Let’s Go in for a Closer Look: Observing Passwords in Their Natural Habitat

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To be presented at ACM CCS 2017

Carnegie Mellon University
Societal Computing

CyLab
Security and Privacy Institute

CUPS
CyLab Usable Privacy & Security Laboratory

How do people manage all their passwords?

Risks of password reuse

CRACKED PASSWORDS

UserID	Password
jane	iloveyou89
john	godoggo!
jur	monkey1
kar	pa$$word
katie	princ3ss2

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Online Store

Bank

Employer

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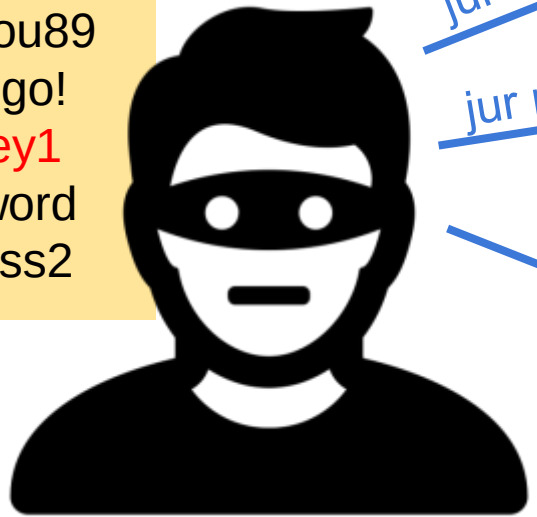

jur monkey1 → Online Store

jur monkey1 → Bank

jur monkey1 → Employer

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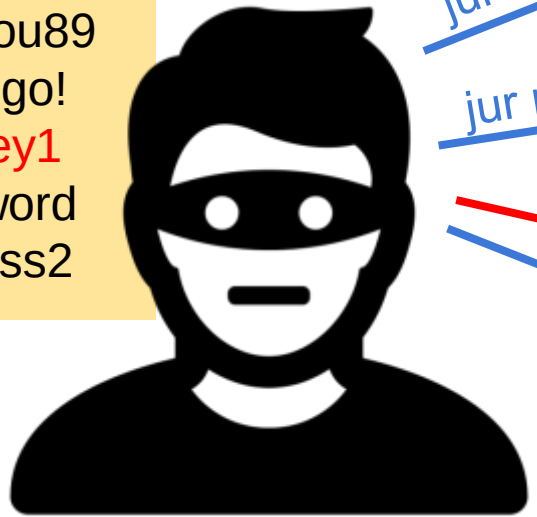

jur monkey1 → Online Store

jur monkey1 → Bank

jur monkey2 → Employer

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  - Passwords created specifically for studies don't provide insights into password portfolio

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- Wash et al 2016 analyzed password use over 6 weeks for 134 students

Security Behavior Observatory (SBO)

- Home Windows computers instrumented with SBO client and browser extensions
- Data from >500 participants since 2014
- Current active participants: ~200
- Allows for empirical observation, scientific analysis of security and privacy behavior

Password data collection

Deployed new SBO browser extensions in January 2017 to collect

- Hashes of passwords and 4+ character substrings
- Length, strength, characters in each class (uppercase, lowercase, digits, special characters)
- Browsing metadata (including URL)

Accurate strength measurement

- Neural network guesser (Melicher et al. 2016)
- Accurate measurement of guessability by sophisticated attacker
- Runs in browser plugin (no need to transmit password)
- No noticeable delay to user

Domain	Password	Reuse Type
nytimes.com	**Usabl3!!**	
yahoo.com	**s3curity**	
google.com	**security123**	
cmu.edu	**p4$$w0rd**	
facebook.com	**p4$$w0rd**	
amazon.com	**security?**	
twitter.com	**security?**	

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facebook.com	p4$$w0rd	
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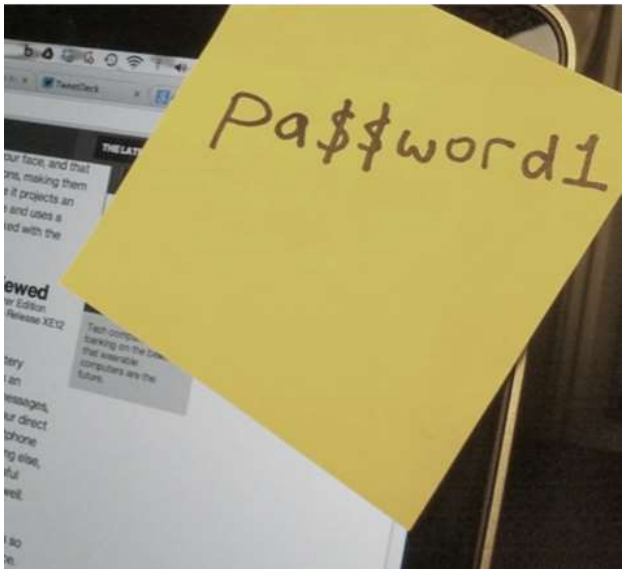
Overview of data collected

- 154 participants
- 31-217 days in study (Mean 147 days)
- 4,057 passwords
- Mean 26.3 passwords/participant
- 2,077 different web domains



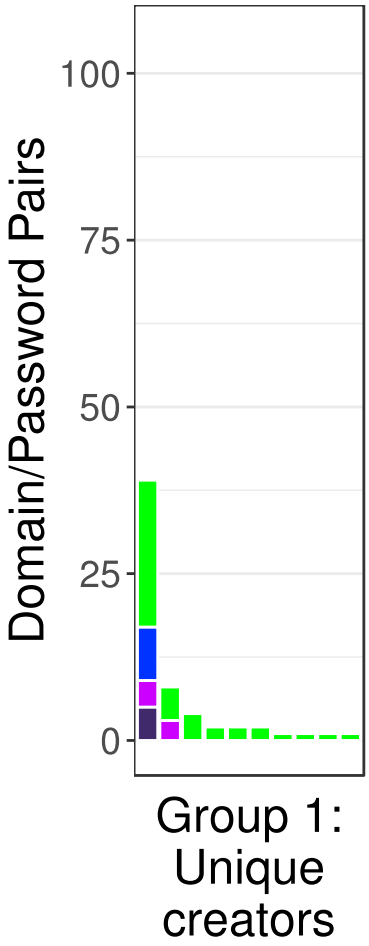
Data continues to be collected

Password reuse per participant

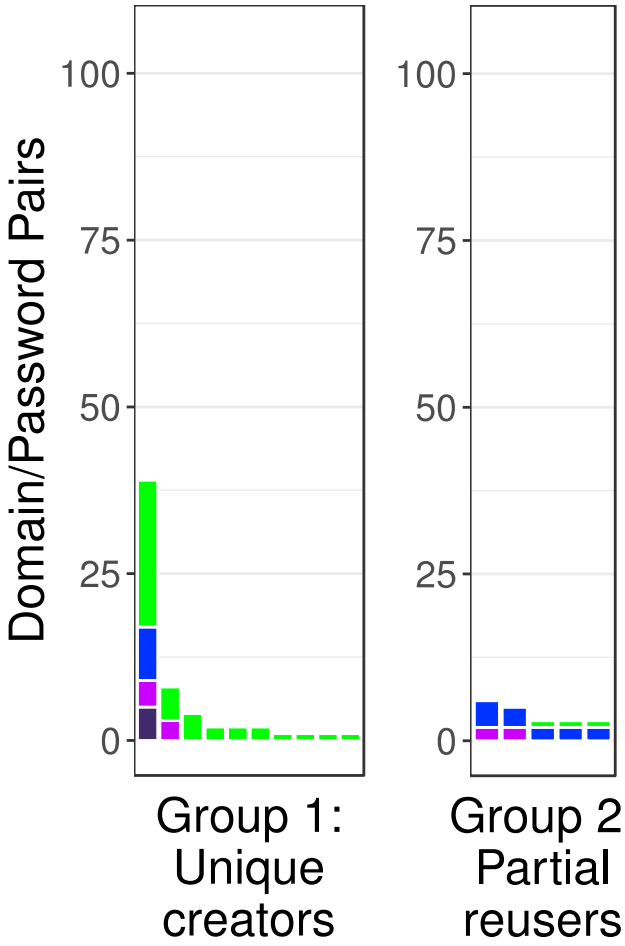
- 26.30 different accounts (domain/password pairs)
- 9.88 distinct passwords

Percentages of accounts:

- With non-reused passwords: 21%
- With only-partially-reused passwords: 12%
- With only-exactly-reused passwords: 16%
- With exactly-and-partially-reused passwords: 51%



Reuse Category
- Not reused
- Partially reused
- Exactly reused
- Partially–and–exactly reused



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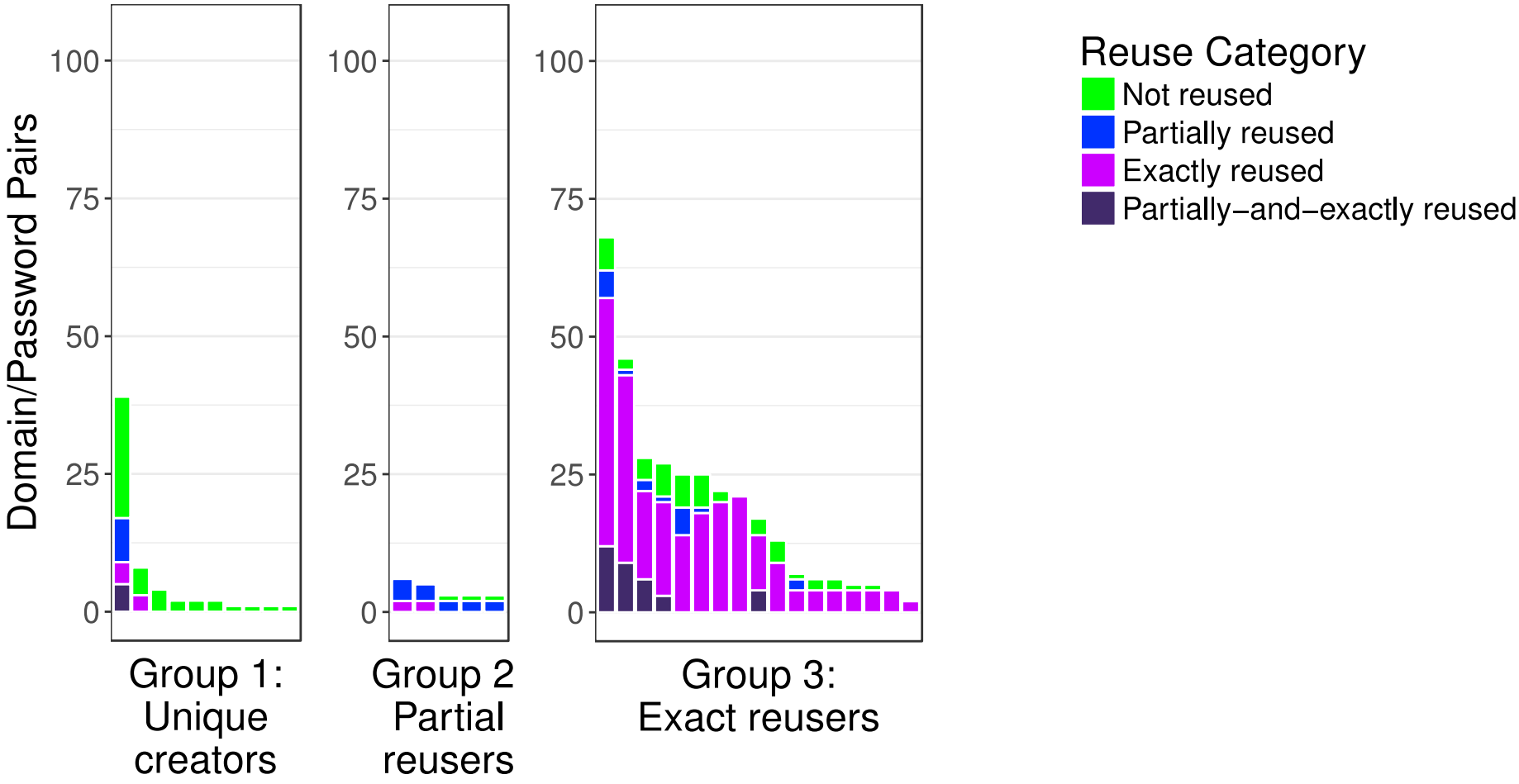
Domain/Password Pairs
100
75
50
25
0
Group 1:
Unique
creators
Group 2
Partial
reusers
Group 3:
Exact reusers
Reuse Category
Not reused
Partially reused
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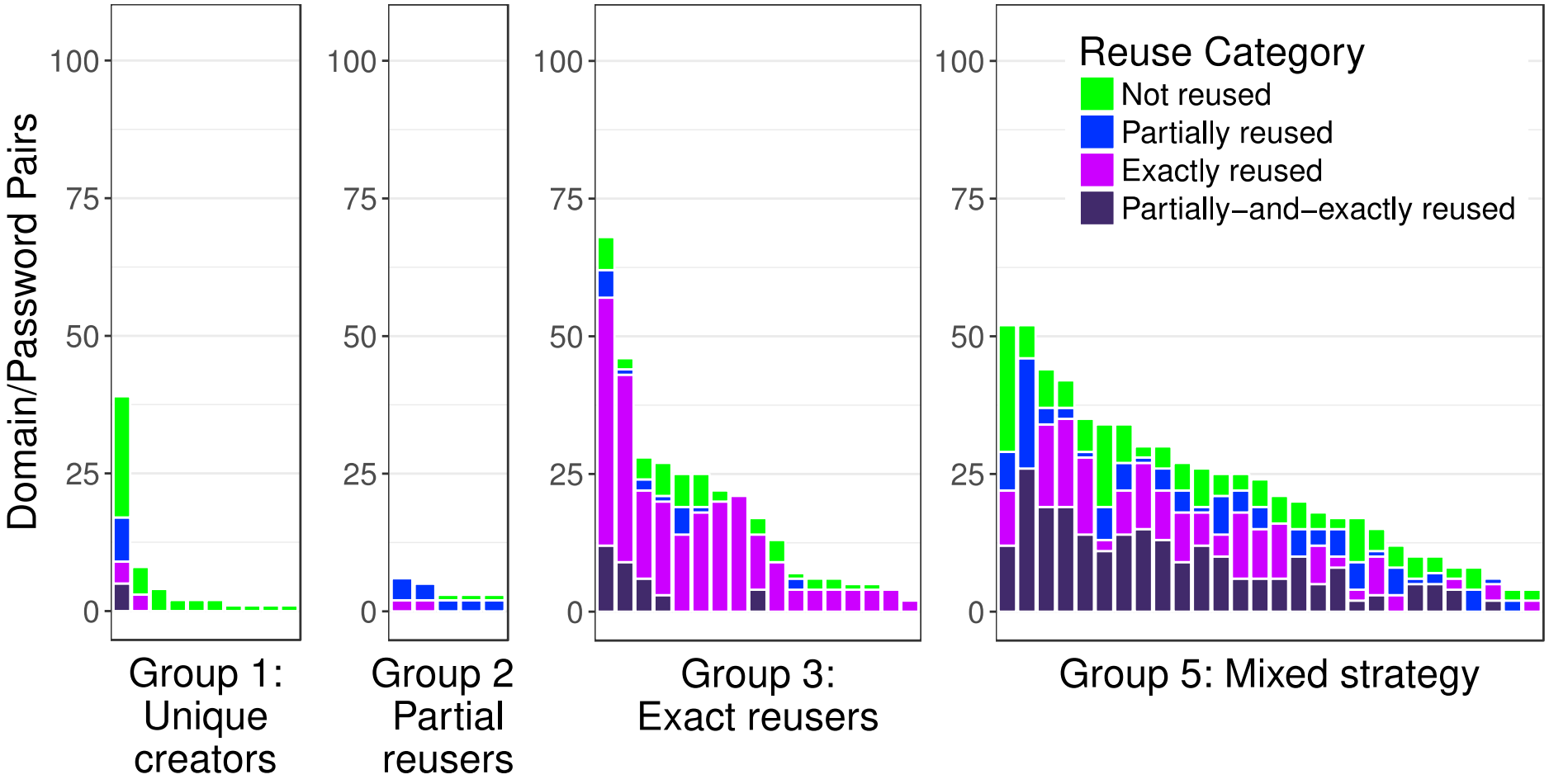
Domain/Password Pairs
100
75
50
25
0
Group 1: Unique creators
Group 2 Partial reusers
Group 3: Exact reusers
Group 5: Mixed strategy
Reuse Category
Not reused
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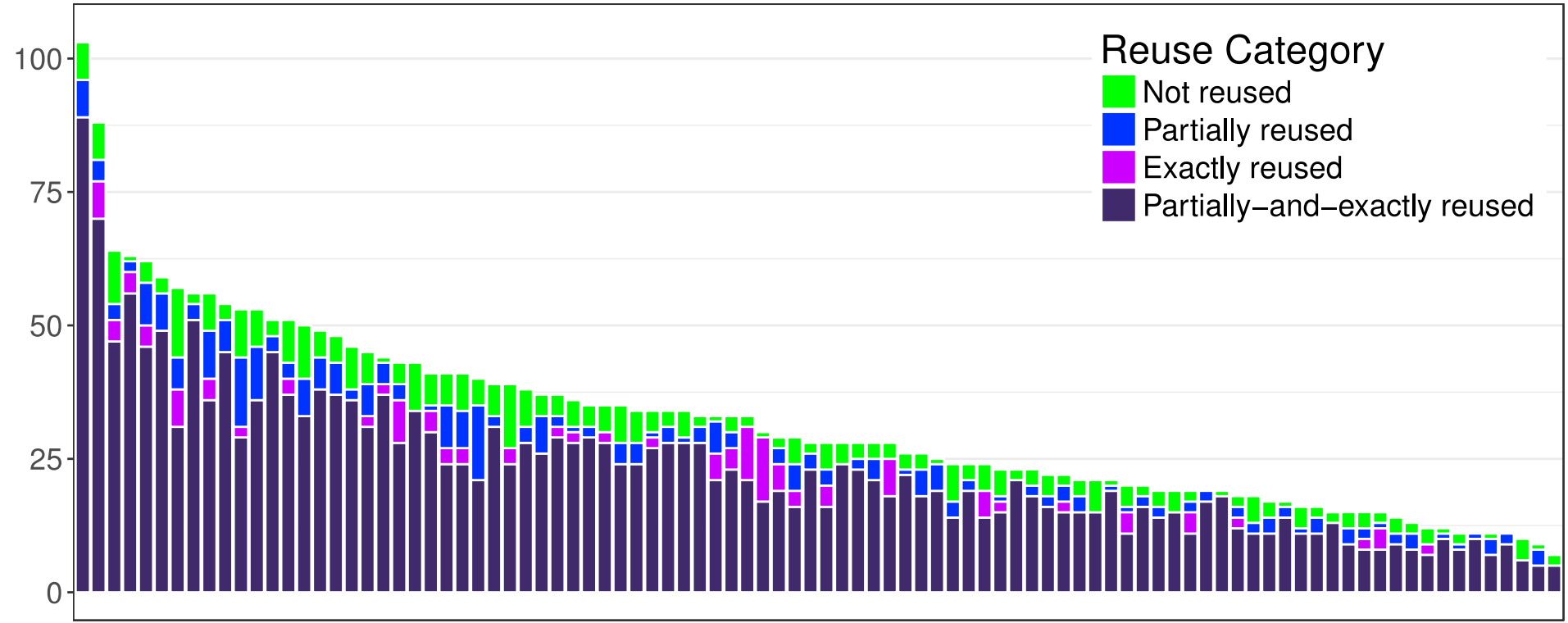
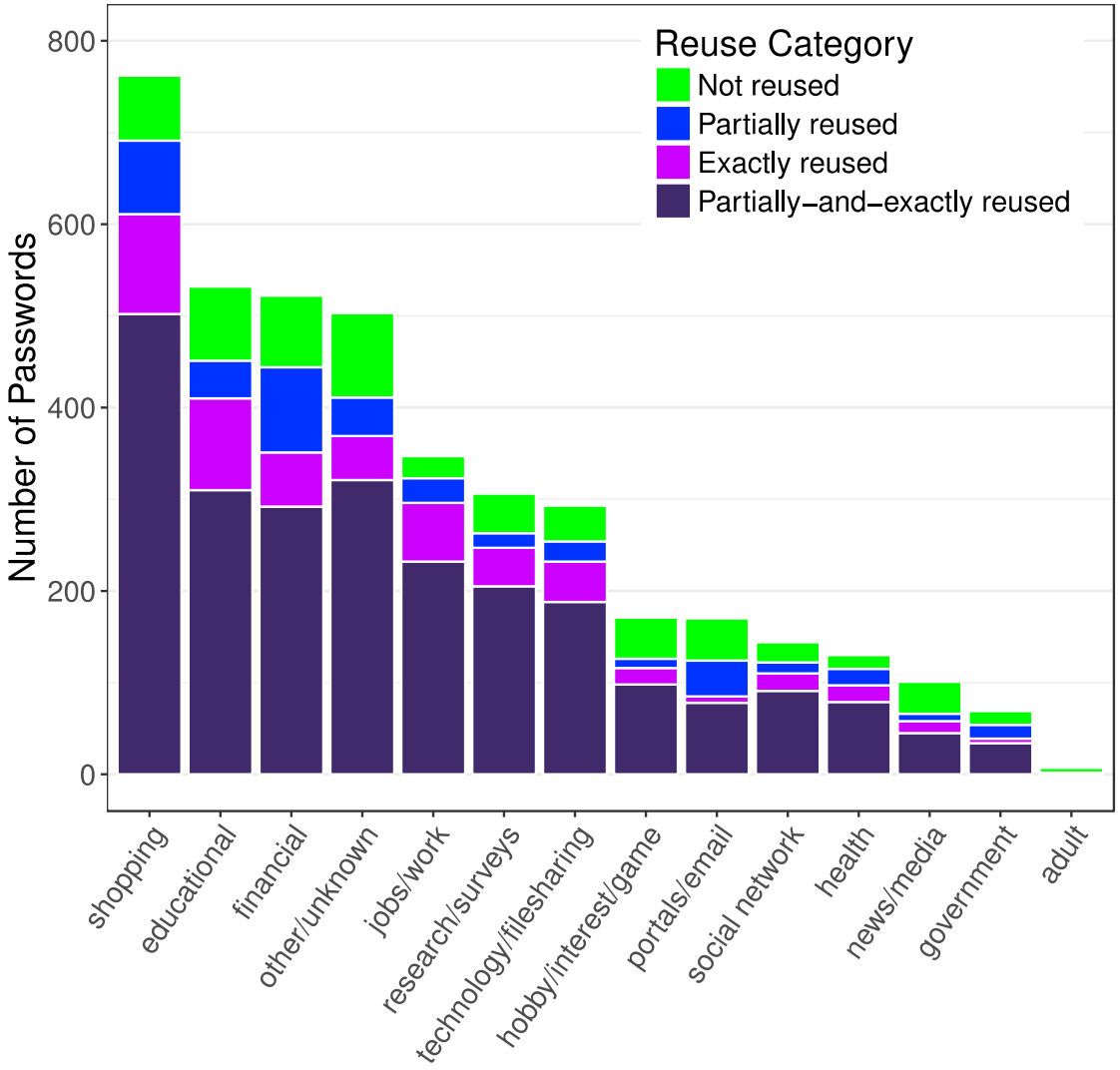
Exactly reused
Partially–and–exactly reused

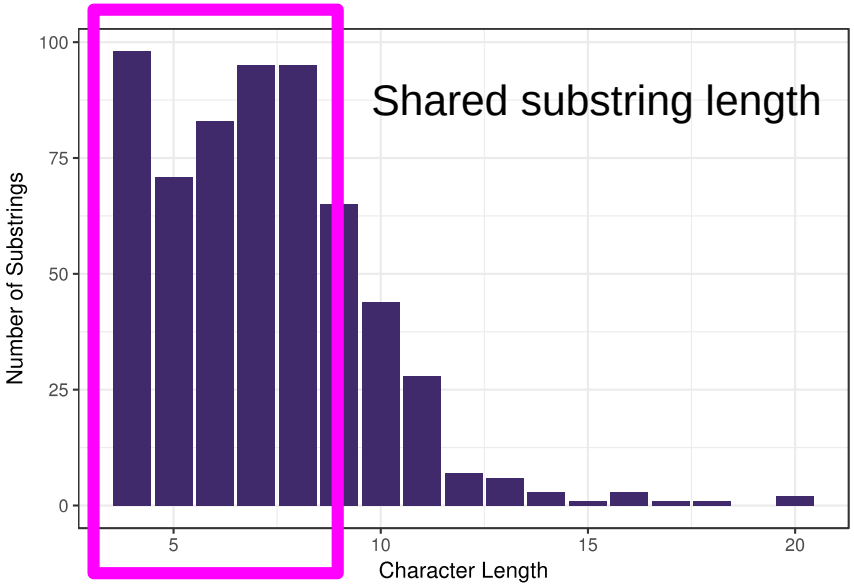


Group 4: Exact–and–partial reusers

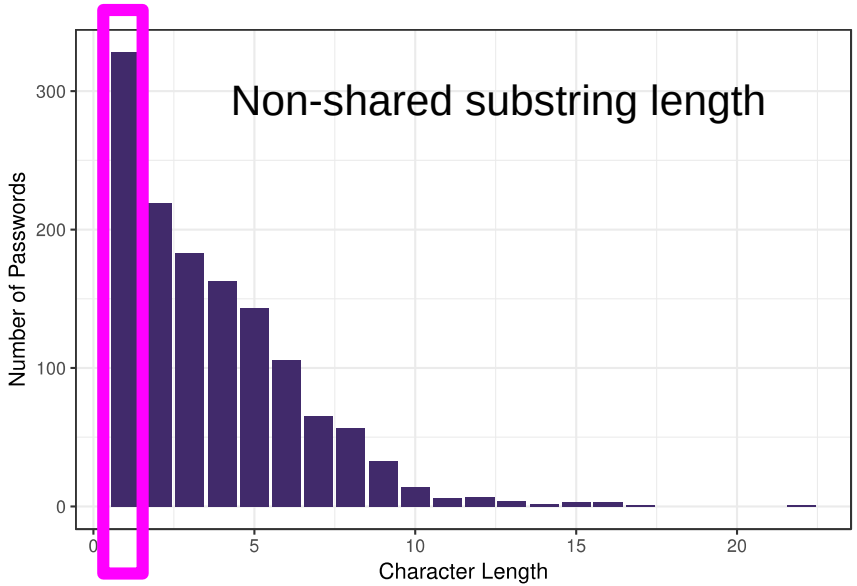
Lots of reuse across almost all categories of websites



Typical partial reuse: 4-8 characters



4-8 characters shared



1character not shared

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  - password strength

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  - frequency of password reuse
  - password strength
- Users may be using password managers to store and autofill passwords, but not to generate random passwords

Reuse is rampant

- SBO provides unique opportunity to study how users manage large numbers of passwords
- Users cope with password demands through a mix of reuse strategies
- Password managers may not be helping very much

SBO project: **http://cups.cs.cmu.edu/sbo.html**