Lessons Learned From Evaluating Eight Password Nudges in the Wild

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Research Question

Users often create weak passwords and hackers are easily able to compromise accounts. [1,2]

Can we find a way to “nudge” people towards better passwords?

The Concept of Nudging

A nudge attempts to influence people towards a wiser option by manipulating the **choice architecture** surrounding the behavior to encourage wiser choices.

[4]

Nudging has Worked

Examples from the Behavioural Scienes:

- Improving tax repayment percentages [5]
- Reducing speeding [6]
- Opt-Out vs Opt-In for organ donations [7]

Nudges and IT Security?

- People can be successfully nudged towards a secure WiFi [8]
- Nudging has helped to steer people away from apps that request too many permissions [9]
- Password Strength Meters? → Inconclusive results
  - Ur et al. (2012) found a positive impact
  - Meters made no difference: de Carné de Carnavalet (2014), Sotirakopoulos (2011), Vance et al. (2013), Egelman et al. (2013)

Method: Apparatus and Procedure

- Two sequential studies running for one academic year each
- Use of a university web application (grades, feedback, coursework deadlines etc.) → Important and frequently-used password
- Display of visual nudges on registration page of web application
- Random assignment of students to either control or one of five nudge conditions
- Informed consent and possibility to opt out

- 497 participants in study 1, 779 participants in study 2
- Mainly Computer Science students

Method: Study Design

	Year 1	Year 2
IV:	Nudge Condition	Nudge Condition
	N0 Control	N0 Control
	N1 Framing Effect	N2 Expectation Effect
	N2 Expectation Effect	N3 In-Group Effect
	N3 In-Group Effect	N6 Social Norms
	N4 Expectation Effect + Strength	N7 Expectation Effect + Reflection
	N5 In-Group Effect + Strength	N8 In-Group Effect + Effect
DV:	Password length	Password length
	Password strength	Password strength

Method: DV

- Password length: measured in number of characters
- Password strength: measured by score metric provided by strength estimator zxcvbn [10]
  - 0 - number of guesses < 10^2
  - 1 - number of guesses < 10^4
  - 2 - number of guesses < 10^6
  - 3 - number of guesses < 10^8
  - 4 - number of guesses above

Year 1

Year 1: N1 - Framing Effect

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- Most systems prompt for a password with the word “Password”
- The second most common password is also “password”
- What would happen if we changed the word to “secret”?

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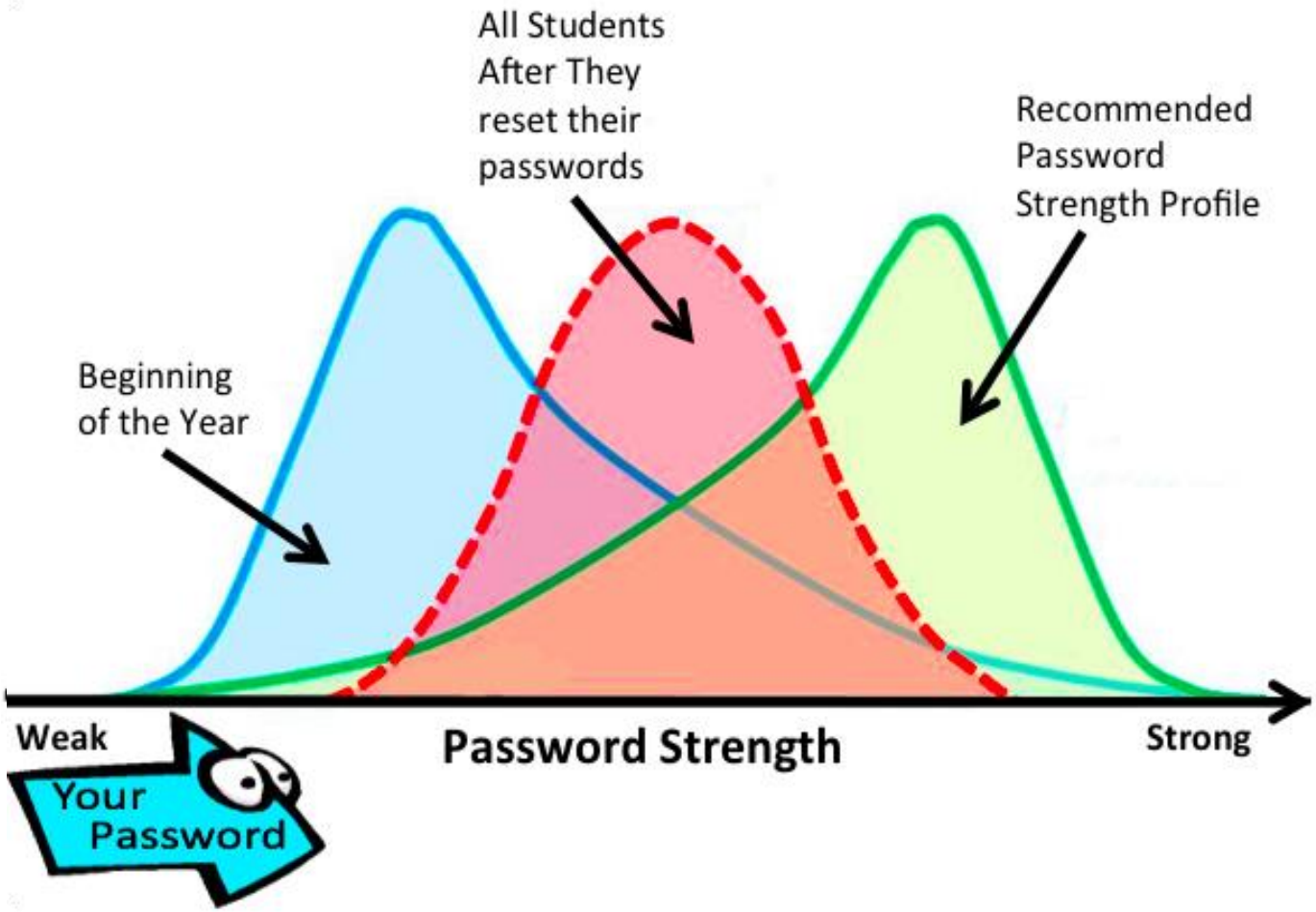
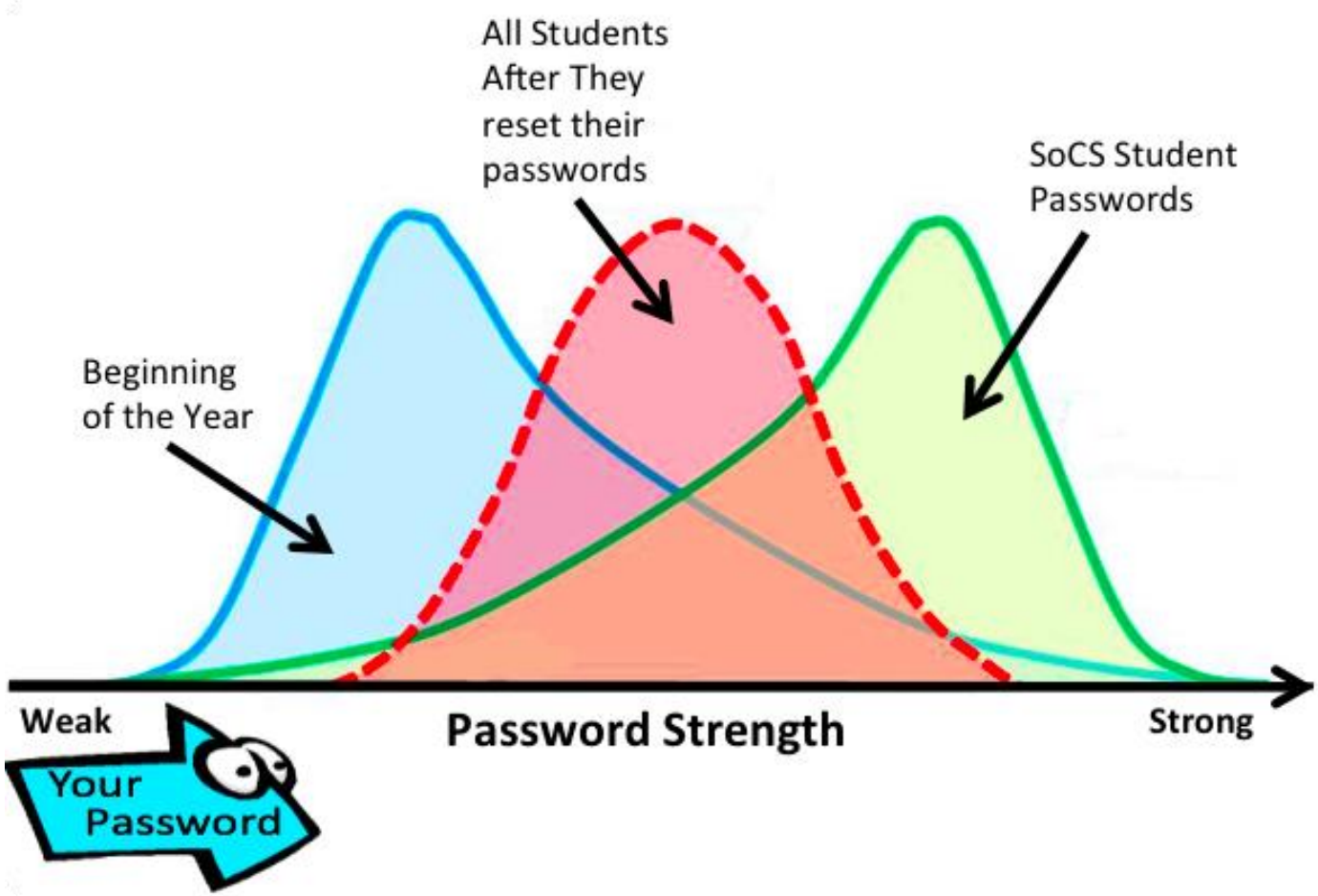
Year 1: N2/N4 - Expectation Effect (Strength)



Year 1: N3/N5 – In-Group Effect (Strength)



Study 1: Results

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Analysis:

- Password strength – ordinal scale, Password length – not normally distributed
- Use of non-parametric Mann-Whitney-U tests and Benjamini-Hochberg correction
- Pairwise comparisons: Control against Nudge Conditions

Results:

- No indication for the framing effect (“Secret”)
- No significant differences between control and nudge conditions found
- Small effect sizes Cliff’s Delta between 0.02 and 0.17

What next?

Sunstein (2017) suggests:

1. Give up, if you have reason to believe that the user knows best
2. Try different nudges
3. Offer an Economic Incentive [12]

Year 2

Year 2: N2/N7 – Expectation Effect (Reflection)

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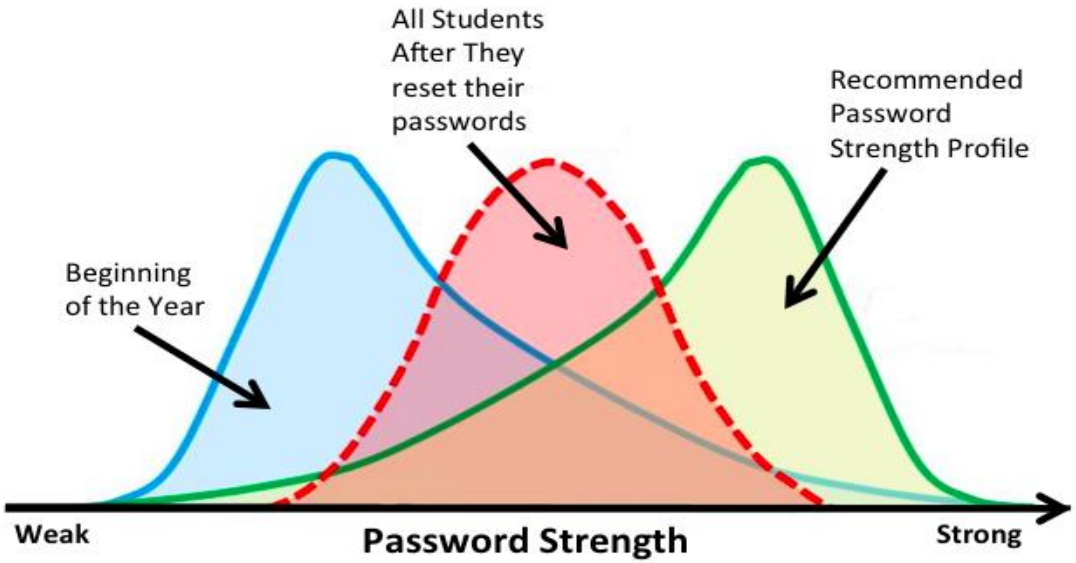
As a student, how strong do you think this password is?

- Very Weak
- Weak
- OK
- Strong
- Very Strong

- Unsure



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Year 2: N3/N8 – In-Group Effect (Reflection)

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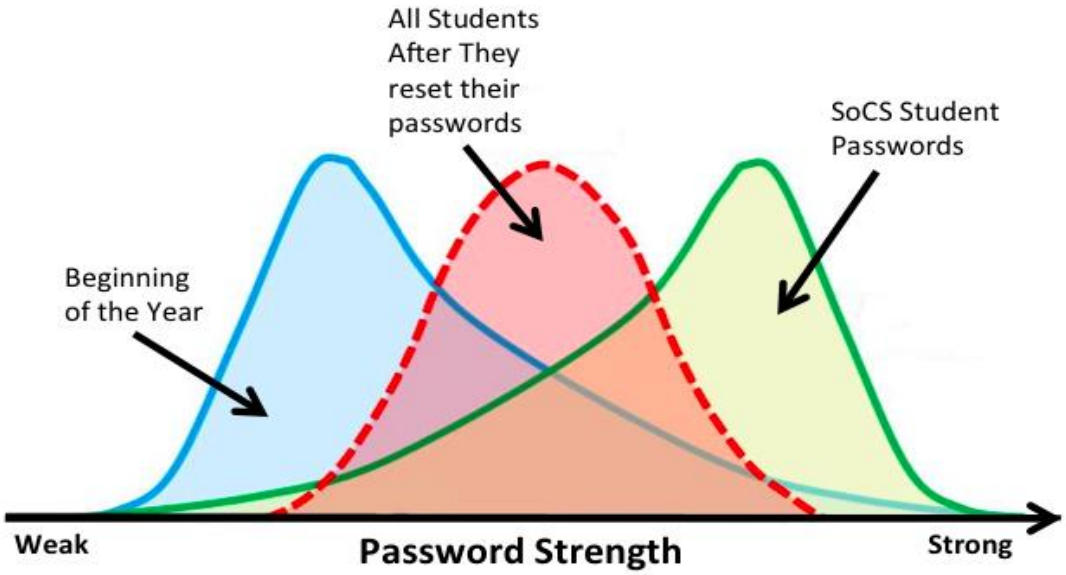
As a SOCS student, how strong do you think this password is?

- Very Weak
- Weak
- OK
- Strong
- Very Strong

- Unsure



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Year 2: N6 – Social Norms

[11]

Year 2: Results

- Similar procedure as in study 1
- No significant differences between control group and Nudge Conditions found

Questions:

- Why is this?
- What do the results mean?
- What shall we do next?

Discussion and Reflection

Methodological Issues

The strength metric

- Ordinal scale required use of nonparametric tests

  → Test power of parametric tests is slightly higher (up to 2%)

- Artificial categorization led to loss of variance and information

  → E.g. passwords that required 1100 vs. 9900 guesses to be broken would both be assigned score 2 (number of guesses between 10^4 and 10^6)

→ Differences existent, but not detectable due to choice of DV and analysis?

User Issues

Authentication is complex

- Authentication is a secondary task
- User has primary task, goals and needs → not fully considered?

Password strength perceptions

- Password strength perceptions can differ from actual password strength [13]
- Nudges only indicated that passwords should be stronger → but how?

Password Reuse

- Passwords might have been reused instead of created [14] → creation process not influenced by nudge?

Lessons learned

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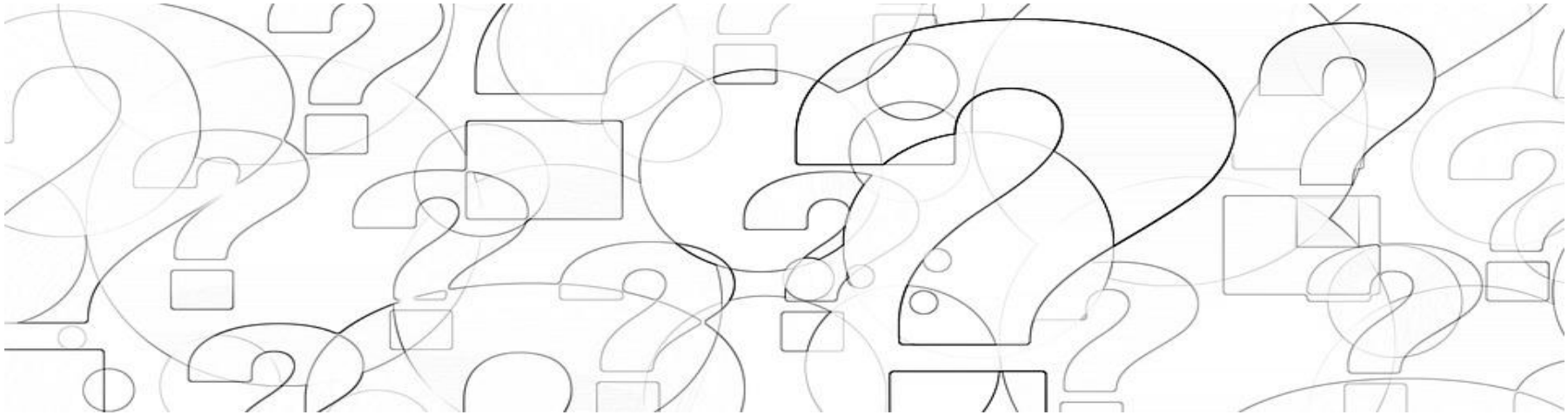
The strength metric

- Different choice of dependent variable, search for alternative metrics

The User

- User context should be fully considered
- Can password reuse be prevented?
- Beyond pure nudging:
  - Offer a benefit for stronger passwords?
  - Provide feedback/ instruction on how to increase password strength?

Are there any Questions?



Contact

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LITERATURE

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