Improving Non-Experts' Understanding of End-to-End Encryption: An Exploratory Study

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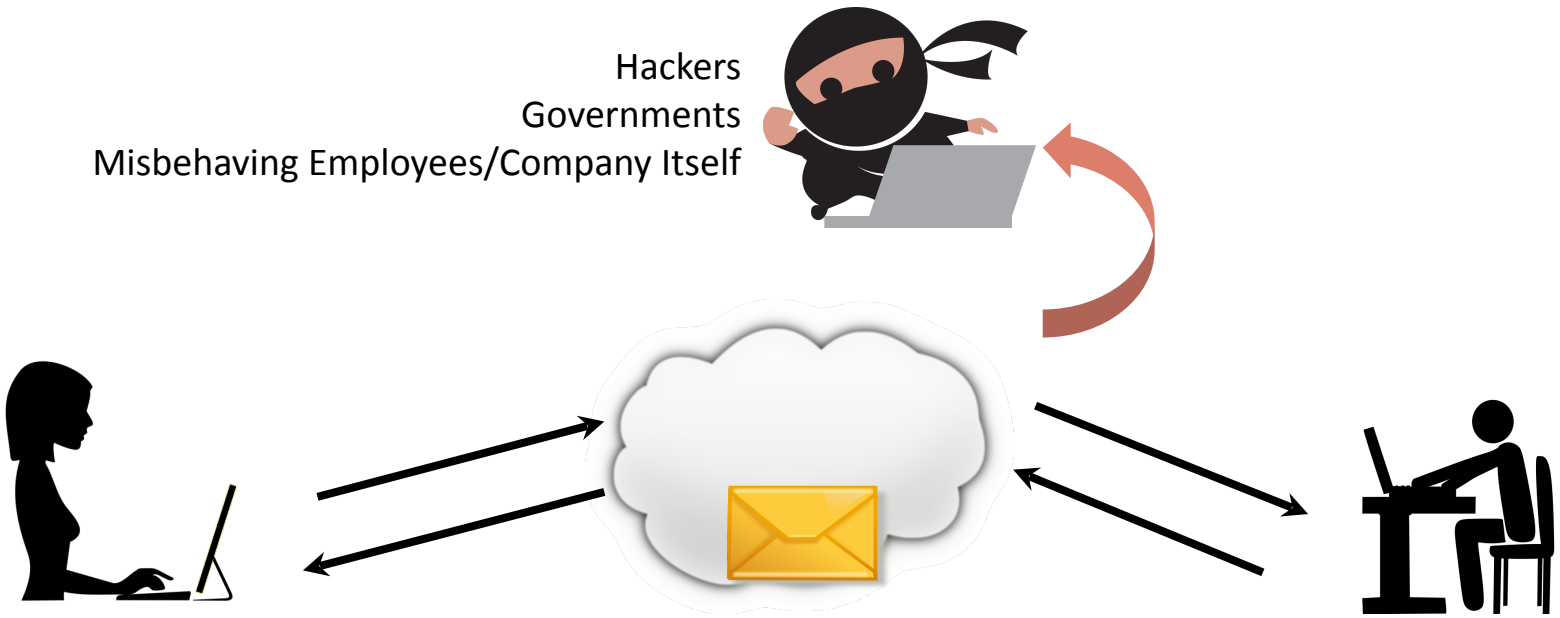
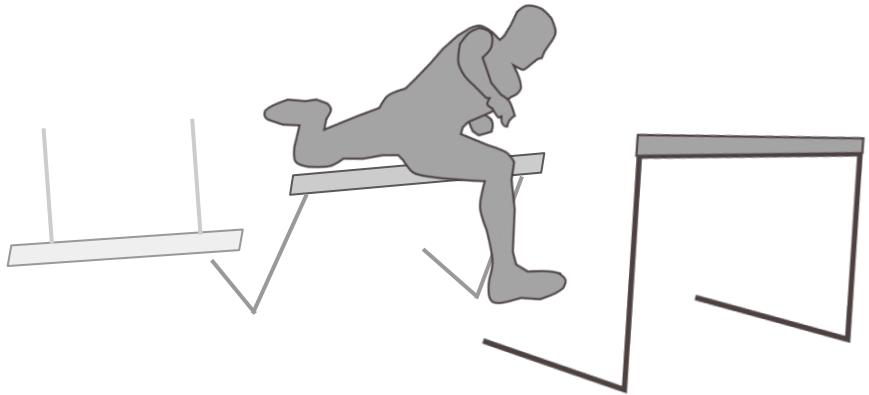
End-to-End Encryption (E2EE)

Hackers
Governments
Misbehaving Employees/Company Itself



Cartoon cloud made by egyninja from http://www.publicdomainfiles.com/show_file.php?id=13946016618385.
Envelope from https://freesvg.org/rg1024-yellow-mail
Attacker from https://pixabay.com/illustrations/ninja-laptop-hacker-cyber-security-4983545/
Person l(eft) https://freesvg.org/computer-access-available-vector-sign11006#
Person (right) https://en.wikipedia.org/wiki/File:Computer_user_icon.svg



Incorrect mental models of E2EE inhibit **confident, proactive and correct** usage.

Icons from https://freesvg.org/vector-silhouette-of-an-athlete with modification

Incorrect Mental Models Inhibit Usage

- People perceive E2EE incorrectly in both directions.
- Difficult for users to make thoughtful decisions.
- Struggled to complete some E2EE tasks.

[1] Abu-Salma et al. Obstacles to the adoption of secure communication tools. In IEEE Security & Privacy, 2017
[2] Wu et al. When is a Tree Really a Truck? Exploring Mental Models of Encryption. In USENIX SOUPS 2018

Icon from https://pixabay.com/illustrations/question-question-mark-response-1015308/

Improve Mental Models

Goal: **Help people grok basic understanding and threats**

- **Enough** to make judgments about how to communicate
- **Without** turning everyone into crypto experts
- **Naturally** **when using the app (e.g., interstitial messages)**
- **Without** requiring people to sign up for training module

Initial Study: Method

Focus: What is important, what is surprising, what to convey to others

- 25 non-expert participants, DC area

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Reasons behind quiz answers

Initial Study: Method

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Important, surprising, worth conveying

Initial Study: Method

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Critique two existing explanations

Initial Study: Method

Focus: What is important, what is surprising, what to convey to others

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Sample message of E2EE educational intervention

Modular Tutorial

- High-level overview
- Risks
- Common misconceptions
- High-level description of how it works

Non-Goal: **design optimal in-person tutorials**

- **Not** to evaluate our tutorials

Confidentiality: Most Significant

- Even though less surprising, participants found it important
- Some subtleties were surprising
  - ISPs are in the message path?

> *“. . . the internet service provider and the app company . . . may still get a copy of the message, that is protected by this wall, that is nearly impossible to break. So they can see you sent a message, but they can’t see what the message says.”*

Explaining Risks Clearly is Useful

- Particularly like comparison of E2EE vs. non-E2EE
- Important to clarify weaknesses of E2EE as well as benefits

"Knowing the risks of the non-E2EE and then really comparing it to how is this better… that's really the most important."

Integrity & Authenticity Still Confusing

- Authenticity is conflated with username/password

“E2EE protects against message modification and impersonation. Not even usernames and/or passwords can be stolen or guessed.”

Takeaways

- Confidentiality: Most significant
- Explaining risks clearly is useful
  - Comparing E2EE vs Non-E2EE
  - Weaknesses
- Some pieces may not worth mentioning
  - Integrity & authenticity

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