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This PIN Can Be Easily Guessed

Analyzing the Security of Smartphone Unlock PINs

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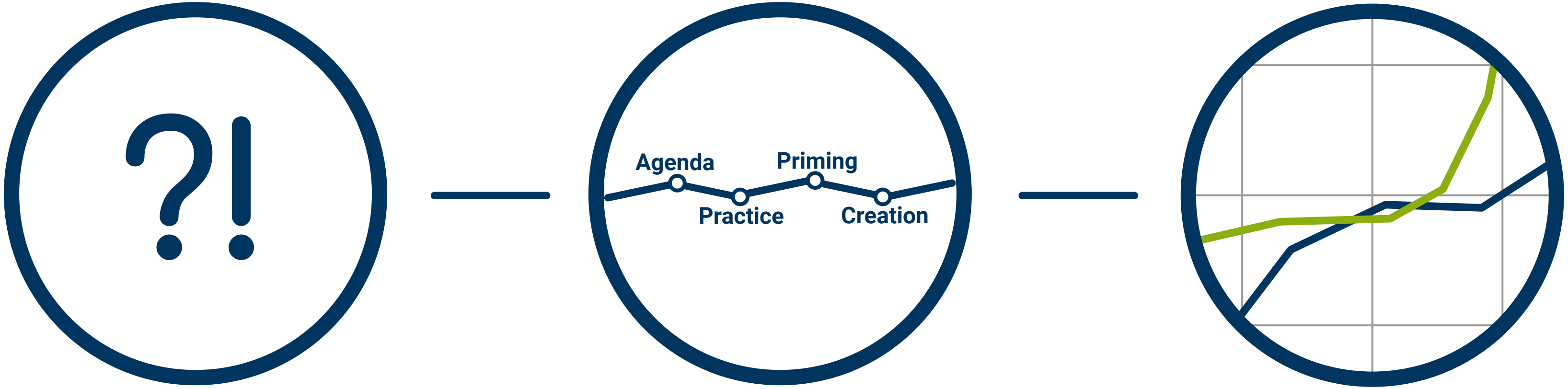
Overview



Agenda

Practice

Priming

Creation

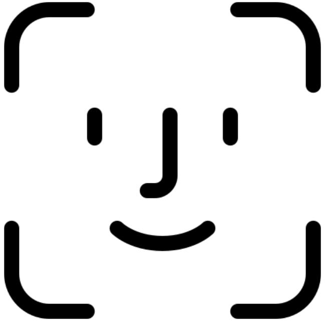
Why study PINs?

User Study

Results

Why PINs?

Fingerprint



Face

PHOTO: Dan Seifert | The Verge (Vox Media)

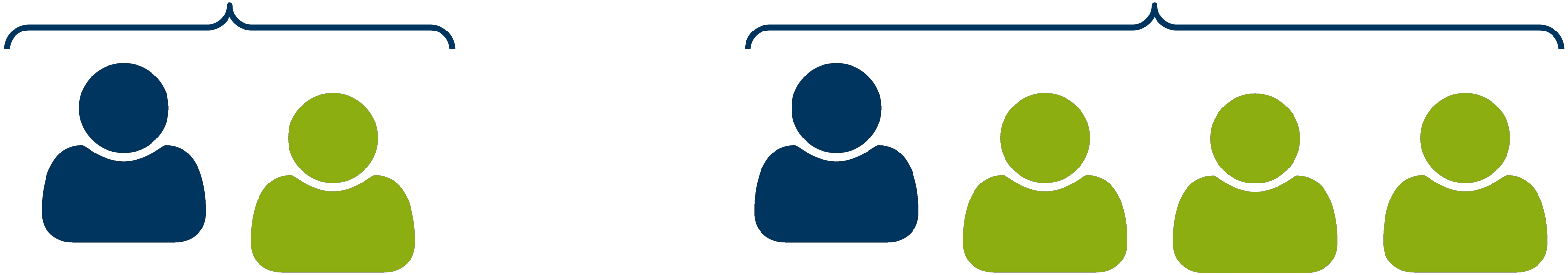
Iris

Who uses PINs?

1220 participants

461 do not use a biometric

759 use a biometric



210 use a PIN

595 use a PIN

Overall 805 (66%) use a PIN

What we know about PINs

- User chosen 4-digit PINs are predictable [1]
- User chosen 6-digit PINs aren’t any better [2]
- Blacklisting popular PINs can increase security [1]

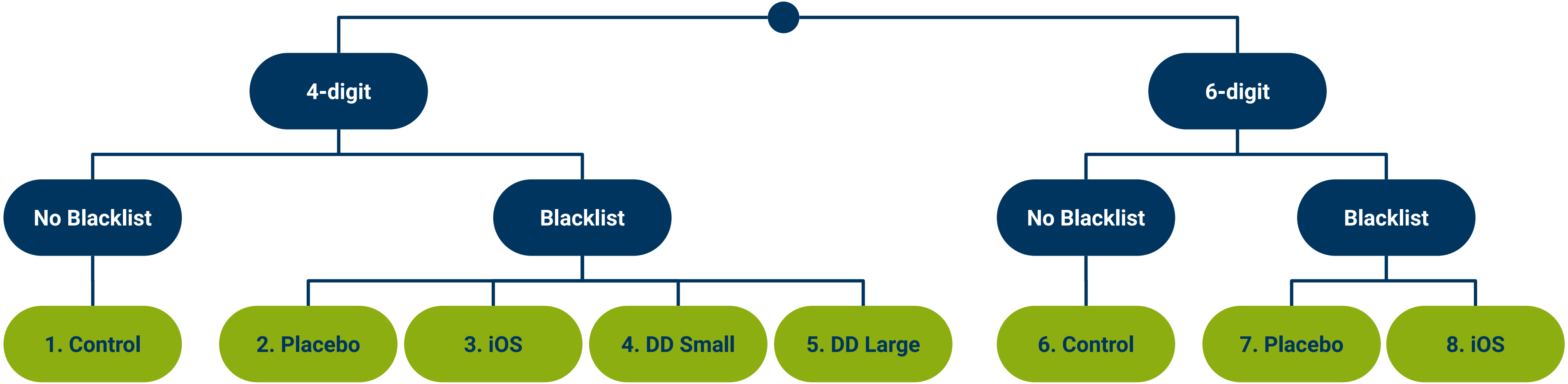
What we don’t know

- How secure are 4- or 6-digit PINs in the smartphone unlock setting?
- What are the effects of different blacklists on the security of PINs?
- How to balance security and usability when composing a blacklist?

[1] J. Bonneau, S. Preibusch, and R. Anderson. **A Birthday Present Every Eleven Wallets?** The Security of Customer-Chosen Banking PINs. FC ‘12

[2] D. Wang, Q. Gu, X. Huang, and P. Wang. **Understanding Human-Chosen PINs**: Characteristics, Distribution and Security. AsiaCCS ‘17

Treatments



- 4-digit
  - No Blacklist
    - 1. Control
  - Blacklist
    - 2. Placebo
    - 3. iOS
    - 4. DD Small
    - 5. DD Large
- 6-digit
  - No Blacklist
    - 6. Control
  - Blacklist
    - 7. Placebo
    - 8. iOS

Placebo

"Test general effect of warning"

Blacklist:

- "1st choice" blocked
- Any other PIN allowed

iOS

"Test effect of iOS blacklists"

Blacklist:

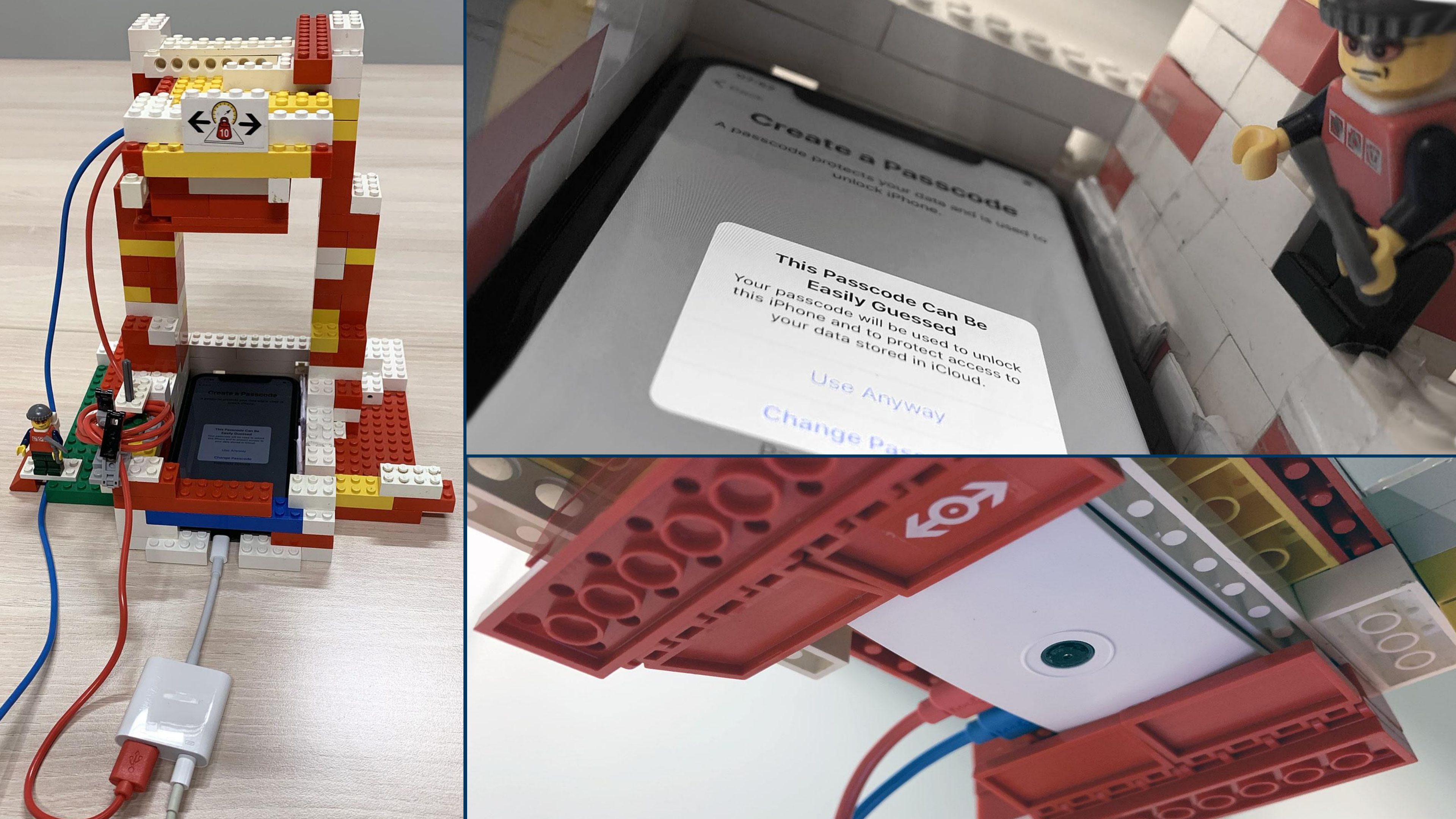
- 274 PINs (4-digit)
- 2910 PINs (6-digit)

Data-Driven (DD)

"Test effect of different blacklist sizes"

Blacklist:

- Top 27 PINs of Amitay (small)
- Top 2740 PINs of Amitay (large)



Create a Passcode

A passcode protects your data and is used to unlock iPhone.

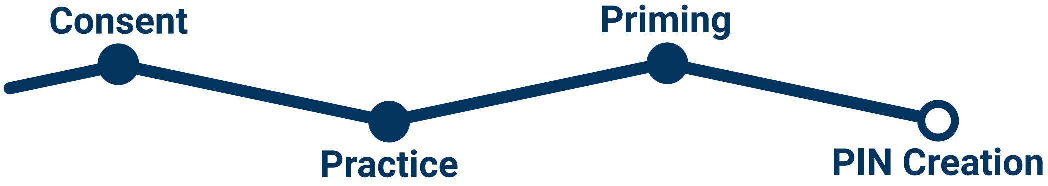
This Passcode Can Be Easily Guessed

Your passcode will be used to unlock this iPhone and to protect access to your data stored in iCloud.

Use Anyway

Change Pass

User Study

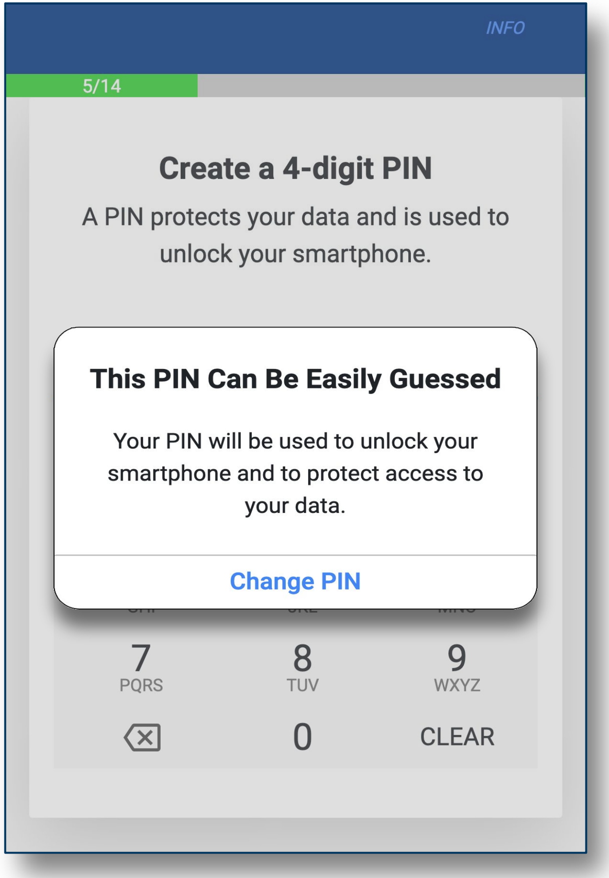


Consent

Practice

Priming

PIN Creation



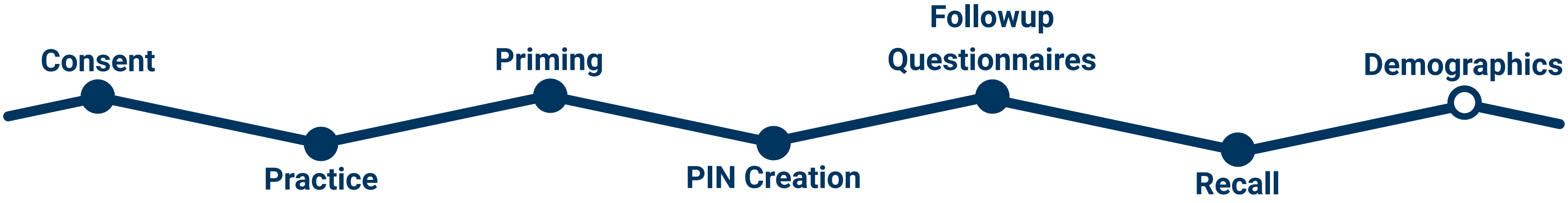
Create a 4-digit PIN

A PIN protects your data and is used to unlock your smartphone.

This PIN Can Be Easily Guessed

Your PIN will be used to unlock your smartphone and to protect access to your data.

User Study



Consent

Practice

Priming

PIN Creation

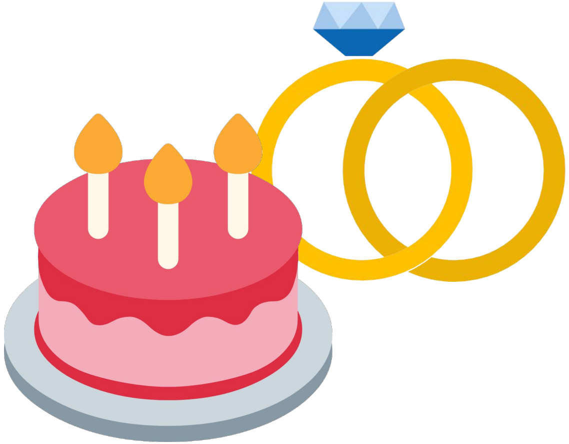
Followup Questionnaires

Recall

Demographics

Attacker Model

- No information about the victim



Attacker Model

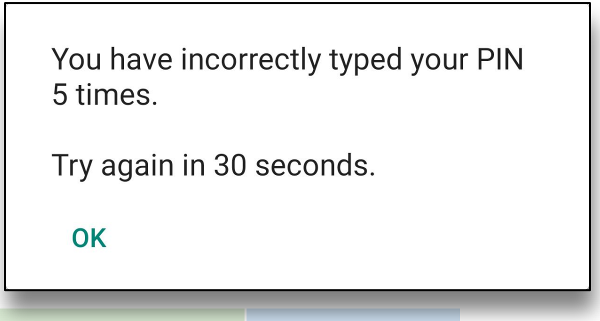
- No information about the victim

- Guesses PINs in decreasing probability order

Rank	4-digit PINs	6-digit PINs
1	1234	123456
2	0000	123123
3	2580	111111
⋮	⋮	⋮

Attacker Model

- No information about the victim
- Guesses PINs in decreasing probability order
- Slowed down by rate-limiting



You have incorrectly typed your PIN 5 times.

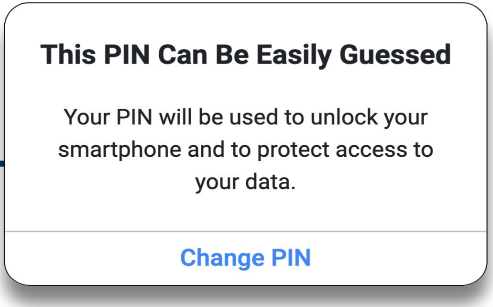
Try again in 30 seconds.

	Android	iOS
10 Guesses	30s	1h 36m 0s
100 Guesses	10h 45min 30s	—

Attacker Model

- No information about the victim
- Guesses PINs in decreasing probability order
- Slowed down by rate-limiting
- Knows the blacklist and skips impossible choices

Rank	4-digit PINs	6-digit PINs
1	1234	123456
2	not allowed ~~0000~~	
3	2580	
⋮	⋮	


This PIN Can Be Easily Guessed

Your PIN will be used to unlock your smartphone and to protect access to your data.

Research Questions

4 vs. 6

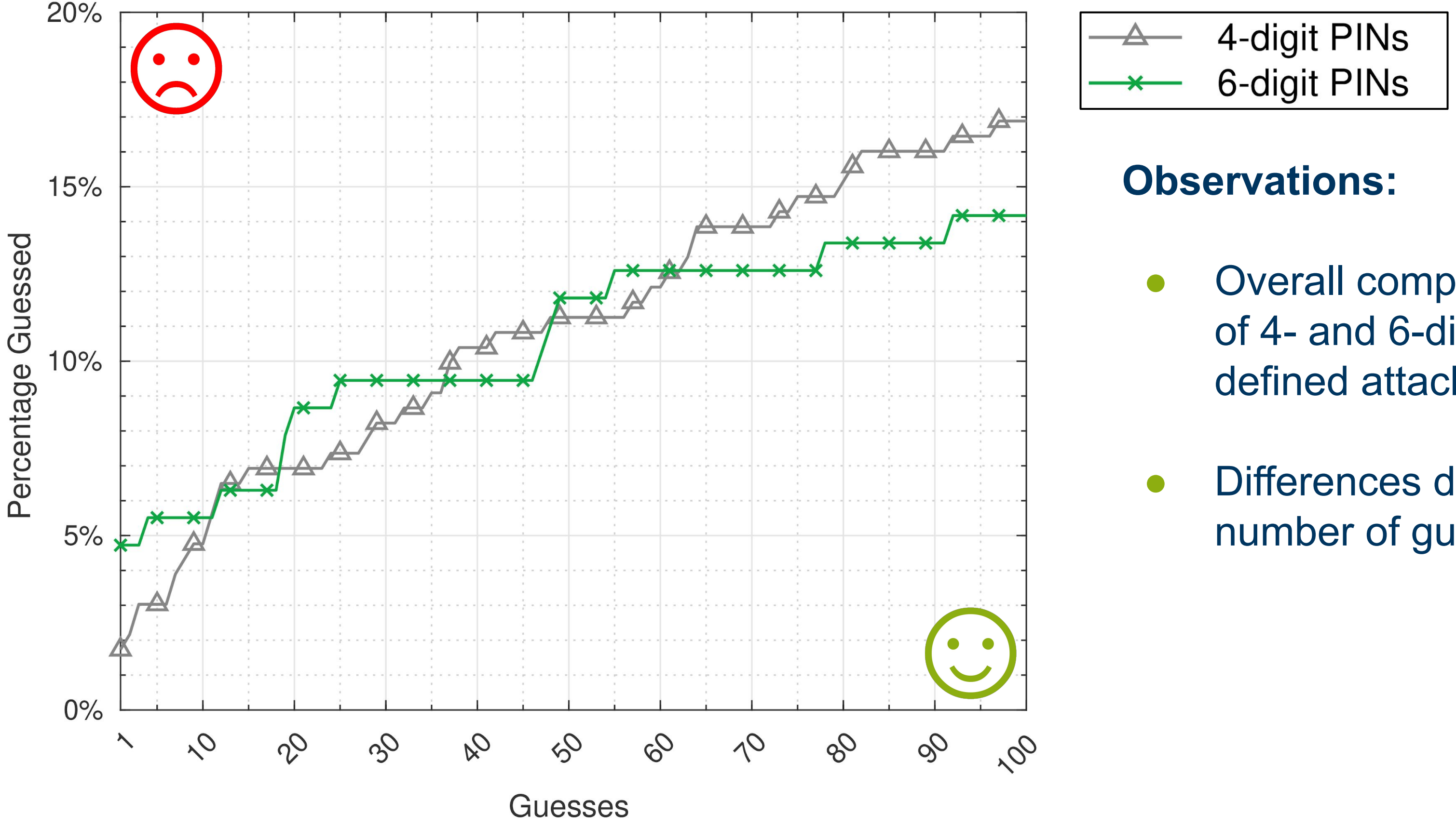
RQ1: How secure are 4- and 6-digit PINs in the smartphone unlock setting?

Small?
Medium?
Large?

RQ2: What are the effects of different blacklists on the security of PINs?

RQ3: How to balance security and usability when composing a blacklist?

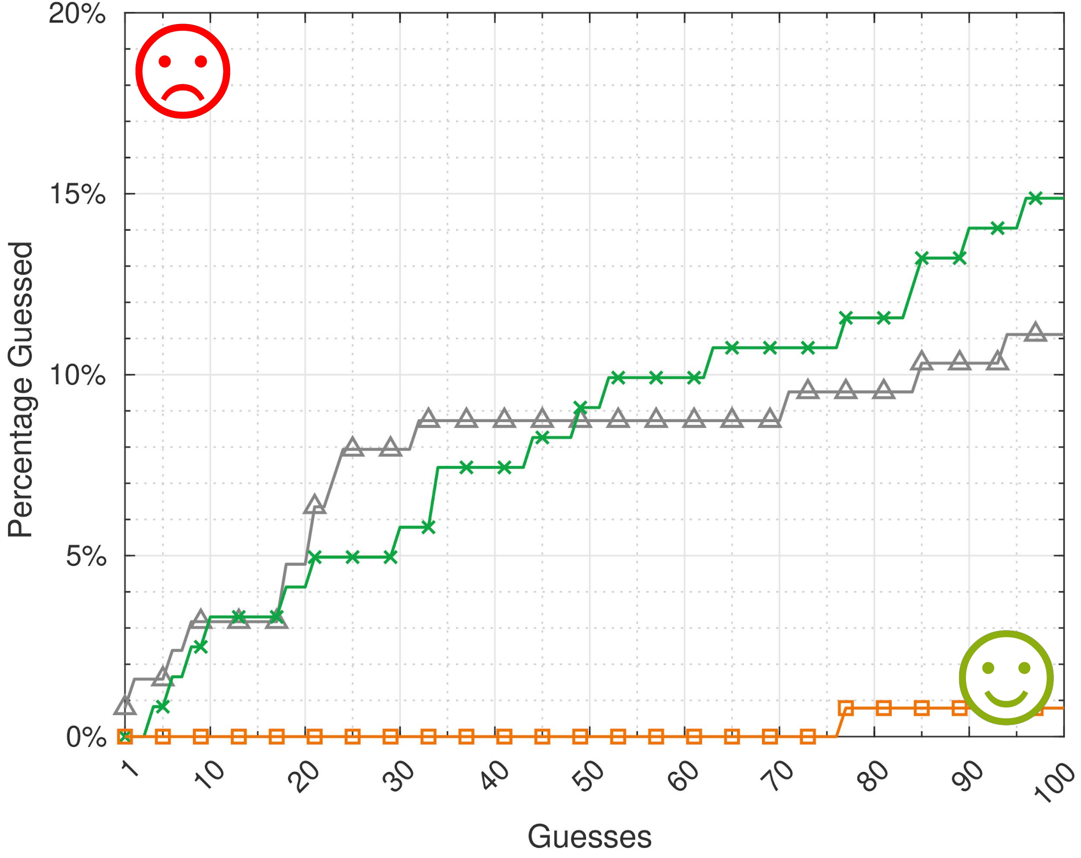
RQ1: 4- vs. 6-digit PINs



Observations:

- Overall comparable security of 4- and 6-digit PINs in the defined attacker model
- Differences depending on the number of guesses

RQ2: Different Blacklist Sizes



Observations:

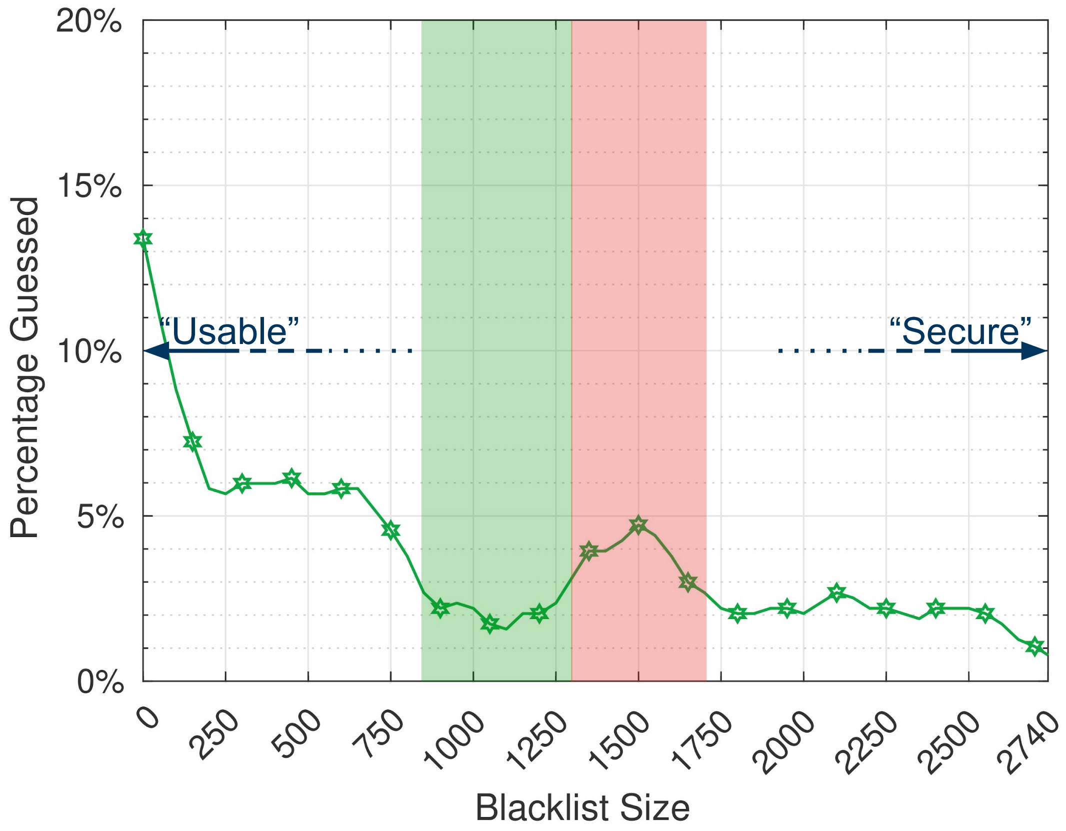
- *iOS* and *Data-Driven Small* offer comparable security
- *Data-Driven Large* drastically increases the security
- Blacklist Hitrate:

DD Small 5%

iOS 15%

DD Large 70%

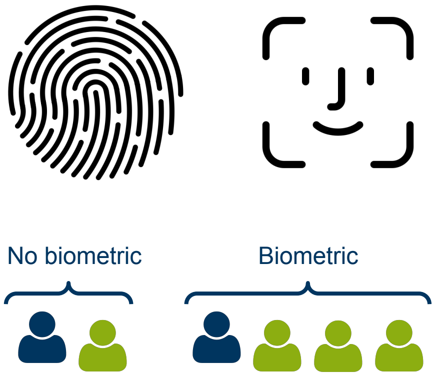
RQ3: Balancing Security and Usability



Observations:

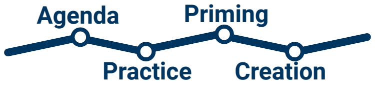
- Different extrema throughout the curve
- Maxima:
  users choose popular PINs
- Minima:
  users choose unpopular PINs
- Blacklisting ~10% is ideal

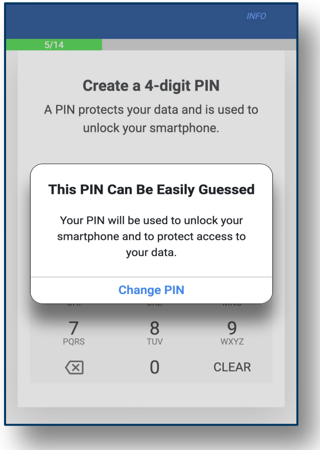
Takeaways



Most of the participants
in our study (66%) use a PIN

Why study PINs?





Create a 4-digit PIN

A PIN protects your data and is used to unlock your smartphone.

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Your PIN will be used to unlock your smartphone and to protect access to your data.

Change PIN

User Study

4 ≈ 6 Security of 4- and 6-digit PINs is comparable

XXL Blacklists need to be large to have an effect

⚖ Blacklisting ~10% is ideal

Results

✉ philipp.markert@rub.de @philipp_markert https://this-pin-can-be-easily-guessed.github.io