Password Creation in the Presence of Blacklists

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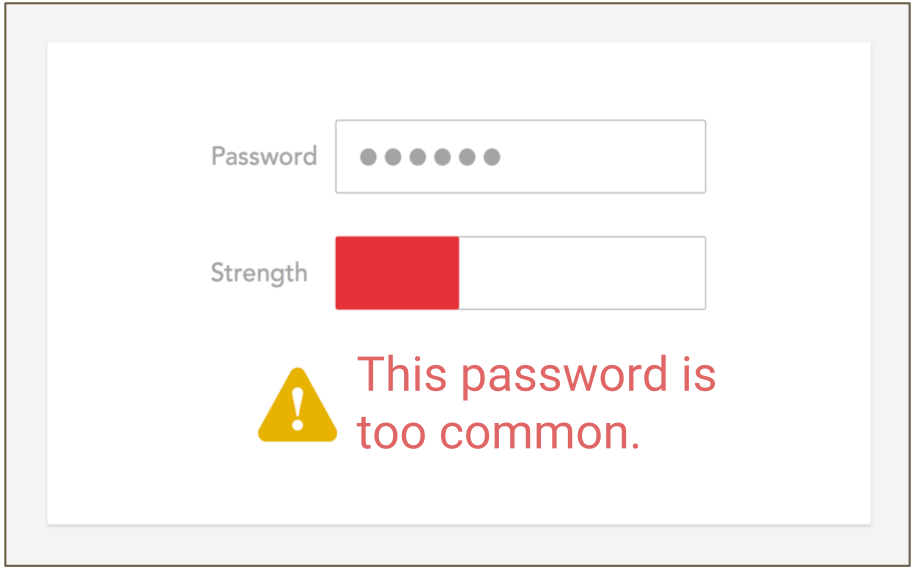
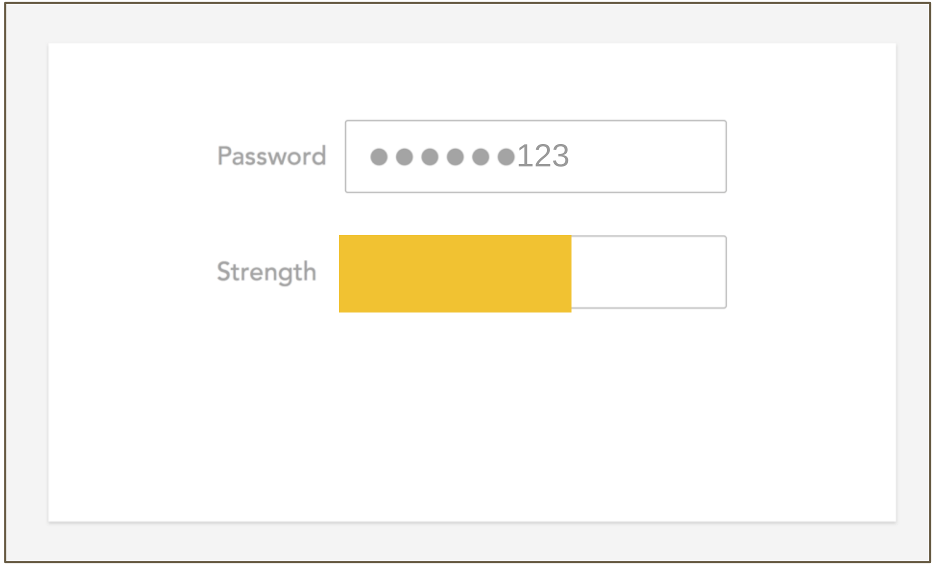
Do blacklists lead to stronger passwords?



Password ●●●●●●

Strength

This password is too common.



Password ●●●●●●123

Strength

Apparently, yes

Weir et al. CCS ‘10

- Removing blacklisted passwords from sets of passwords increases strength

Kelley et al. IEEE SP ‘12

- Bigger and complex blacklists are better

Shay et al. CHI ‘15

- Blacklists increase security less than forcing a pattern
- Blacklists led to an increase in security with better usability

DRAFT NIST Special Publication 800-63B

Digital Identity Guidelines - Authentication & Lifecycle Management

- Different assurances levels
- Moving toward multi-factor authentication

For memorized secrets (i.e. passwords)

- Do not require password complexity
- Use blacklists

NIST
National Institute of
Standards and Technology

Blacklists may be helpful, but are they enough?

How do users react to blacklists?

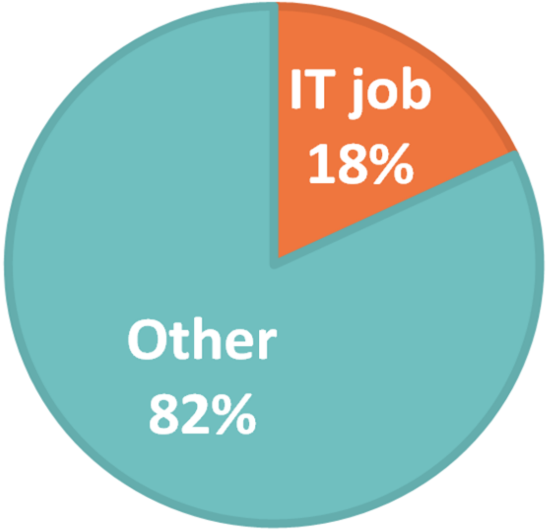
Can we help them improve their passwords?

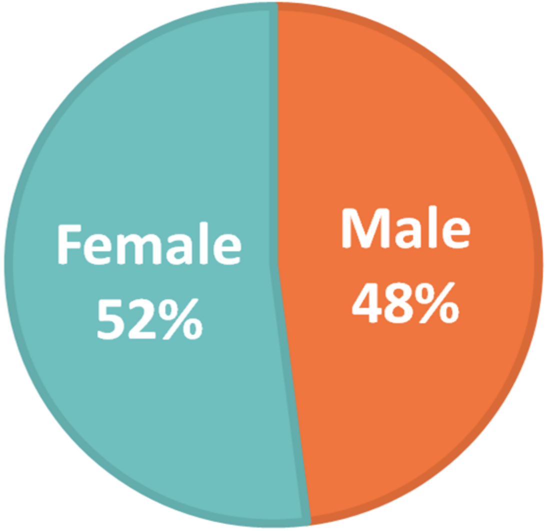
Methodology

2,280 participants created passwords

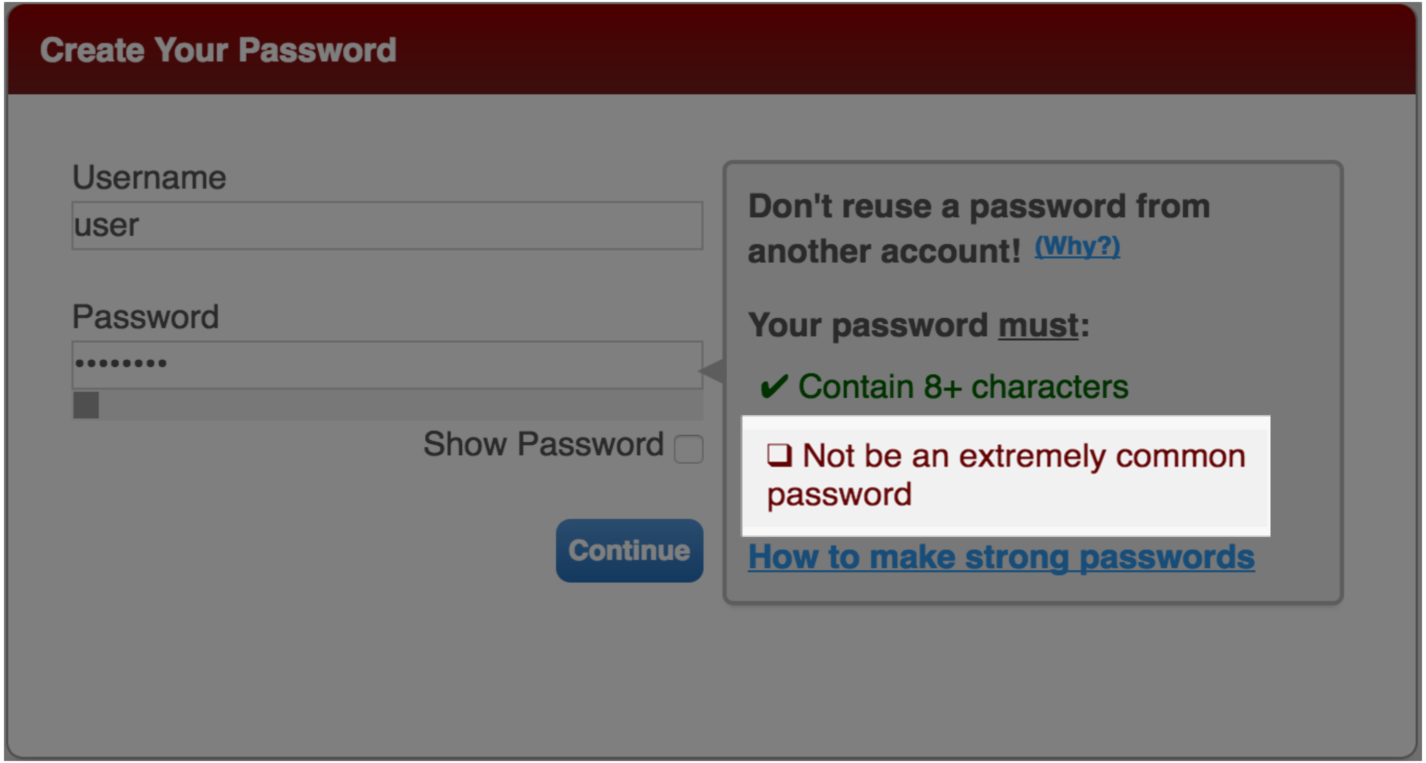
Mechanical Turk, ages 18+ in the U.S.

Collected for Ur et al. CHI ’17





Requirement: Not one of 96,480 passwords



Create Your Password

Username

user

Password

•••••••••

Show Password □

Don't reuse a password from another account! (Why?)

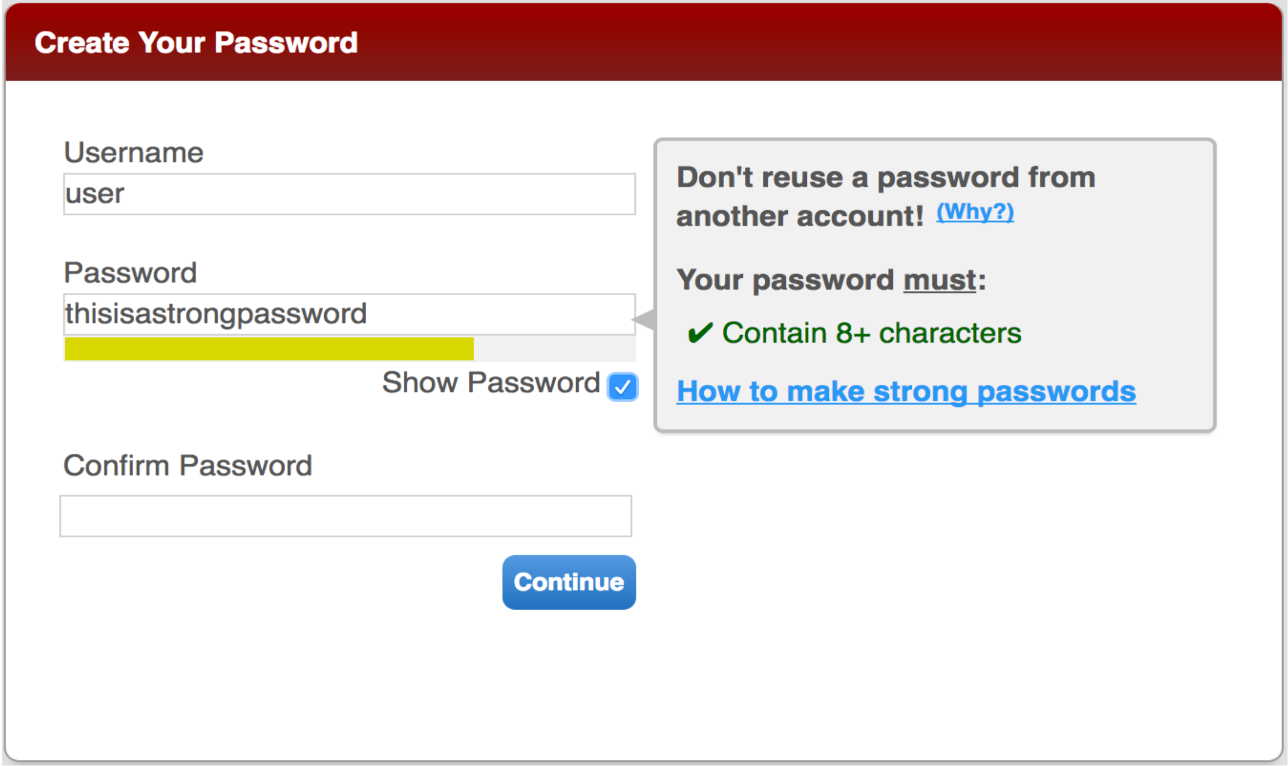
Your password must:

✔ Contain 8+ characters

❑ Not be an extremely common password

How to make strong passwords

Condition 1: No text feedback



Create Your Password

Username

user

Password

thisisastrongpassword

Show Password ☑

Confirm Password

Continue

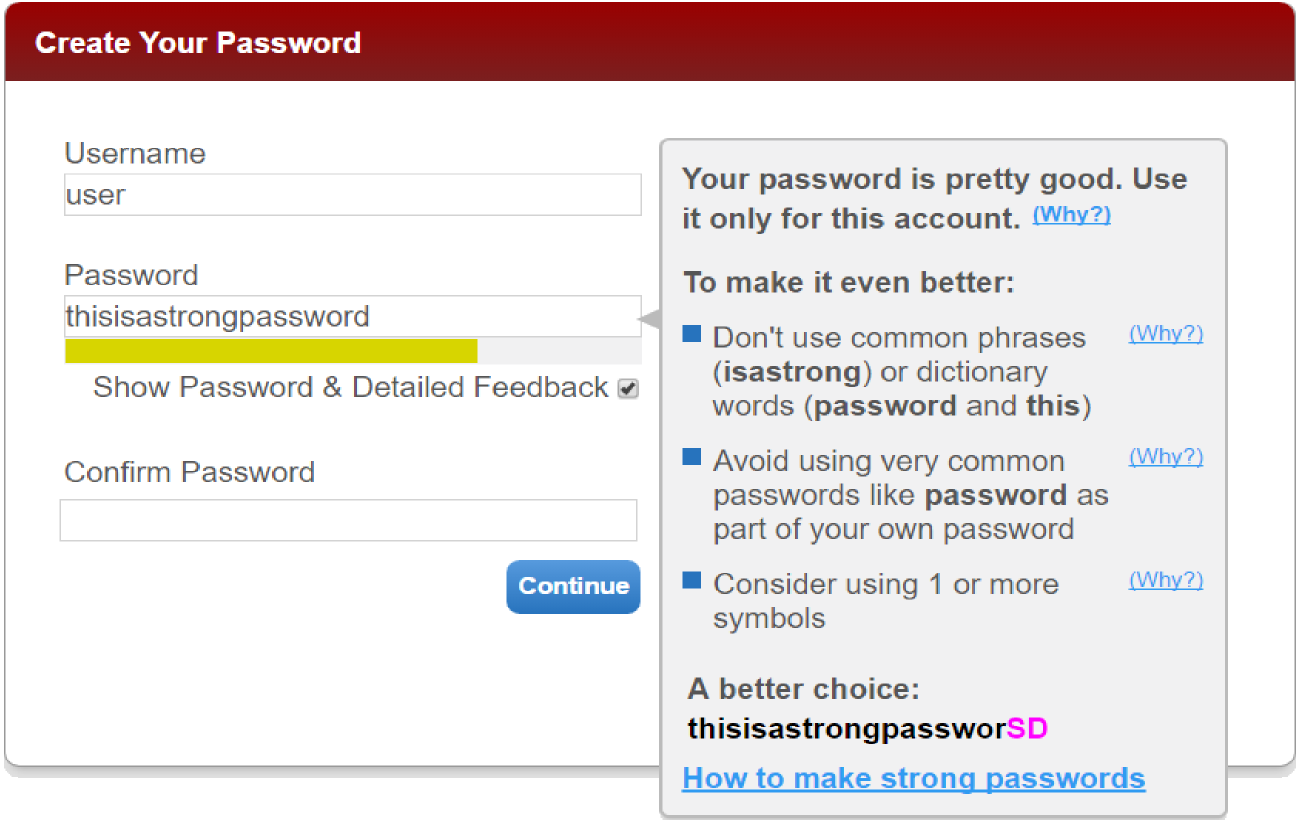
Don't reuse a password from another account! (Why?)

Your password **must**:

✔ Contain 8+ characters

How to make strong passwords

Condition 2: Text feedback



Create Your Password

Username

user

Password

thisisastrongpassword

Show Password & Detailed Feedback ☑

Confirm Password

Your password is pretty good. Use it only for this account. (Why?)

To make it even better:

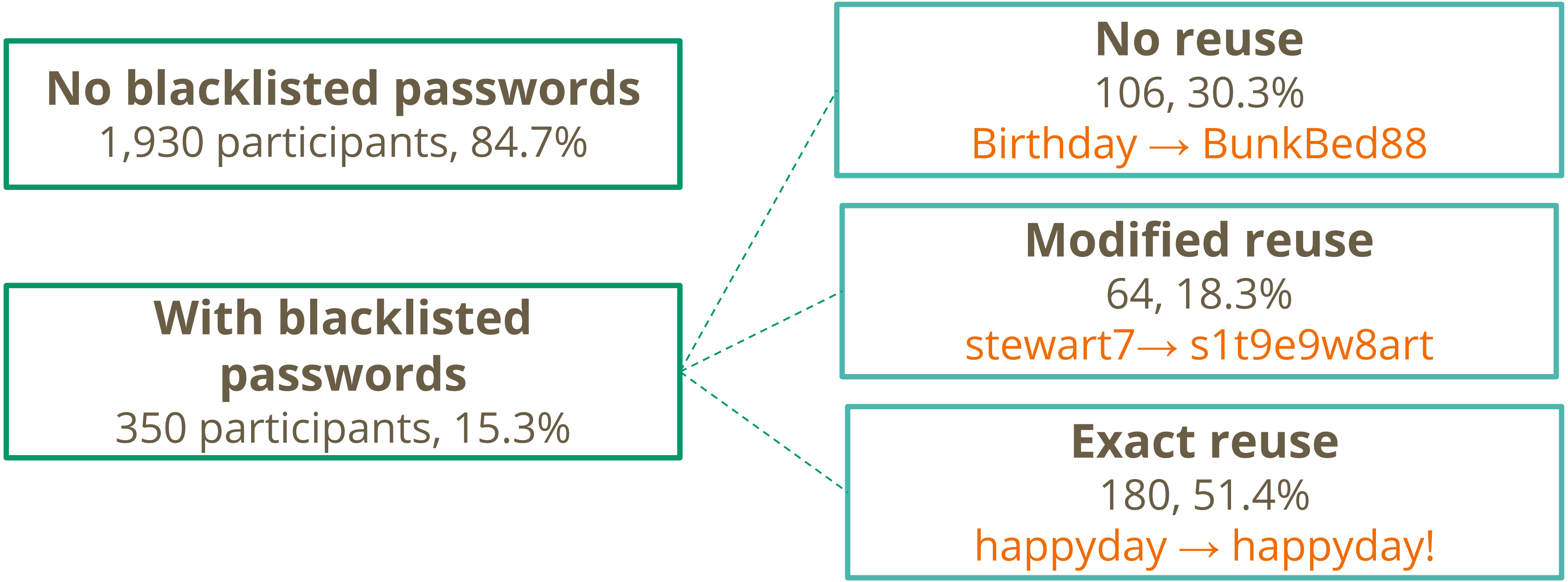
- Don't use common phrases (**isastrong**) or dictionary words (**password** and **this**) (Why?)
- Avoid using very common passwords like **password** as part of your own password (Why?)
- Consider using 1 or more symbols (Why?)

A better choice:

thisisastrongpassworSD

How to make strong passwords

Participant groupings



No blacklisted passwords
1,930 participants, 84.7%

With blacklisted passwords
350 participants, 15.3%

No reuse
106, 30.3%
Birthday → BunkBed88

Modified reuse
64, 18.3%
stewart7→ s1t9e9w8art

Exact reuse
180, 51.4%
happyday → happyday!

Research questions

1. How does the strength of the final password differ between groups?

2. How do blacklisted passwords differ from final passwords?

3. What is the impact of text feedback on password strength?

4. What impact does a blacklist have on password creation sentiment?

Results

No blacklisted attempt → More complex passwords

A B C D E F G
H I J K L M N
O P Q R S T
U V W X Y Z

1.7 x as many capital letters

! @ # $ %
^ & * ( ) _
{ } - + = ? ;

1.4 x as many symbols

1 2 3 4 5
6 7 8 9 0

1.1 x as many digits

Notification increases complexity

A B C D E F G
H I J K L M N
O P Q R S T
U V W X Y Z

3 x as many capital letters

! @ # $ %
^ & * ( ) _
{ } - + = ? ;

28 x as many symbols

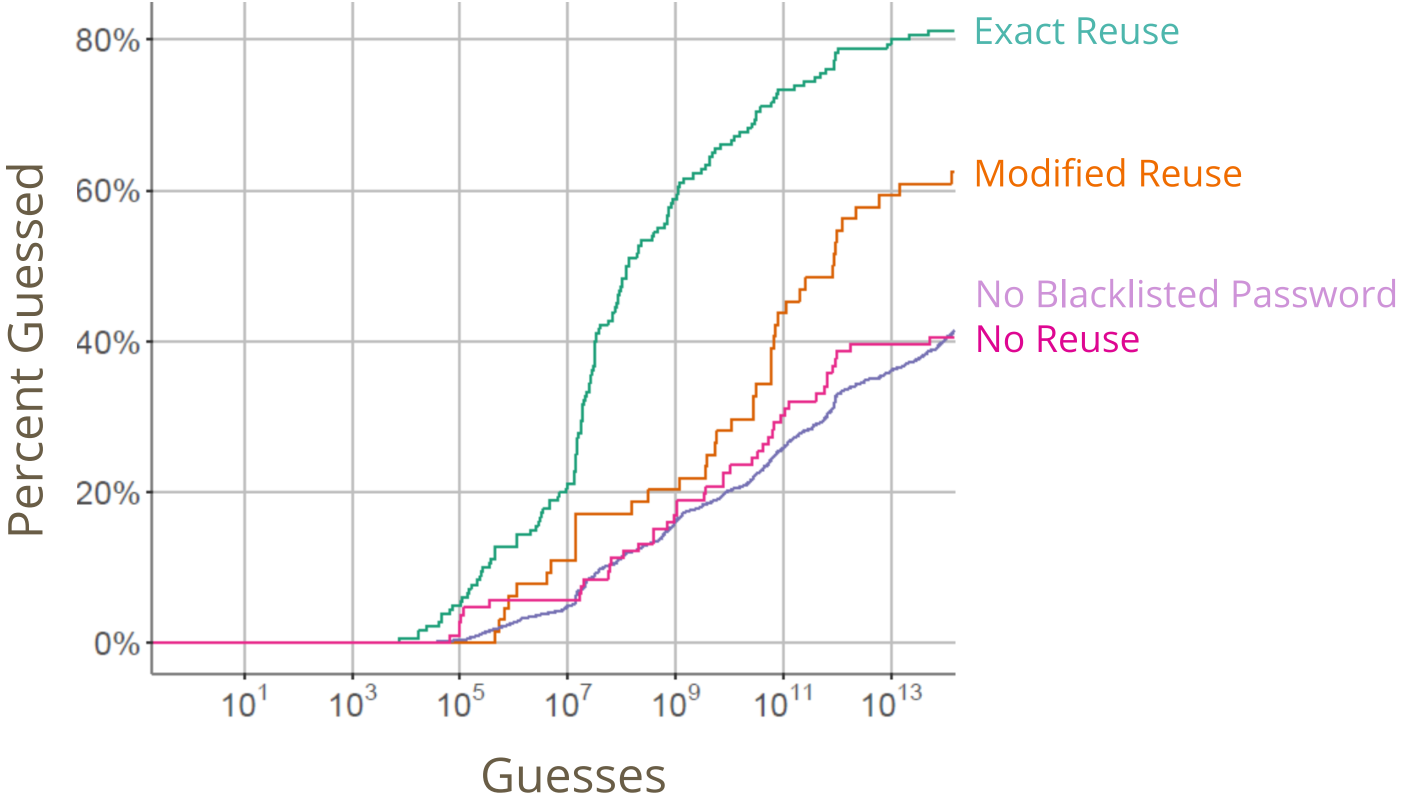
1 2 3 4 5
6 7 8 9 0

2.3 x as many digits

People change passwords in simple ways

	% of Reuse Participants	Modified Reuse	Exact Reuse
Added Digits	92%	pass1word	password1
Added Symbols	36%	pass_word	password_
Added Words	24%	passmyword	passwordword

Modifications → Stronger passwords



Feedback helps with complexity

A B C D E F G
H I J K L M N
O P Q R S T
U V W X Y Z

1.5 x as many capital letters

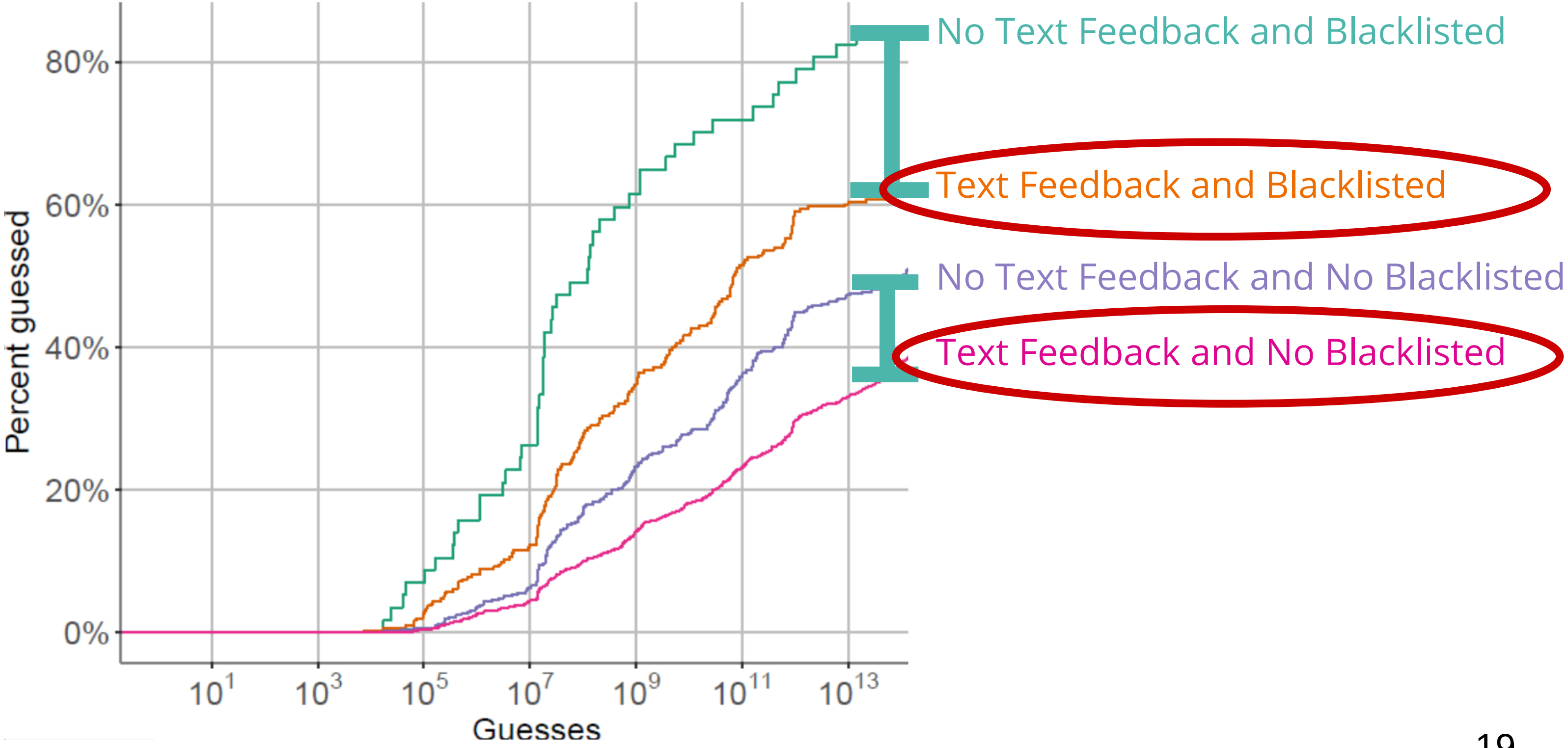
! @ # $ %
^ & * ( ) _
{ } - + = ? ;

1.6 x as many symbols

1 2 3 4 5
6 7 8 9 0

1.1 x as many digits

Feedback helps with strength



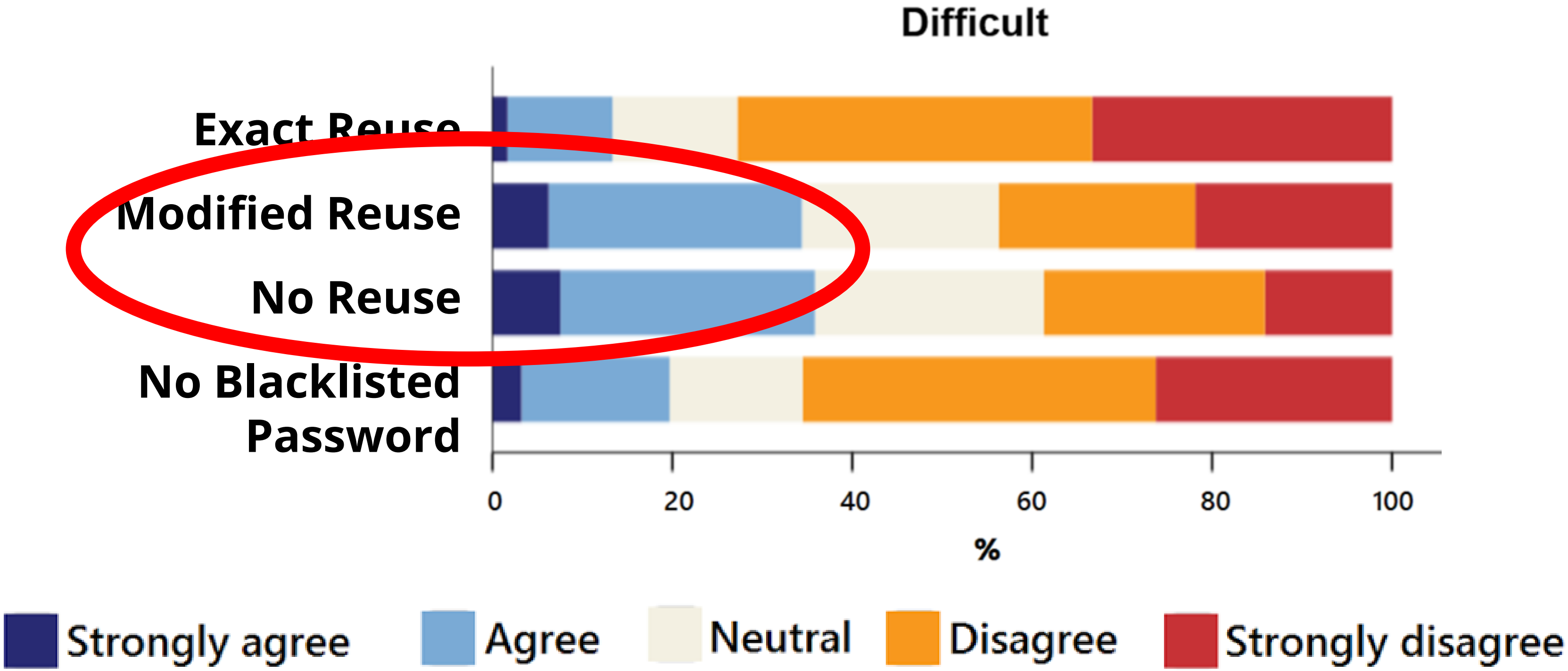
No Text Feedback and Blacklisted

Text Feedback and Blacklisted

No Text Feedback and No Blacklisted

Text Feedback and No Blacklisted

Increased effort is difficult and annoying



Recommendations for your system admin

Check for reuse of blacklisted passwords

Perform substring check

Strip out digits & symbols

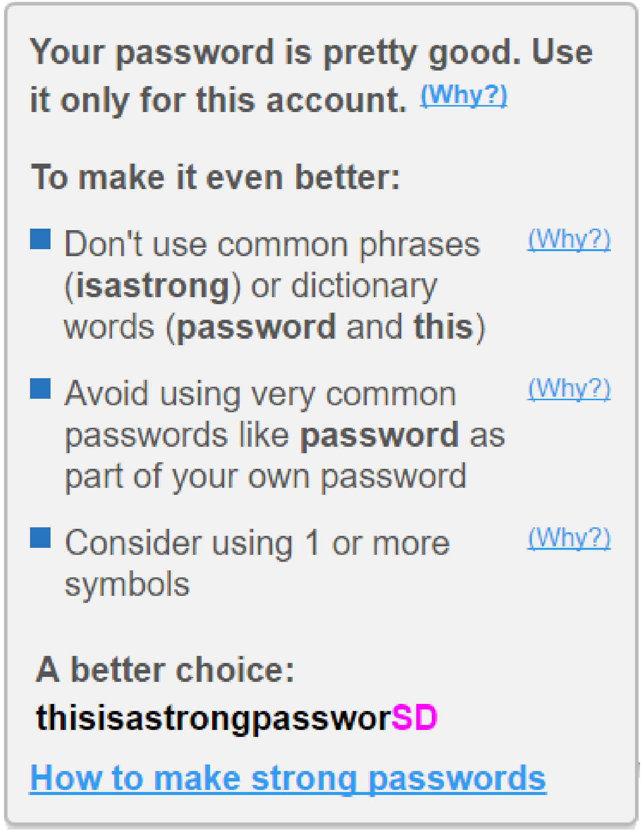
~~password~~

~~password!~~

~~123password!~~

US3Cs4nd!3G0.17

Provide text feedback



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For more on this: ups.cs.cmu.edu/passwords/