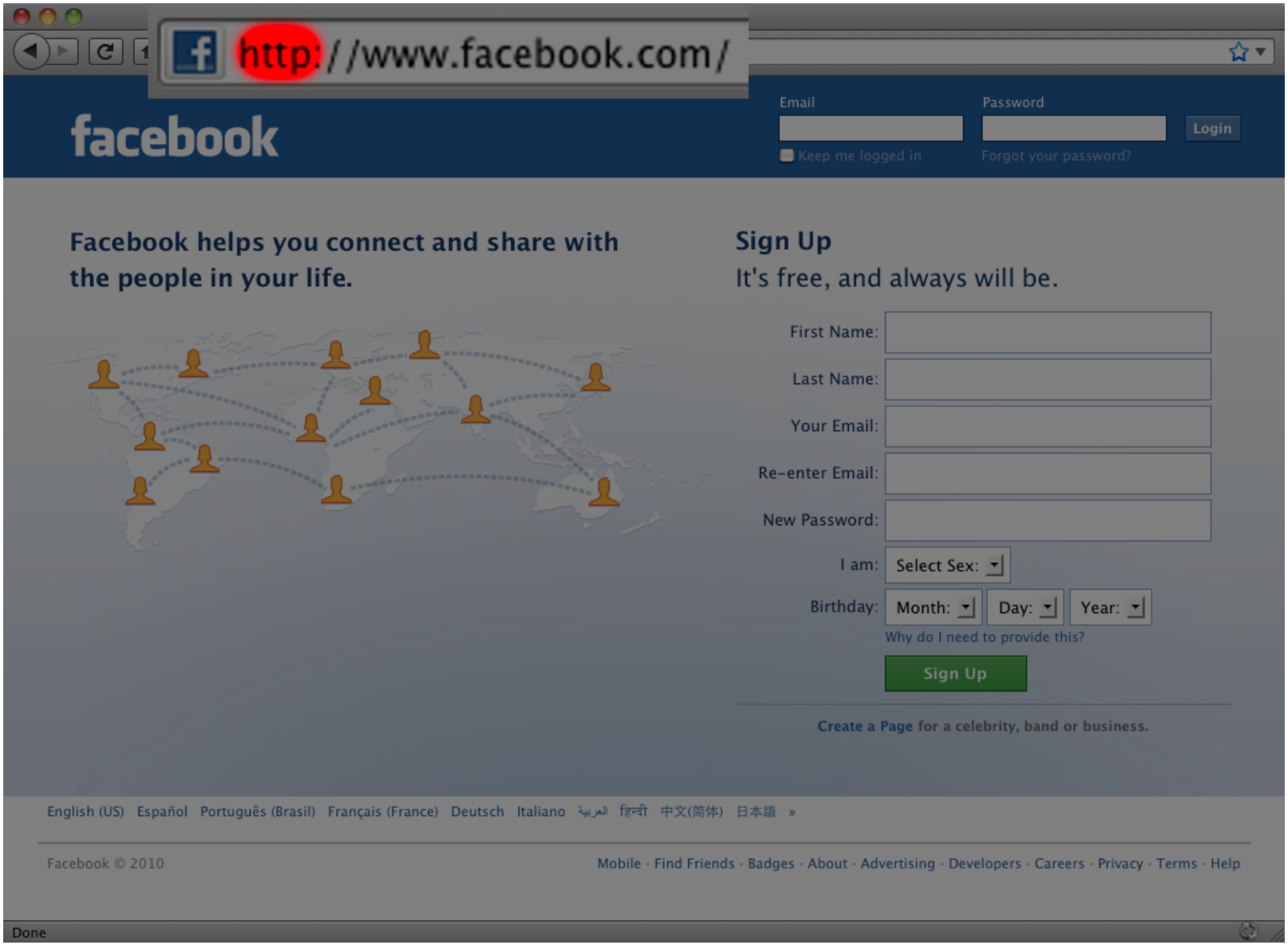
Methodology

- Identified security criteria and indicators from previous studies and expert analysis.
- Assembled list of 125 popular websites:
  - top 100 sites by traffic (as ranked by Alexa Topsites)
  - top banks in USA, UK, Canada, Australia
  - top 4 webmail services (Yahoo!, Hotmail, Gmail, AOL)
- Visited the website by typing in the domain name (hotmail.com).
- Checked for presence/absence of security criteria/indicators.

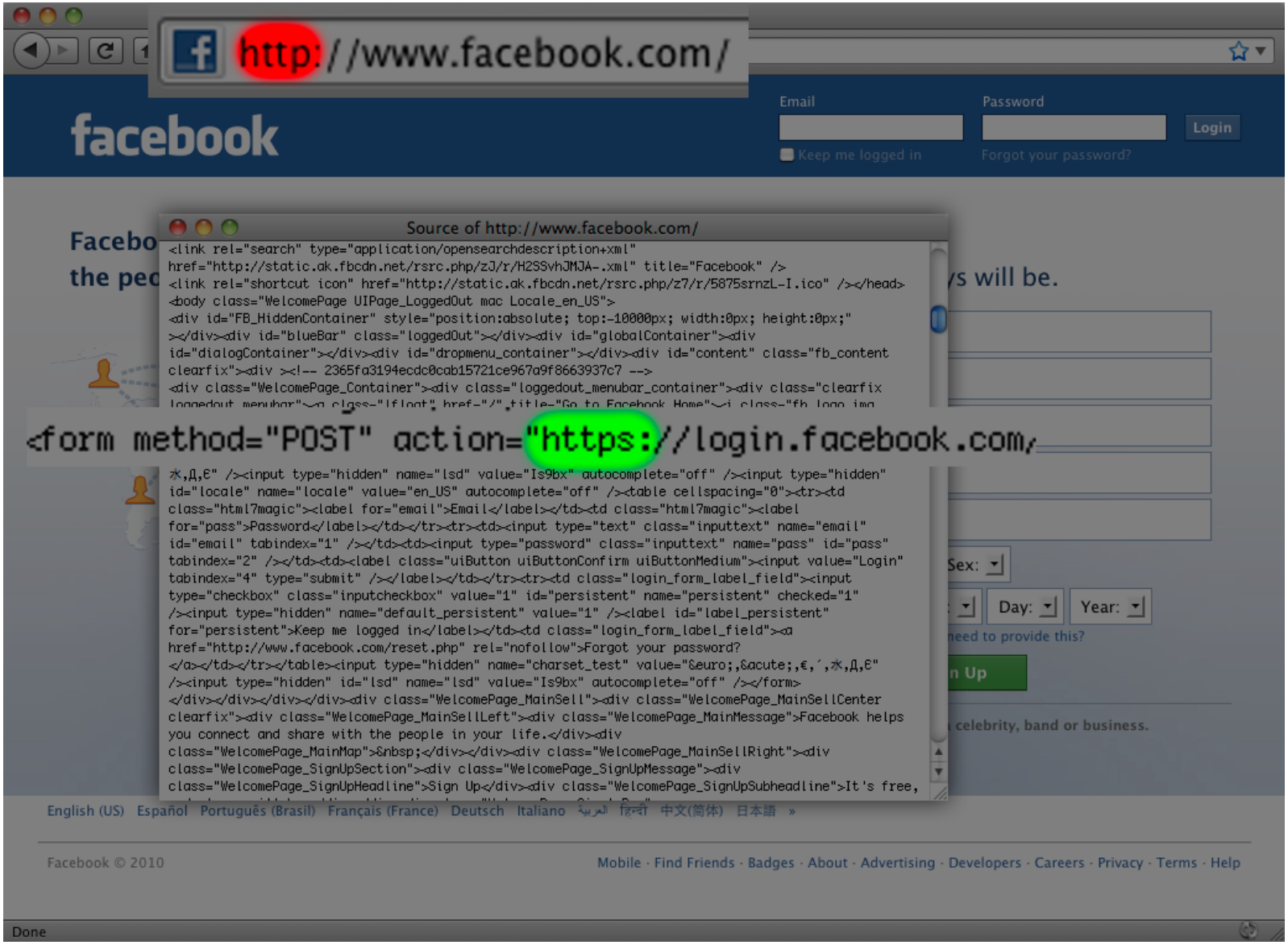
Misuse of security indicators

- HTTP login page with HTTPS form submission
- Lock icon on page or as favicon
- Hidden location bar
- Mismatched domain name
- Very complicated URL

Misused indicator: login protocol vs. form protocol



Misused indicator: login protocol vs. form protocol

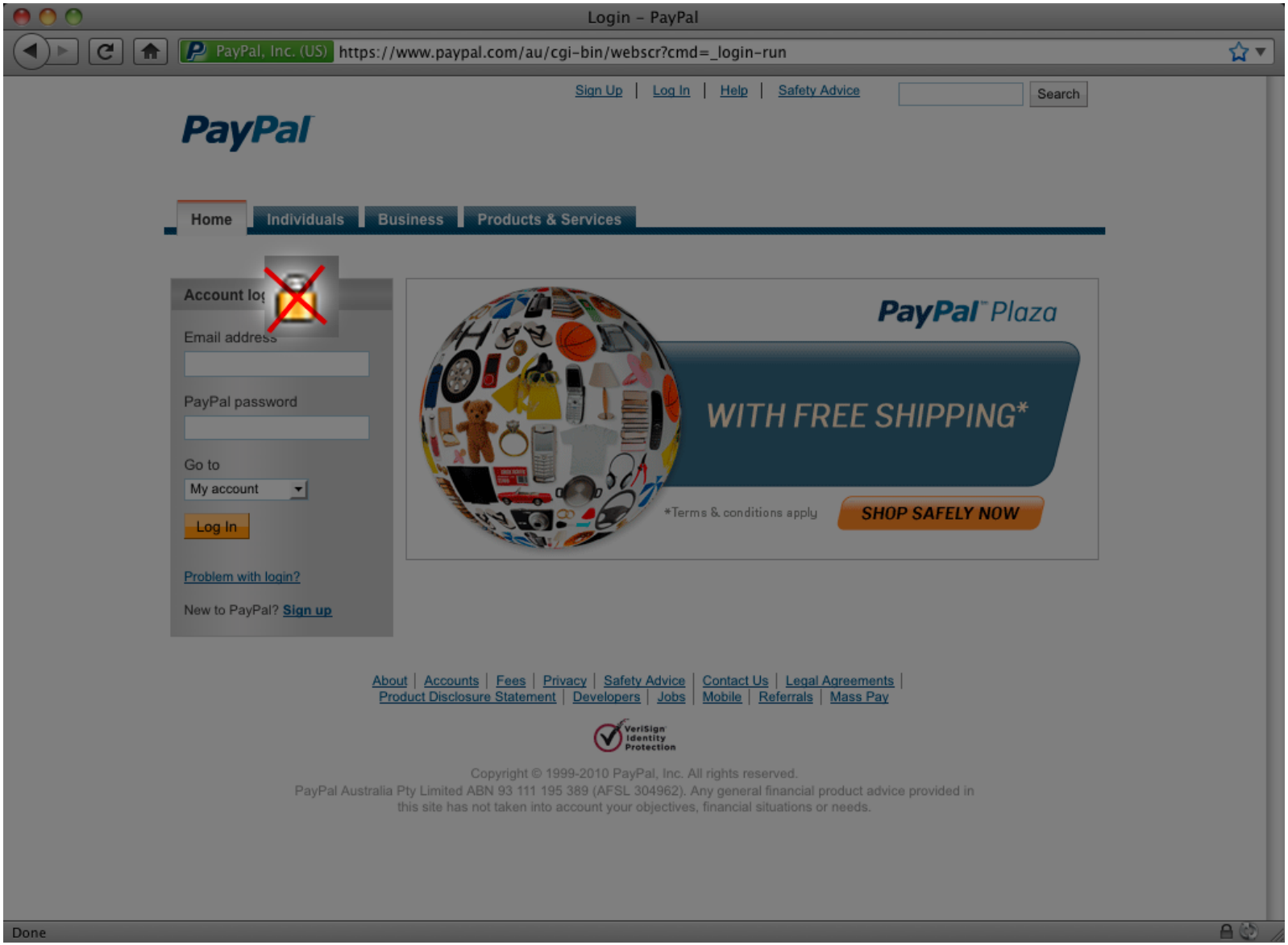


Misused indicator: login protocol vs. form protocol

Login page	Form submission		
HTTP	HTTP	45%	*
	HTTPS	10%	✗
	HTTPS w/EV cert.	5%	✗
HTTPS	HTTPS	32%	✓
HTTPS w/EV cert.	HTTPS w/EV cert.	8%	✓

* HTTP form submission provides no protection whatsoever for usernames or passwords.

Misused indicator: lock icon on page or as favicon



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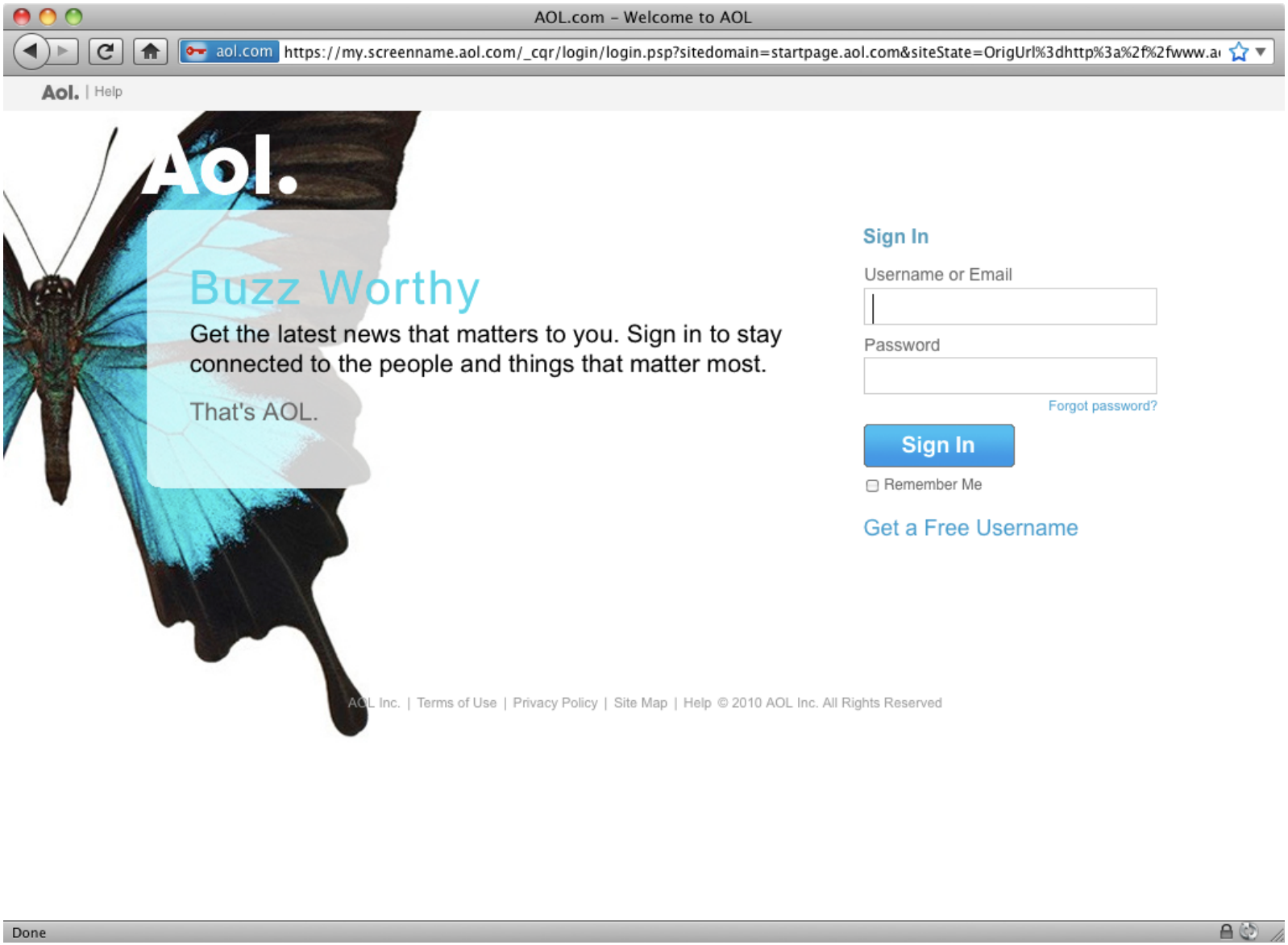
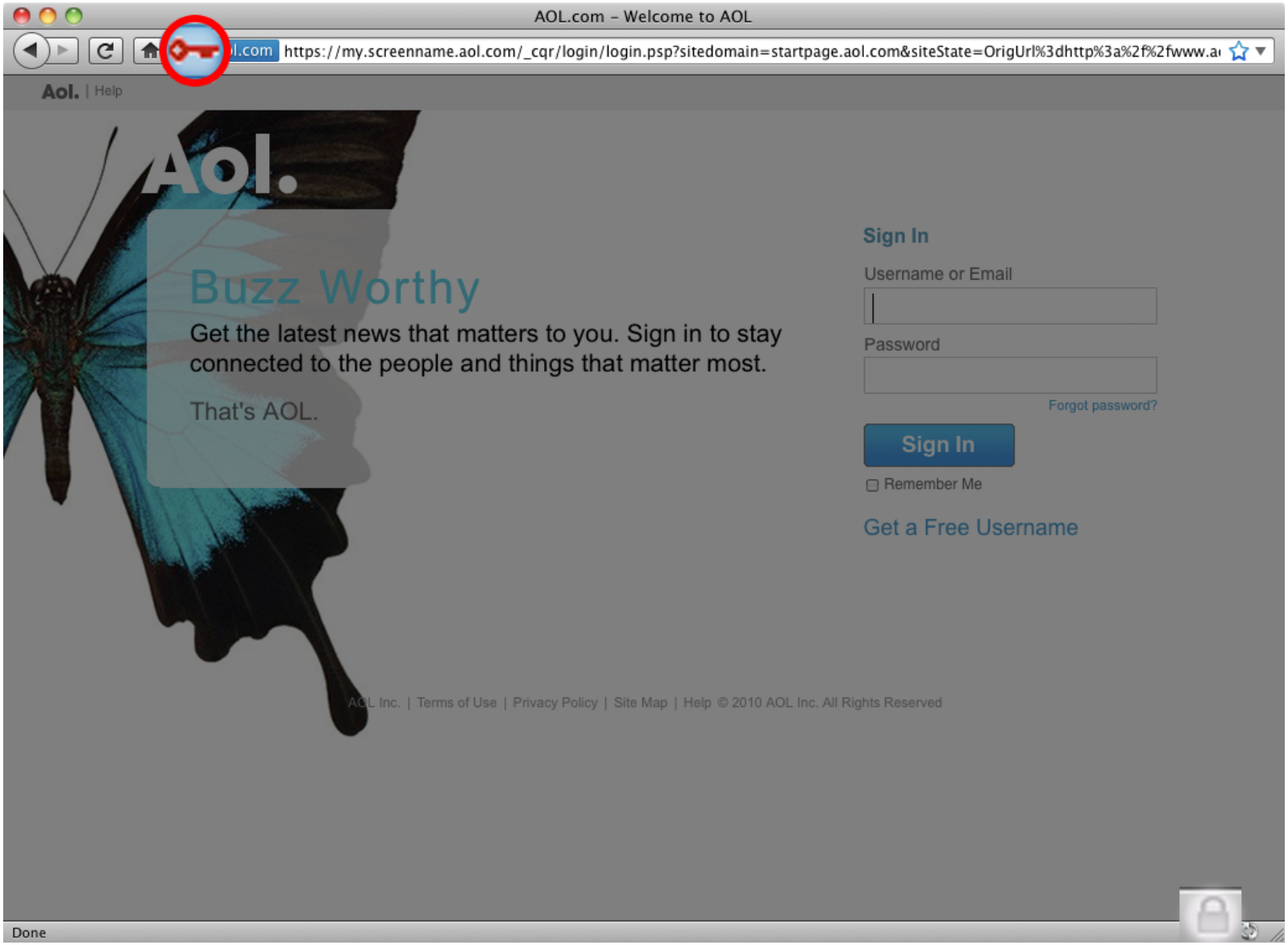


Misused indicator: lock icon on page or as favicon



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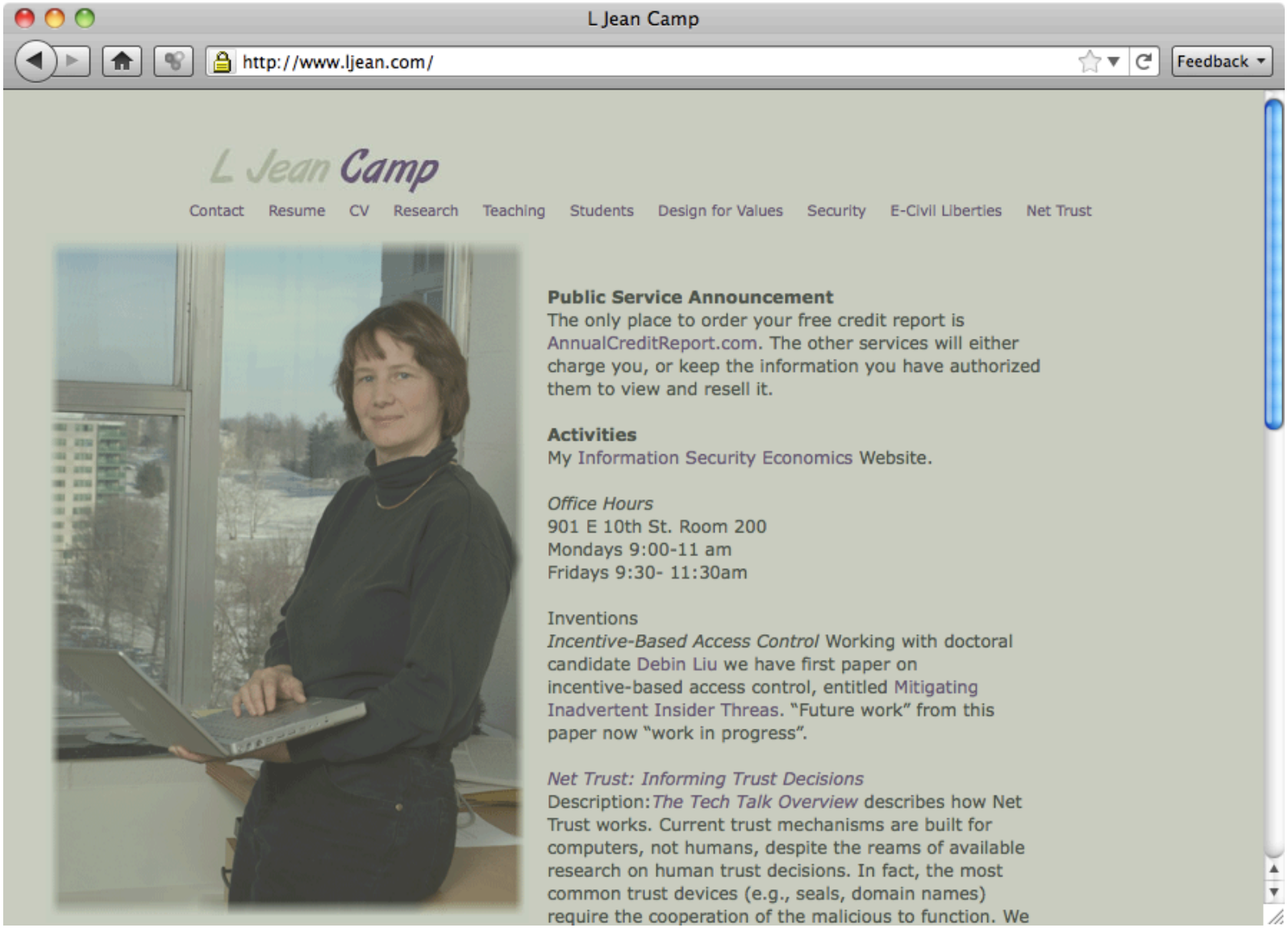
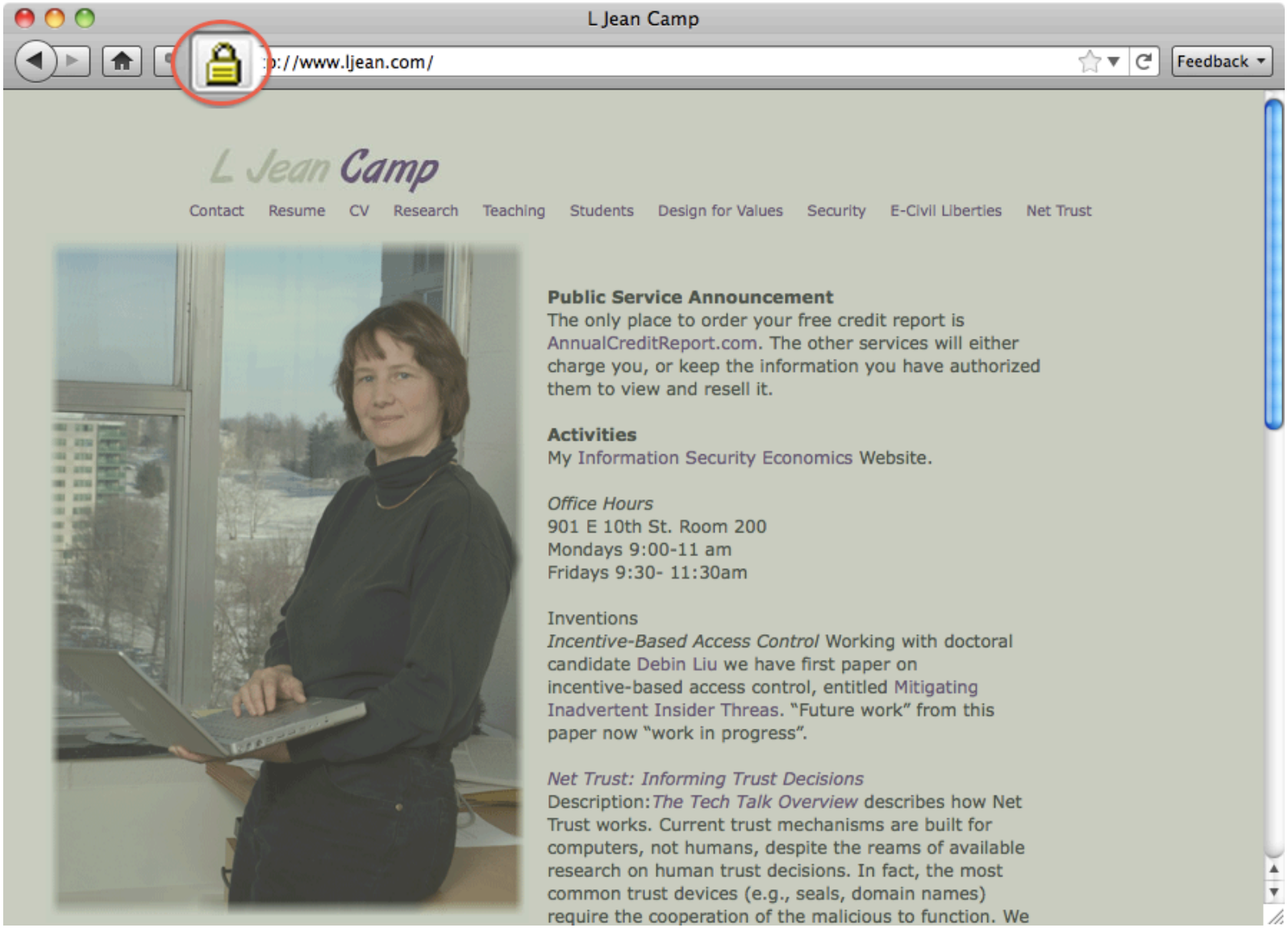


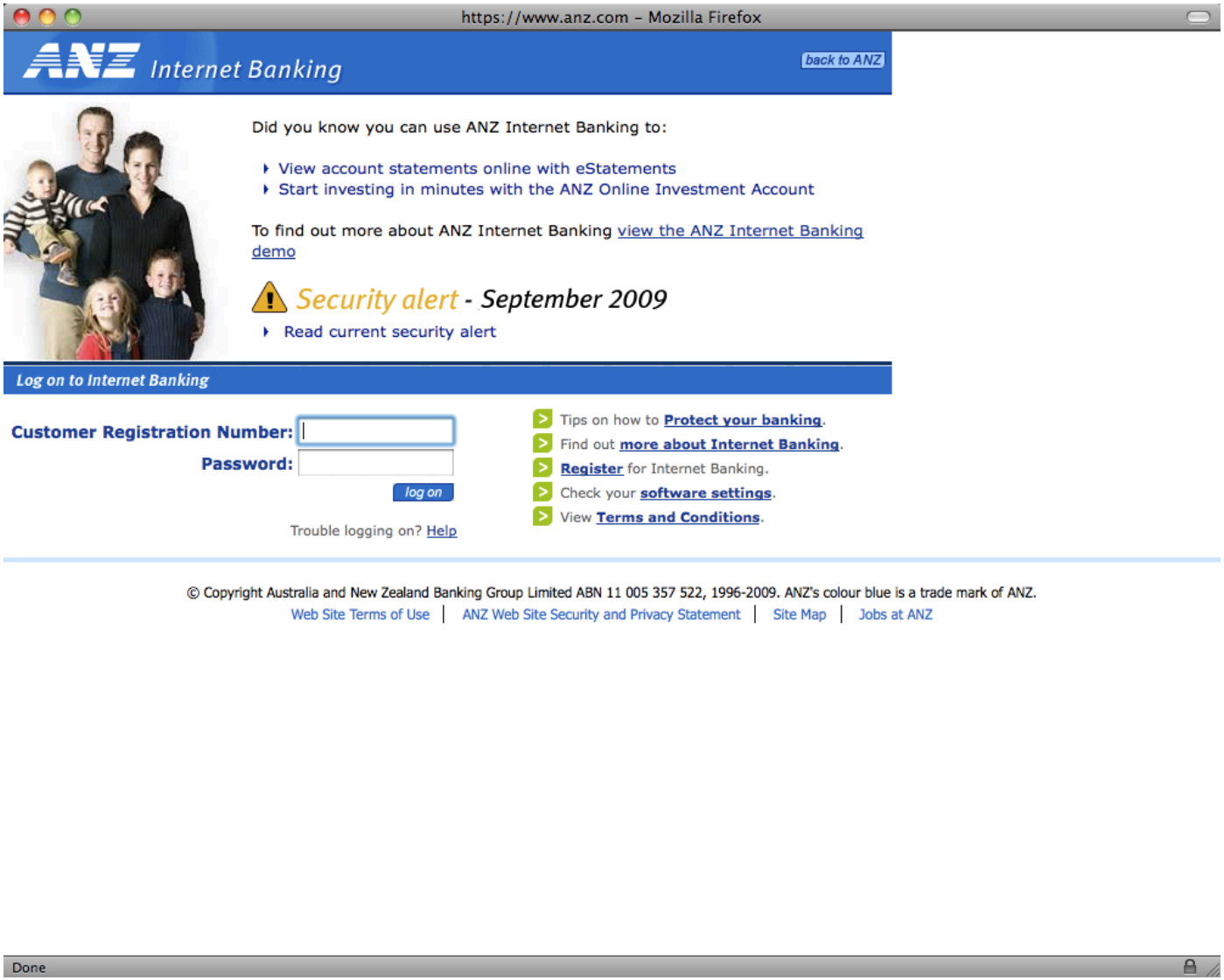
Misused indicator: lock icon on page or as favicon



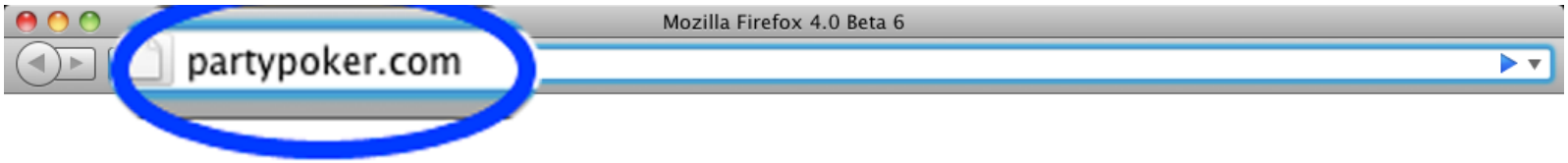
Misused indicator: lock icon on page or as favicon

lock icon on HTTP pages	5%	××
lock icon on HTTPS pages	15%	×
banks with lock icon on HTTPS pages	70%	×
lock icon as favicon	2%	××

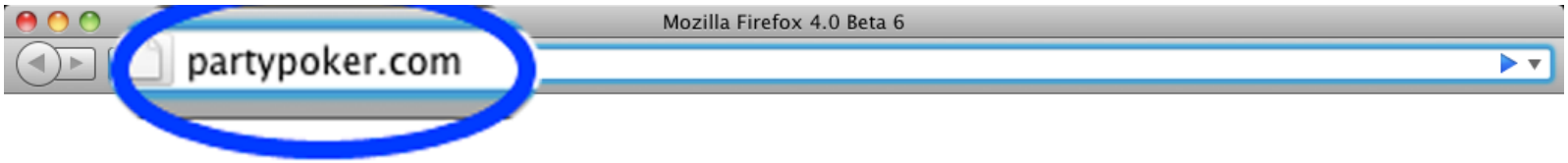
Misused indicator: hidden location bar – 2%

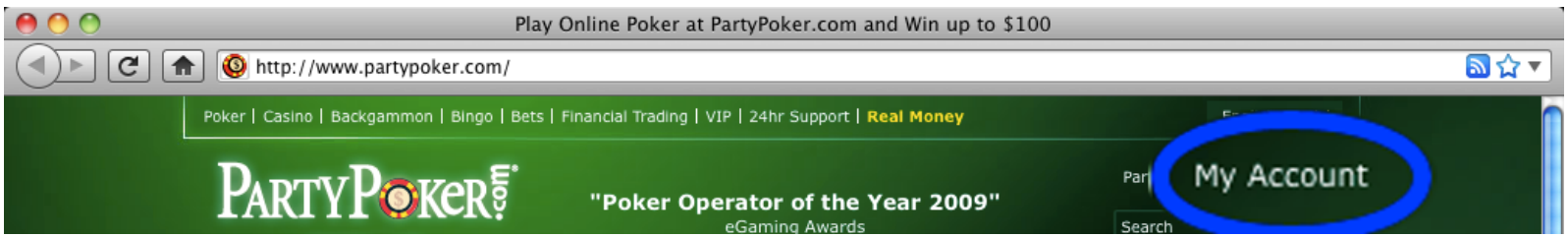


Misused indicator: mismatched domain name



Misused indicator: mismatched domain name





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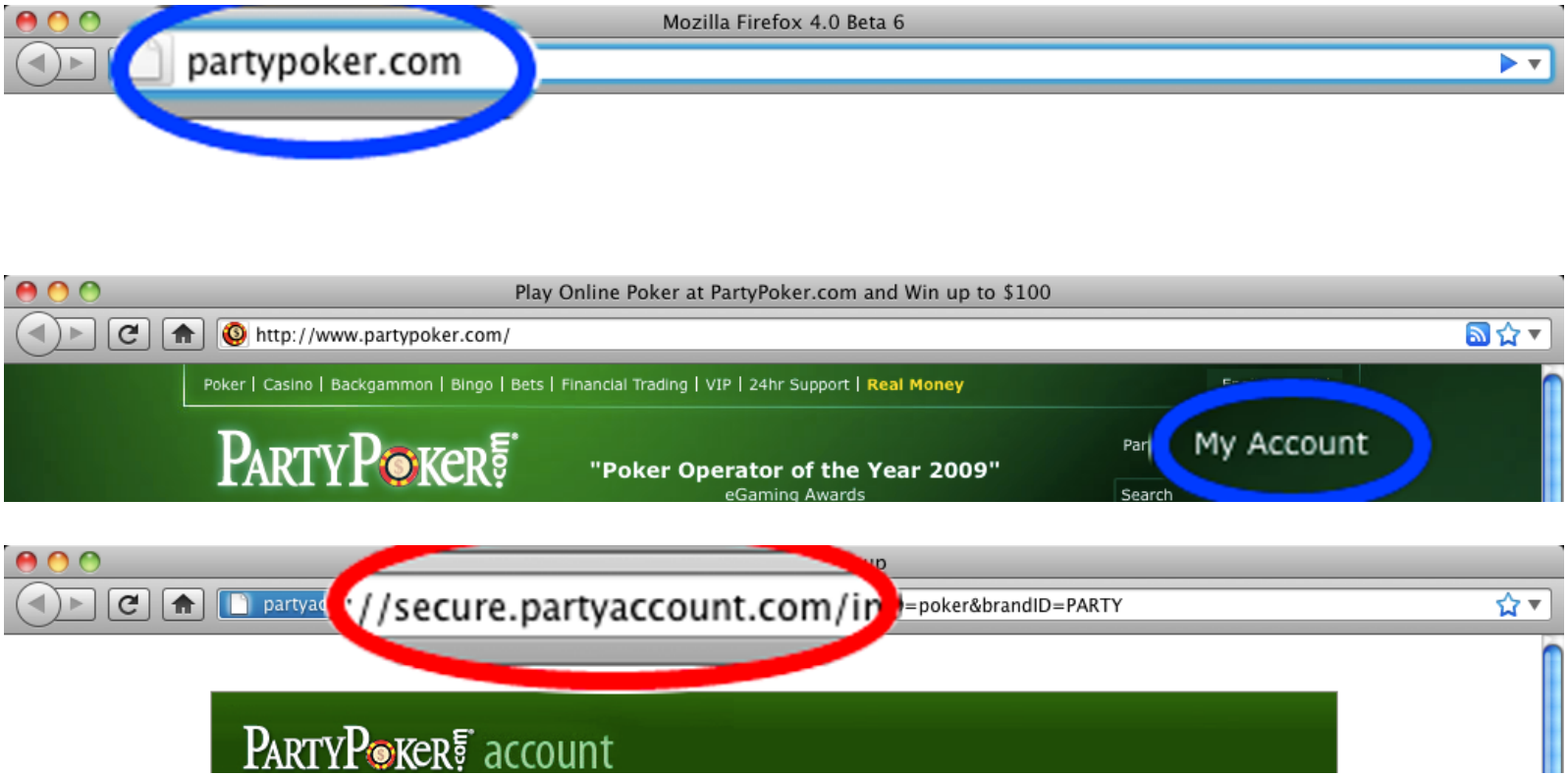

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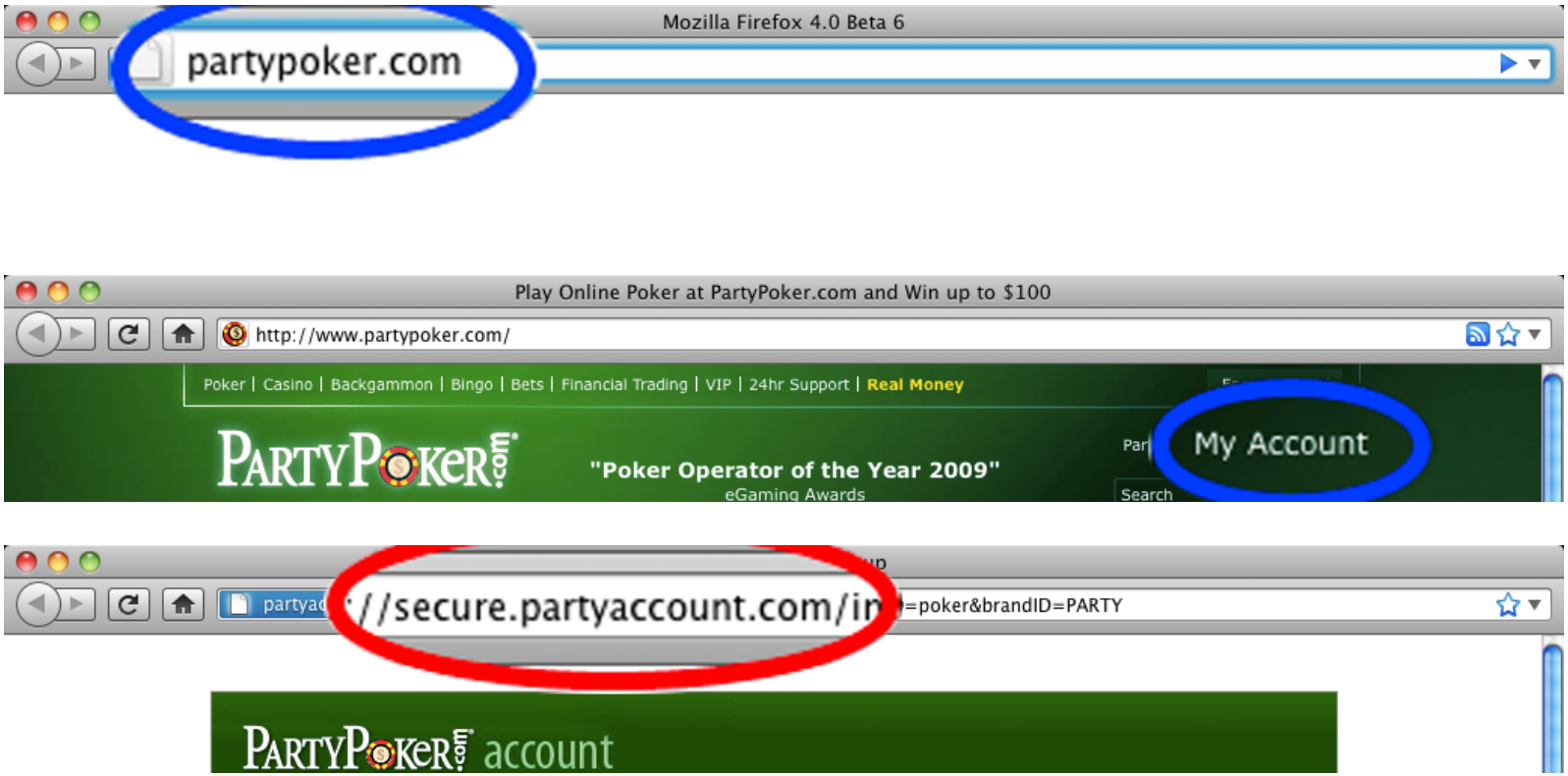
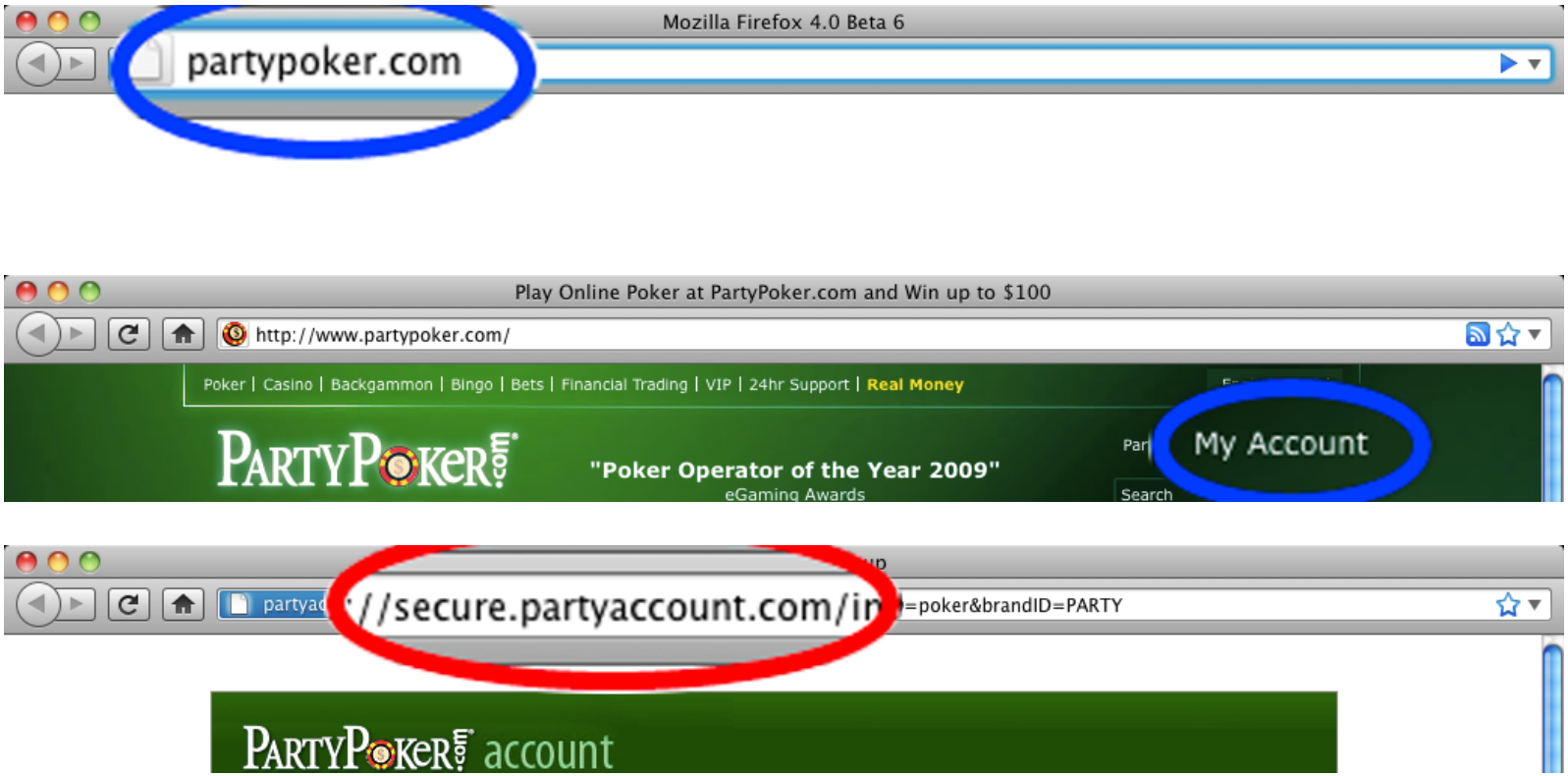


Is secure.partyaccount.com the right domain name to login to partypoker.com?

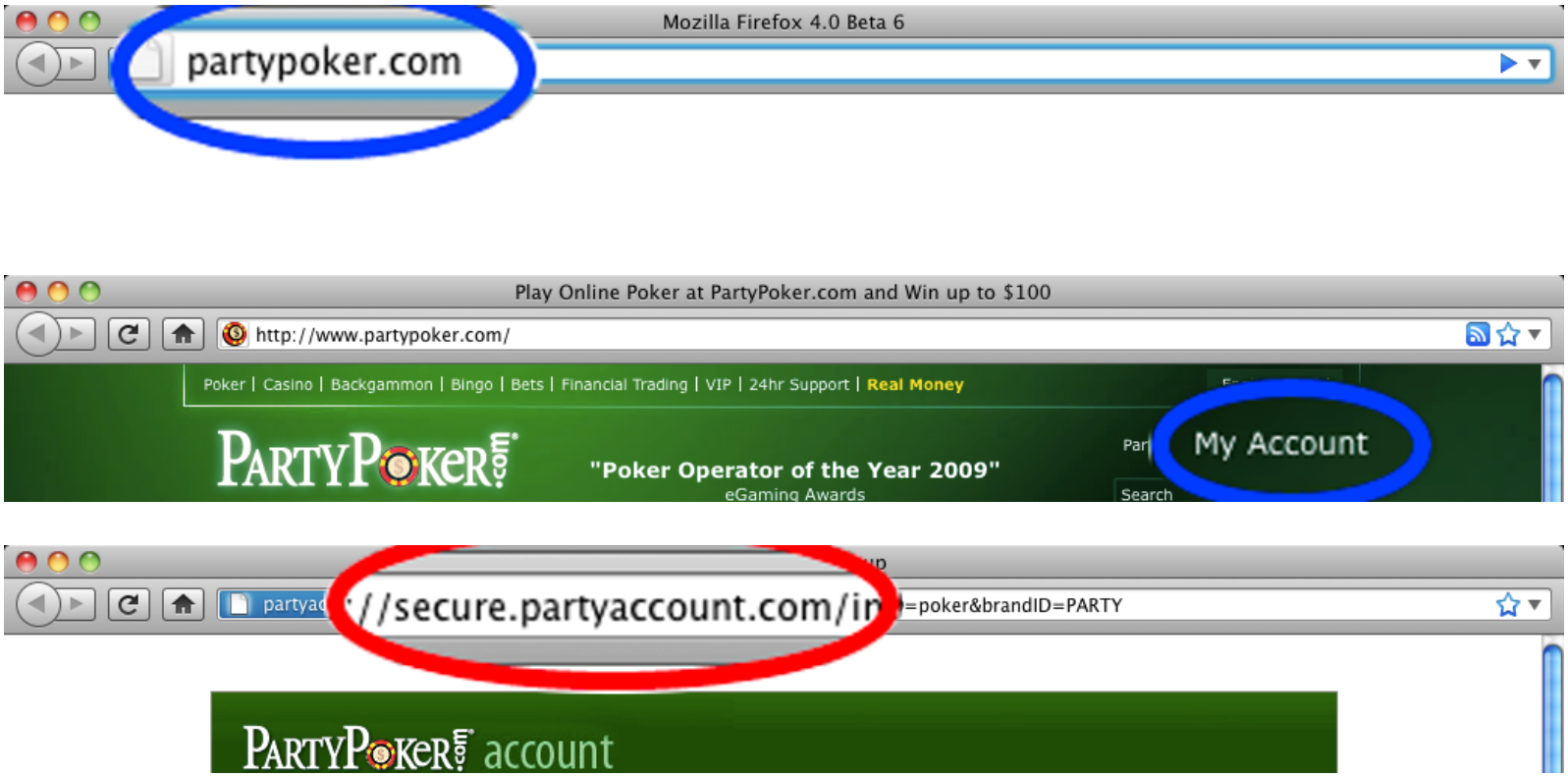
- Apparently, yes.

Misused indicator: mismatched domain name



What about partypoker-account.com?

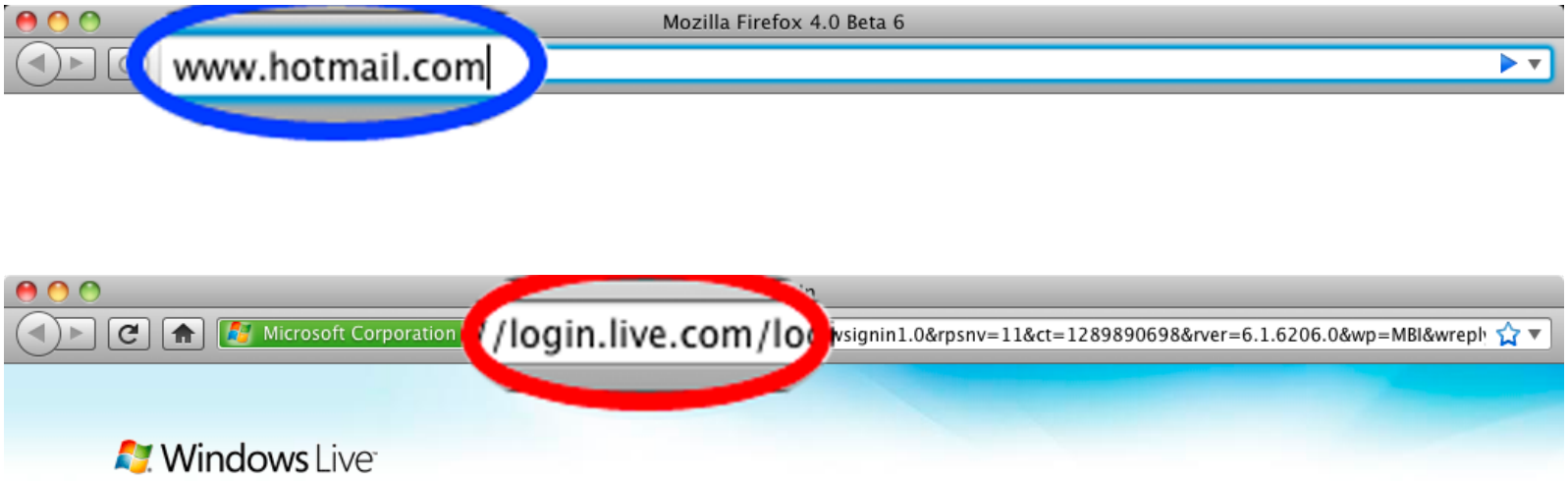
Misused indicator: mismatched domain name



What about partypoker-account.com?

- Definitely not! I could buy this domain name right now.

Misused indicator: mismatched domain name



Misused indicator: mismatched domain name

Match?	Example typed domain → login domain		
Exact match	google.com → www.google.com	57%	✓
Close match	yahoo.com → login.yahoo.com	30%	
No match	hotmail.com → login.live.com	13%	×

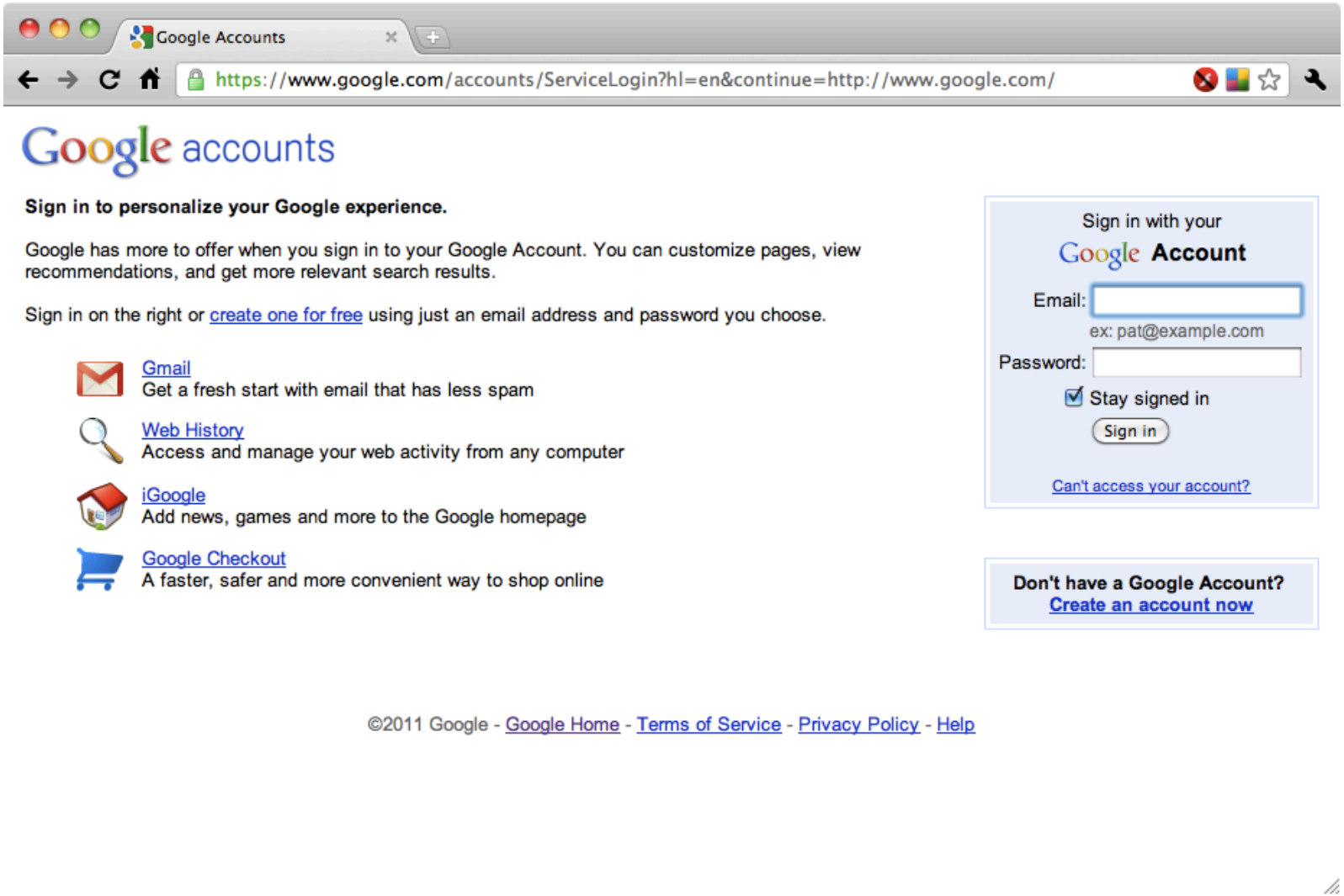
Misused indicator: complicated URL

- Complicated URL makes checking domain name harder
- "URL as UI"[7]

Complexity	Example	Avg. Len.		
Domain only	https://www.chase.com/	21.9	40%	✓
One path	https://www.blogger.com/start	32.9	17%	
More than one path component	https://www.google.com/accounts/ServiceLogin?uilel=3&service=youtube&passive=true&continue=http%3A%2F%2Fwww.youtube.com%2Fsignin%3Faction_handle_signin%3Dtrue%26nomobiletemp%3D1%26hl%3Den_US%26next%3D%252F&hl=en_US&ltmpl=sso	110.1	42%	×

[7] Jakob Nielsen. URL as UI, March 1999. http://www.useit.com/alertbox/990321.html

Improved UI design for URL as UI: Google Chrome



Summary of results

Misused security indicators	
HTTP login page with HTTPS form submission	15%
Lock icon on page or as favicon	23%
Hidden location bar	2%
Mismatched domain name	13%
Very complicated URL	42%

"Of the 125 sites we evaluated, only 5 avoided all misleading security indicators. Hence, a typical user will, much more often than not, be asked to make security decisions against best-practice recommendations on security indicators."

Design recommendations

- Deliver the page containing the login form over HTTPS.
- Don't try to hide the location bar.
- Ensure the domain name of the login page matches the domain name of the site in question.
- Don't use lock icons anywhere in the web page content.
- Try to use simple URLs, especially for the login page.

To improve security, we need...

- ... better user education.
  - Security indicators to look for.

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- ... better web designer/programmer education.
  - Design recommendations to follow.

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- ... better web browser design (and evaluation of those designs!).
  - Stronger / simpler error messages.
  - More / simpler / different security messages.

To improve security, we need...

- ... better user education.
  - Security indicators to look for.
- ... better web designer/programmer education.
  - Design recommendations to follow.
- ... better web browser design (and evaluation of those designs!).
  - Stronger / simpler error messages.
  - More / simpler / different security messages.
- ... better web security technologies.
  - Single sign-on (with browser support?).
  - Cryptographically strong password-based mutual authentication.
  - Design with usable security in mind.

Open questions

- Dataset of most-frequently-logged-in-to sites, not most-frequently-used sites.
- Usability study of single sign-on systems, such as Facebook Connect and Twitter OAuth: how does users understand flow and security of single sign-on systems?

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Queensland University of Technology

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