



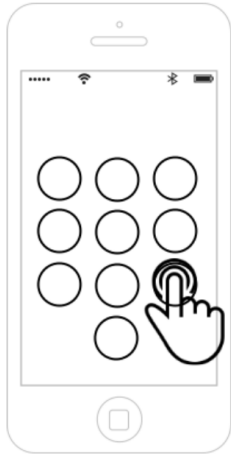
Use the Force

Evaluating Force-Sensitive Authentication for Mobile Devices

Katharina Krombholz, Thomas Hupperich, Thorsten Holz
SBA Research Ruhr-Universität Bochum

Presented by: Wilfried Mayer, SBA Research

What's the Force?



What's the content?

Lab Study

Security Evaluation

Field Study

Lab Study - Design

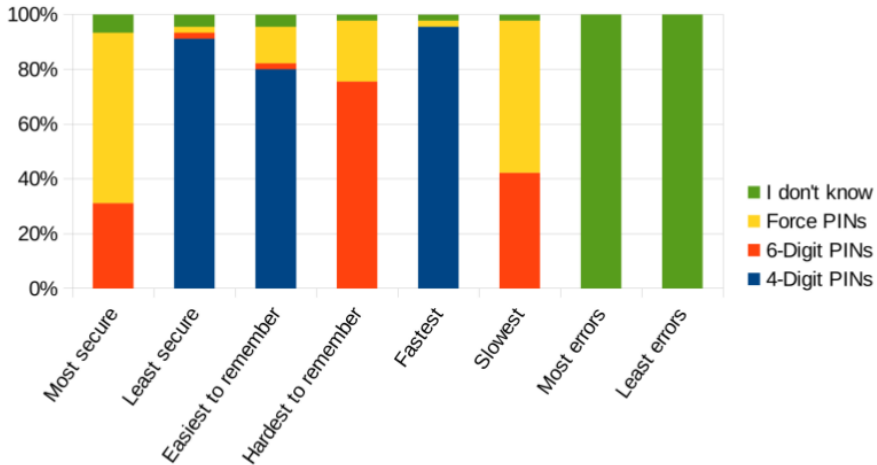


- 50 participants / 3 methods / 3 attempts
- Self-defined PIN / Random order of methods
- Authentication speed & Error rate
- Additional questionnaire

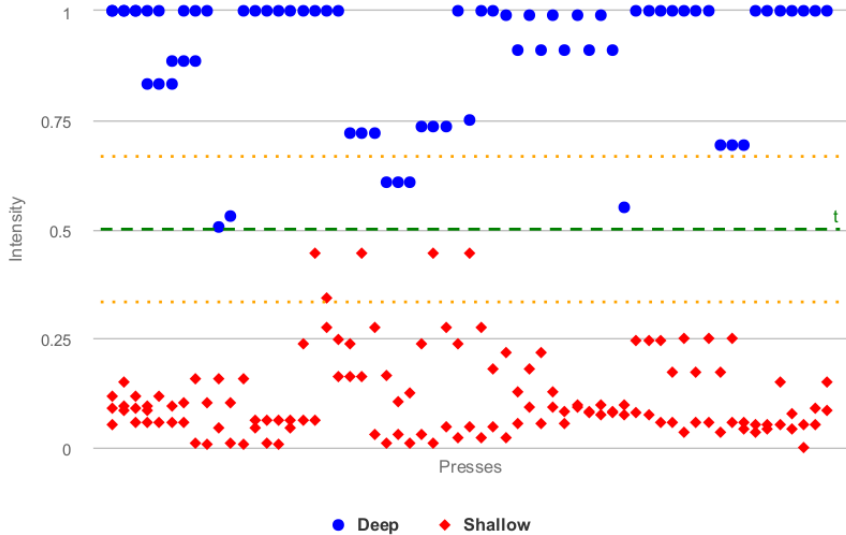
Lab Study - Results

Authentication Speed	Mean	SD
4-digit	2.34	1.21
6-digit	3.33	1.56
Force	3.66	1.96
Error Rate	Basic	Critical
4-digit	21	0
6-digit	22	0
Force	36	4

Lab Study - Perceived Usability & Security






Lab Study - Force





“I like the additional dimension. It is invisible and therefore makes my PIN more secure.” (P5)

Security Evaluation - Theoretical Entropy

method	combinations	entropy
	10^4	13.28 bit
	10^6	19.93 bit
	$20^4[-10^4]$	17.28 bit

Security Evaluation - Practical Entropy


	theoretical	13.28 bit
	practical	11.42 bit ¹

¹Bonneau et al.

Security Evaluation - Force patterns

Force Pattern	Number	Percent
DSSS	8	14.0%
SDSS	8	14.0%
SSSD	7	12.2%
SSDS	6	10.5%
DSSD	6	10.5%
SDDS	5	8.7%
DDDD	5	8.7%

Security Evaluation - Practical Entropy

	11.42 bit
D / S	3.41 bit

Security Evaluation - Shoulder Surfing Experiment

Direct observation

- Trustworthy experimenter watches while lab
- **50** PINs, **21** sequences guessed, **0** force-patterns

Filmed patterns

- Two volunteers watch recorded videos of PINs
- **50** PINs, **39** sequences guessed, **0** force-patterns

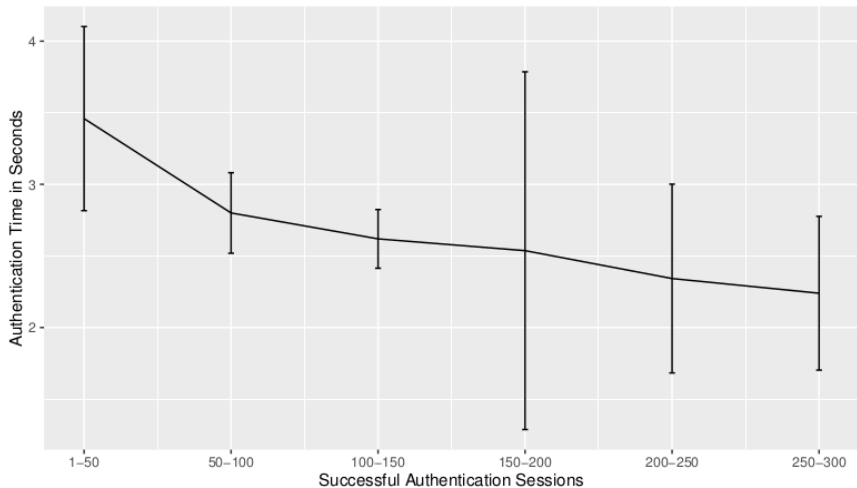
*“I think it might take a while to fully get used to it, as this concept is new to me.”
(P23)*

Field Study - Design

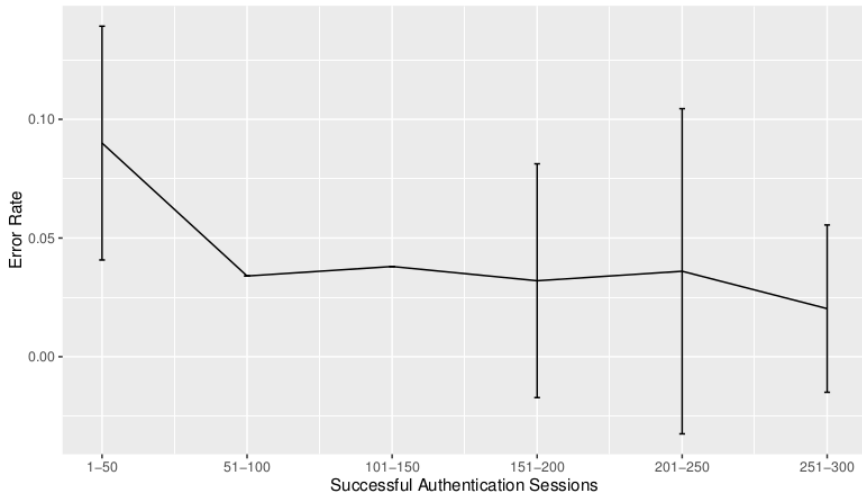


- 10 participants / Min. 300 attempts / 2 weeks
- Restrictions in iOS - Single daily reminder
- Designed like iOS lock screen
- Additional debriefing interview

Field Study - Results (Time)



Field Study - Results (Error Rate)



- Task overhead
 - Initially higher
 - Decreases with training
- Improves security
 - Entropy
 - Perceived security
 - Shoulder surfing

May the Force be with you

Questions
kkrombholz@sba-research.org

Participant characteristics

Gender			
Male	31	62%	
Female	19	38%	
Decline to answer	0	0%	
Age			
Min.	19		
Max.	56		
Median	25		
IT Background			
Yes	4	8%	
No	46	92%	

Participant characteristics

IT Background		
Yes	4	8%
No	46	92%
Smartphone		
Android	32	64%
iPhone	14	28%
Windows Phone	2	4%
Other	2	4%
Used Authentication Method		
4-digit PIN	26	52%
6-digit PIN	2	4%
Password (digits/characters)	3	6%
Unlock Pattern	14	28%
Fingerprint Sensor	7	14%
Face Recognition	0	0%
Android Smartlock	1	2%
None	5	10%