Exploring User Mental Models of End-to-End Encrypted Communication Tools

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8th USENIX Workshop on Free and Open Communications on the Internet (FOCI)

Our Main Message

Secure messaging has a messaging problem!

Introduction

- Our community has advocated the adoption of secure communication tools.
- These tools offer different security properties:
  - Confidentiality
  - Integrity
  - User authentication

Related Work

- Why Johnny Can’t Encrypt? A Usability Evaluation of PGP 5.0 (Whitten and Tygar, 1999)
- …
- Why Doesn’t Jane Protect Her Privacy? (Renaud et al., 2014)
- Obstacles to the Adoption of Secure Communication Tools (Abu-Salma et al., 2017)

Prior work has shown that incorrect mental models are a barrier to the adoption of secure tools.

In This Work

We **quantitatively** explore user mental models of end-to-end (E2E) encrypted communication tools.

Research Questions

- RQ1. What are users’ general mental models of E2E encryption?
- RQ2. Do users understand the security properties offered by E2E encrypted communication tools?

Soteria: A Hypothetical E2E Encrypted Tool

Imagine you are considering using a new tool named Soteria to communicate with your family members, friends, colleagues, and others. When you install Soteria, the following message is displayed:

“Soteria communications (messages, phone calls, and video calls) are end-to-end encrypted.”

Survey Topics – Mental Models (RQ1)

- Have you heard of the term “end-to-end encryption?”
- Do you feel confident explaining what it means?
- What does end-to-end encryption mean to you?
- What do the ends in “end-to-end encryption” refer to?
- What are the benefits and drawbacks of using Soteria?
- Do different types of communication have the same level of security?

Survey Topics – Security Properties (RQ2)

- Which of the following entities could access your Soteria communications?
  - People who work at Soteria
  - People with a technical background
  - People who are up to no good
  - Corporations other than the company that develops Soteria
  - Governments
  - ISPs
  - Other
  - No one

Survey Recruitment

- Iteratively developed questionnaire.
- Conducted survey in the UK in April 2018.
- Recruited 125 survey respondents using Prolific Academic.
- Paid each respondent £2.5.
- Average completion time = 10 minutes.

Data Analysis

- Two researchers coded qualitative responses using Thematic Analysis.
- Cohen’s kappa coefficient = 0.87.

Results – Demographics

♀ ♂

58% 40%

Age

18 – 44: 80%

Educational level

College degree: 34%

Graduate degree: 20%

Results – Demographics

90%

Use (or used) E2E encrypted tool

Results – Demographics

90%

Use (or used) E2E encrypted tool

87%

Use (or used) WhatsApp

Results – Demographics

62%

Had heard of E2E encryption

Results – Demographics

62%

Had heard of E2E encryption

12%

Felt confident explaining E2E encryption

Results – General Mental Models

- Benefits?

86%

Provides E2E encryption

Results – General Mental Models

- Benefits?

86%

Provides E2E encryption

- Drawbacks?

11%

Partners need to use Soteria

9%

Cybercrime

Results – General Mental Models

- What does E2E encryption mean?

34%

No one could access

33%

Only sender and recipient could access

5%

Only devices could access

Results – General Mental Models

- What do the ends refer to?

50%

Sender and recipient

30%

Devices/instances

Results – General Mental Models

- What do the ends refer to?

50%

Sender and recipient

30%

Devices/instances

15%

Start and end of exchanged message

Results – Security of Different Types of Communication

~70%

Same level of security (Soteria communications)

Results – Security of Different Types of Communication

~70%

Same level of security (Soteria communications)

~75%

Soteria text messages <= landline phone calls, mobile phone calls, SMS

Results – Access to Soteria Communications

~40%

No one could access

Results – Access to Soteria Communications

~40%

No one could access

~60%

At least one entity (governments, Soteria employees, technical people) could access

Results – Access to Soteria Communications

~40%

No one could access

~60%

At least one entity (governments, Soteria employees, technical people) could access

~75%

Were not confident

Our Main Message

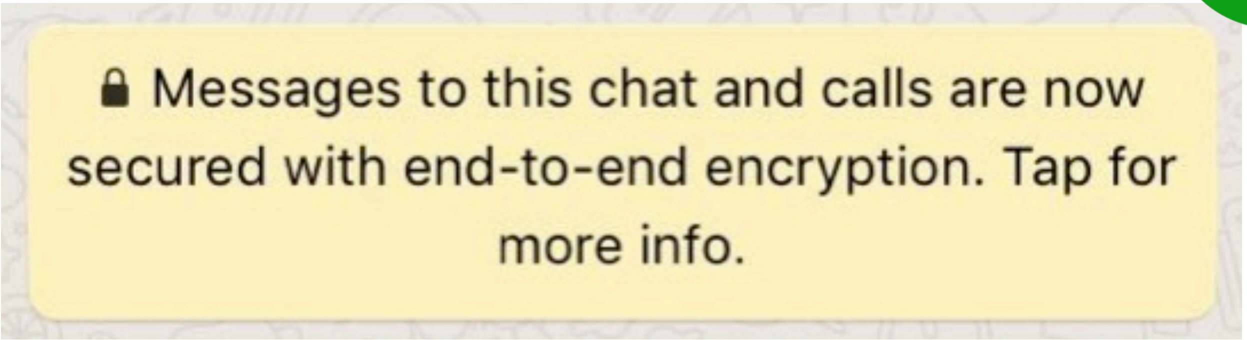
Secure messaging has a messaging problem!

Key Takeaways

- Users might not feel threatened by proposals of "backdoors."
- Primary user-related challenge for E2E encrypted tools is appropriate use, not adoption.

Hypothesis

- A high-level description of a secure communication tool as “end-to-end encrypted” does not provide users with the necessary information.



🔒 Messages to this chat and calls are now secured with end-to-end encryption. Tap for more info.

Recommendations

- Designing better descriptions to communicate the security properties of E2E encrypted communication tools, and increase users' feelings of self-efficacy.

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- Developing educational interventions targeted towards activists, dissidents, and policy makers.
- Focusing on appropriate use, not adoption.

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