Responsibility and Tangible Security: Towards a Theory of User Acceptance of Security Tokens

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Pico Team

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Agenda

• Passwords
• Background to Pico
• Approach
• Analysis
• The Grounded Theory
• Conclusions
Passwords

- Coping strategies (reusing, storing, etc.)
- Alternative password types (passphrases, graphical passwords, etc.)
- Password managers
- FIDO
- Two-factor authentication
- Purely token-based schemes
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Pico (Stajano, 2011)

Pico = Small, dedicated device; Passwords → Scan a QR code

**Usability** benefits: Memory, Effort, Scalability

**Security** benefits: Continuous authentication; Resistant to guessing, phishing, and key-logging; **Theft-resistant**
Picosiblings

• It locks itself!
• Detects how close it to its Picosiblings
• Smaller devices you carry with you
• Collection → only need some
What explains the acceptability of a token-based authentication mechanism, such as Pico?
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Approach: Overview

Data obtained from semi-structured interviews in which participants interacted with low-fidelity prototypes

Data analysed using Grounded Theory (Glaser & Strauss, 1967; Strauss & Corbin, 1998)
Approach: Low Fidelity Prototypes (1)

a. Paper designs
b. Re-design
c. Plasticine
d. Polymorph

Students involved:
T. Brouwer, K. Phatpanichot, R. Dorrity, G. Liang, J. Luo, E. J. Kay-Coles
Approach: Low Fidelity Prototypes (2)

Pilot Study of Picosiblings: Everyday and makeshift items

Main Interview Study: Uniform items and more options
Approach: Semi-Structured Interviews

- **Pilot** Phase: Open and axial coding of first 6 interviews
- **Main** Phase: Open, axial, and selective coding of 16 interviews
- **Expanding**: Testing the fit of the data in the final model from an additional 4 interviews → **20 interviews**
Approach: Participants

The range (count and percentages) of participant occupations

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Count</th>
<th>(Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting (female)</td>
<td>1</td>
<td>(5%)</td>
</tr>
<tr>
<td>Engineering (male)</td>
<td>1</td>
<td>(5%)</td>
</tr>
<tr>
<td>Military (male)</td>
<td>1</td>
<td>(5%)</td>
</tr>
<tr>
<td>Admin/Clerical (male)</td>
<td>1</td>
<td>(5%)</td>
</tr>
<tr>
<td>Publishing (female)</td>
<td>1</td>
<td>(5%)</td>
</tr>
<tr>
<td>Translating (female)</td>
<td>1</td>
<td>(5%)</td>
</tr>
<tr>
<td>Software Developer (male)</td>
<td>1</td>
<td>(5%)</td>
</tr>
<tr>
<td>Homemaker (female)</td>
<td>1</td>
<td>(5%)</td>
</tr>
<tr>
<td>Unemployed:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software Engineer (male)</td>
<td>1</td>
<td>(5%)</td>
</tr>
<tr>
<td>Product Designer (female)</td>
<td>1</td>
<td>(5%)</td>
</tr>
<tr>
<td>Research:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics (male)</td>
<td>1</td>
<td>(5%)</td>
</tr>
<tr>
<td>Neuronal development (male)</td>
<td>1</td>
<td>(5%)</td>
</tr>
<tr>
<td>Cancer (female)</td>
<td>1</td>
<td>(5%)</td>
</tr>
<tr>
<td>No Occupation given (female)</td>
<td>1</td>
<td>(5%)</td>
</tr>
<tr>
<td>Student (undisclosed subject) (male)</td>
<td>1</td>
<td>(5%)</td>
</tr>
<tr>
<td>Education (teaching assistant) (1 male, 1 female)</td>
<td>2</td>
<td>(10%)</td>
</tr>
<tr>
<td>Post-grad student:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustainable Energy (female)</td>
<td>1</td>
<td>(5%)</td>
</tr>
<tr>
<td>Computer Science (1 male; 1 female)</td>
<td>2</td>
<td>(10%)</td>
</tr>
</tbody>
</table>

Gender: 10 male, 10 female

Age: 20-57 years (mean = 30.5)

Occupation: See table
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Open Coding

Reducing the data into codes

- Trial open-coding (interviews 1-6):
  - Double-coding
  - Blind-coding
- Open-coding proper (interviews 1-16):
  - “Memoing”
  - Developing a coding frame
Axial Coding

Grouping codes into conceptual categories that reflect relationships
# Axial Coding: Pico Token

<table>
<thead>
<tr>
<th>Convenience</th>
<th>Prototype Preferences</th>
<th>Trustworthiness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Efficiency (effort &amp; time)</td>
<td>1. Familiarity (of concept &amp; design)</td>
<td>1. Reliability (uninterrupted use)</td>
</tr>
<tr>
<td>2. Deployment (widely adopted)</td>
<td>2. Easy to carry, hold, and use (shape, size, &amp; button functions)</td>
<td>2. Security (misuse, loss, &amp; theft)</td>
</tr>
<tr>
<td>3. Something to carry (vs. dual-purpose or app)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Axial Coding: Picosiblings

<table>
<thead>
<tr>
<th>Hedonic Concerns</th>
<th>Utilitarian Concerns</th>
<th>Routine Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Self-presentation (personal style)</td>
<td>1. Dual-purpose (e.g. a watch)</td>
<td>1. Day-to-day (fixed or frequent)</td>
</tr>
<tr>
<td>2. Personalisation (novelty, fun, &amp; creativity)</td>
<td>2. Practical Convenience (e.g. a key-ring)</td>
<td>2. Exceptions (loss &amp; theft)</td>
</tr>
<tr>
<td>3. Flexibility (e.g. a sticker)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Selective Coding

Interpretation of codes in terms of an underlying process

- Integration of axial codes
- Refining the theory
- Developing a story line to demonstrate the theory
Selective Coding: Inconvenience

“I like the card kind of idea, kind of because you can maybe put it with other secure... with your bank card”
“Is there a way to do, like, a time thing on them? ... I guess it just makes it even more secure ... because it changes all the time”
“The worry would be obviously if you lost one and then you went to your access point and then realised that you lost one: where would you always keep the spares?... You wouldn’t want to carry too many things”
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The Grounded Theory

Cost-Benefit Analysis

- Personal Responsibility
- Inconvenience (Annoyance)
- Risk Perception (Anxiety)

Token Acceptance
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Conclusions

Passwords $\rightarrow$ Abstract  
Tokens $\rightarrow$ Tangible

Tangible security increases perceived responsibility for:

a. Mitigating security risks
b. Managing physical item

= anxiety-provoking and inconvenient
Conclusions

Three key challenges:

1. Reducing annoyance (associated with inconvenience) and anxiety (associated with risk)
2. Avoiding system failures (reliability issues)
3. Aligning mental models of Pico with how it actually works
Questions?