Two Heads are Better Than One: Security and Usability of Device Associations in Group Scenarios

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Outline

1. Introduction
2. Experimental Design
3. Results
4. Analysis and Discussion
5. Summary and conclusion

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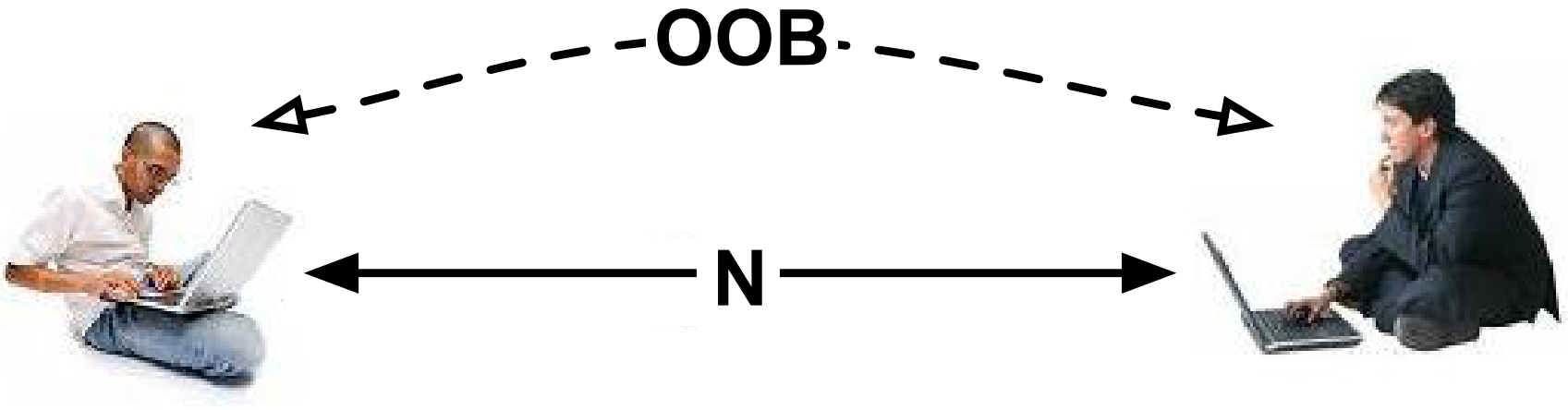
Introduction - Device association

Human-Interactive Security Protocols (HISP)



- OOB = Out-Of-Band, N = Normal

Introduction - Device association

Single user scenarios

- Two or more devices
- User has control of all devices
- Data available on performance of methods

Introduction - Device association

Group scenarios

- Different challenges from single user scenario
- Different context
- No studies

Introduction - Group device association

Association scenarios

- One-to-many
- Many-to-one
- Partial symmetric
- Full symmetric

Introduction - Group device association

Usability and security challenges

- Communication from initiator to group members
- Communication from group members to initiator
- Inattentiveness by initiator
- Inattentiveness by group members

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Experimental Design

Methods – compare and confirm

- Numeric
- Images

Experimental Design

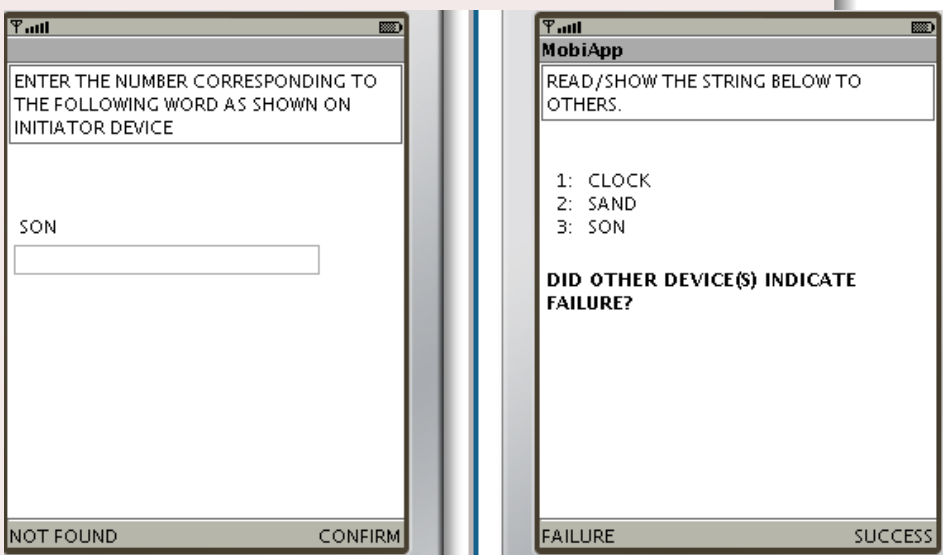
Methods – copy and enter

- Similar to Bluetooth PIN entry
- Display and keypad
- Numeric

Experimental Design

Methods – word-matching and number-typing

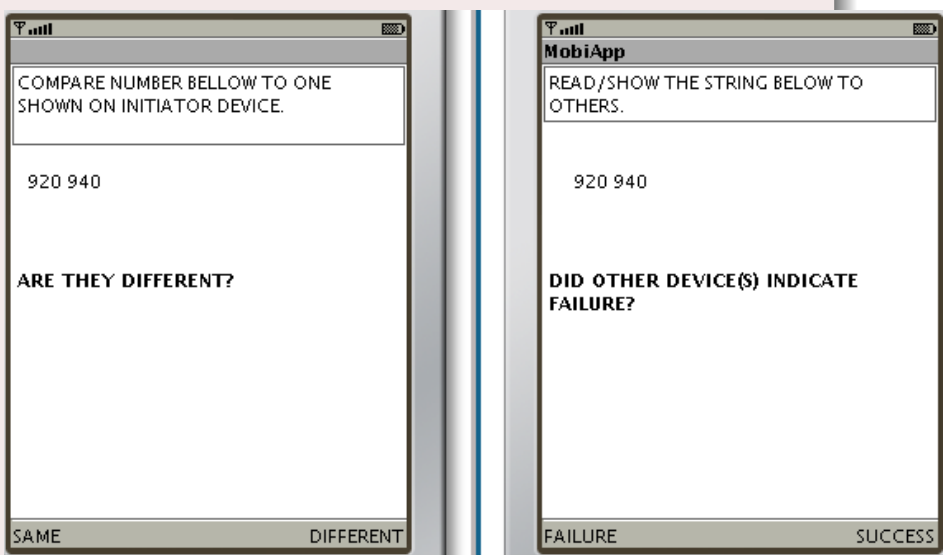
- Locally stored dictionary
  - proposed two 1024 word dictionaries
  - Phonetically distant
  - less than 40kb file
- Display and button



Experimental Design

Methods – repeated comparison

- Similar to *compare and confirm*
- Display and button
- Correct response is in 2^n



Experimental Design

Cases

- Normal case
- Failure case

Experimental Design

Design

Dependent variables

- Completion times
- Non-security failures
- Security failures

Independent variable

- Method

Experimental Design

Participants

- 47 participants

Gender	Male:	46.7%
	Female:	53.3%
Age	18 - 25	51.1%
	26 - 35	21.3%
	36 - 45	17%
	46 - 55	8.5%
	56+	2.1%
Education	High School:	19.1%
	College:	31.9%
	Graduate:	27.7%
	Postgraduate:	21.3%

Experimental Design

Participant tasks

- Primary tasks - exchanging contacts, digital cash transfer, group messaging, and group quiz
- Questionnaires
- Interview

Experimental Design - Apparatus

- Devices: Nokia N95 and Blackberry Bold 9500
  - Bluetooth support
  - Multi-tap and qwerty keyboard
- Software:
  - Simulated primary tasks
  - Device communication using Bluetooth
  - Software created a log of participant's actions
- Video camera
- Questionnaires
  - Enrolment
  - After scenario (ASQ)
  - After experiment/exit (AE)

Experimental Design

Hypotheses

- H1: there is no difference between different age groups in terms of completion times
- H2: there is no difference between different methods in terms of completion times
- H3: there is no difference between different methods in terms of rating scores

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Results - Analysis by age

	ASQ (Mode)		Failures (%)		Time (Seconds)	
	Y	O	Y	O	Y	O
Compare and confirm	7(8)	6(5)	0	0	7	8
Repeated comparison	6(9)	6(3)	9	14	14	19
Copy and enter	7(9)	7(5)	5	0	12	13
Word-matching and number-typing	6(5)	6(3)	3	11	18	26

- Performance by age: Y = younger group (<36 years, n=27), O = older group (>35 years, n=9). X(Y): X = mode, Y = frequency

Statistical analysis

- *Compare and confirm* – p (2-tailed)= .666
- *Repeated comparison* – p (2-tailed) = .185
- *Copy and enter* – p (2-tailed) = .414
- *Word-matching and number-typing* – p (2-tailed) = .024.

Results - Analysis by method

Security and non-security failures

	Security %	Non-security %
Compare and confirm	0	0
Repeated comparison	2.4	17.9
Copy and enter	0	3.6
Word-matching and number-typing	0	8.3

Results - Analysis by method

Completion times

- Group members

	Min	Max	Mean
Compare and confirm	2	42	7.89
Repeated comparison	3	64	17.63
Copy and enter	5	46	12.97
Word-matching and number-typing	6	94	22.89

- Analysis of variance $F(2.084,216.77) = 36.6$ and $p = .000$
- Pairwise comparison p-values ranging from .000 to .017

- Initiators

	Min	Max	Mean
Compare and confirm	7	278	40.97
Repeated comparison	11	105	33.94
Copy and enter	8	107	36.27
Word-matching and number-typing	11	147	48.27

- Analysis of variance $F(2.04,71.3) = 1.22$ and $p = .277$

Results - Analysis by method

Rating scores - group members

- ASQ scores significant – Friedman test $\chi^2(3) = 11.655$ and p = .009
- *Copy and enter* ranked first, then *compare and confirm*, *word-matching and number-typing*, and finally *repeated comparison*
- No significance on overall scores – Friedman test $\chi^2(3) = 5.526$ and p = .137

Results - Analysis by method

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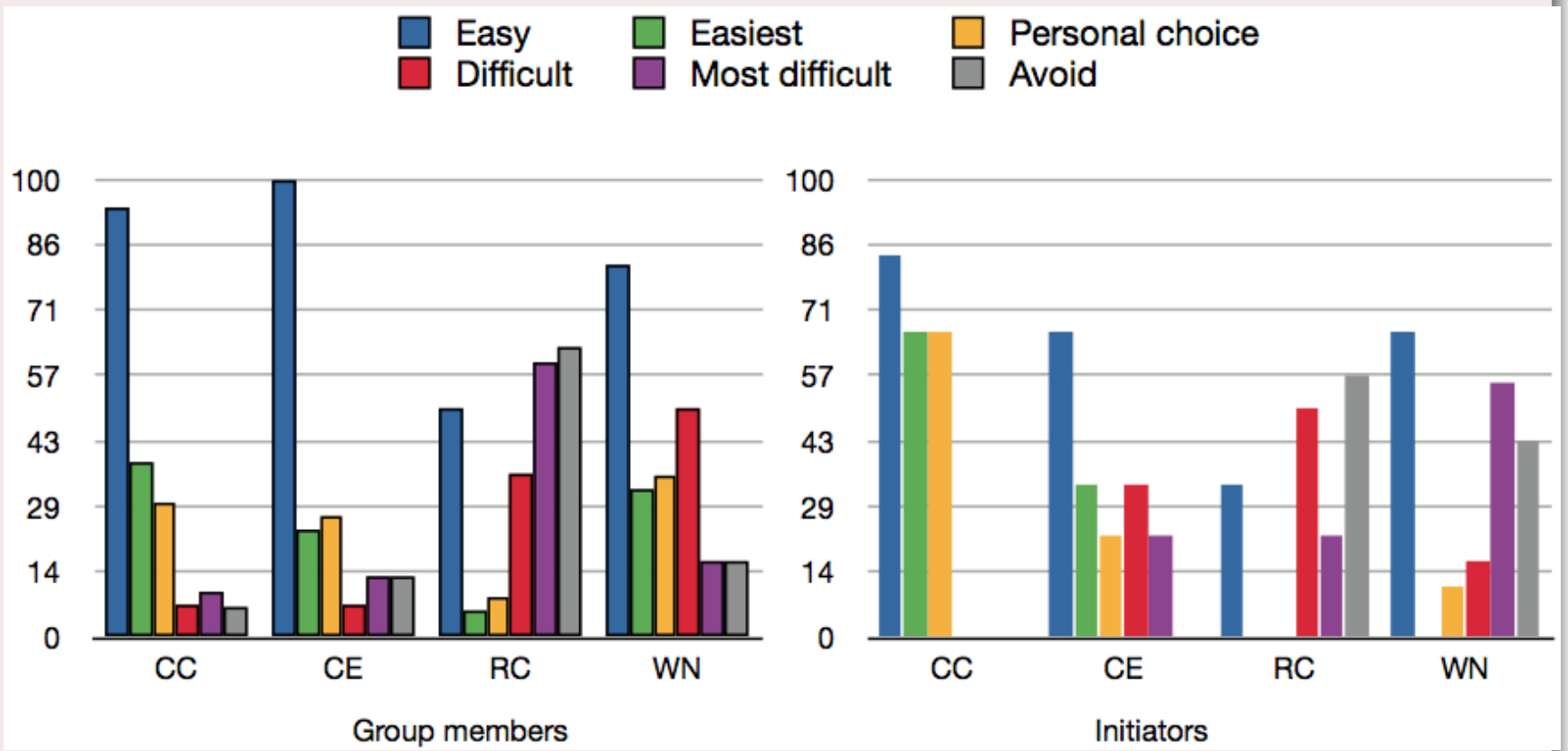
Rating scores - Initiators

- No significance on ASQ scores – Friedman test $\chi^2(3)$=4.558, p = .207
- Significance on overall scores – Friedman test $\chi^2(3)$=11.082, p = .011
- *Copy and enter* ranked first, followed by *repeated comparison*, *word-matching and number-typing*, and lastly *compare and confirm*

Results - Analysis by method

Preferences



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Analysis and Discussion

Findings - Number 1

- Security through trial and error

Analysis and Discussion

Findings - Number 2

- Importance of context

Analysis and Discussion

Findings - Number 3

- Sum-of-efforts security

Analysis and Discussion

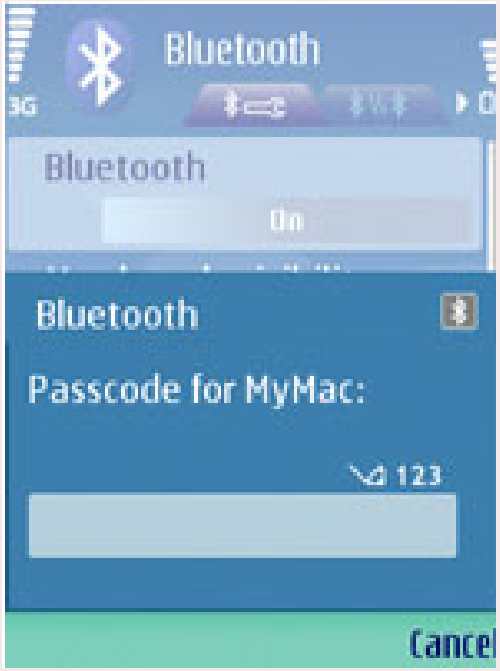
Findings - Number 4

- Insecurity of conformity

Analysis and Discussion

Findings - Number 5

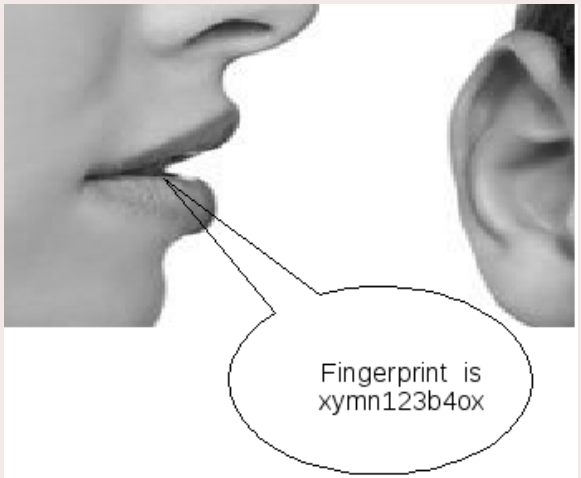
- Security beyond user interfaces



Analysis and Discussion

Findings - Number 6

- Difficult task implies security



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Conclusion

- Security is a sum of efforts
- Users learn by trial and error
- Security = difficult-to-use
- Completion times depend on initiator
- Statistical significance between methods (group members completion times)
- No statistical significance between methods (initiator completion times)


THANK YOU