Biometric Authentication on iPhone and Android: Usability, Perceptions, and Influences on Adoption

Chandrasekhar Bhagavatula, Blase Ur, Kevin Iacovino, Su Mon Kywe, Lorrie Faith Cranor, Marios Savvides
iPhone 5S
Touch ID

Android 4.0
Face Unlock

Images fair use from androidcentral.com, creativebits.org, and businessinsider.com.
How usable are these biometric systems?
What are users' experiences using these systems in the real world?
Have people adopted these systems? Why/why not?
Overview

• Study 1: **Lab study**
  - Face unlock, fingerprint unlock, and PINs
  - How usable is each system in common usage scenarios?
  - Comparative ranking

• Study 2: **Online survey**
  - Investigate adoption decisions
  - Understand real-world usability experiences and perceptions
Lab study methodology

• 10-participant, within-subjects usability study
• Four mechanisms: iPhone fingerprint unlock, iPhone PIN, Android face unlock, Android PIN
• 1) Demographic survey
• 2) Registration phase for each system
• 3) Usability in 5 scenarios
• Likert-scale usability questions
• We provided iPhone 5S & Samsung Galaxy S4
• Recruited on Craigslist and with flyers
• Compensated $10 for ~ 1 hour
Five lab study scenarios

• Sitting (baseline)
Five lab study scenarios

• Sitting in a dark room
Five lab study scenarios

• Sitting with wet hands (moisturizer)
Five lab study scenarios

• Walking
Five lab study scenarios

- Walking carrying a bag in one hand
Lab study participants

- 10 participants (8 male, 2 female)
- Relatively young (2 over 30)
- 4 regular iPhone users; 6 regular Android users
- 2 had used Fingerprint Unlock; 2 had used Face Unlock
Lab study results

• Preconceived notions:
  – Biometrics secure and easy to learn
  – Biometrics inconvenient and uncool
• Registration process was relatively easy

Registration

- Android PIN
- iPhone PIN
- Android Face
- iPhone Fingerprint

# Participants

- Very Easy
- Easy
- Neutral
- Difficult
- Very Difficult
Lab study results

- Participants found all schemes usable in all situations except for Face Unlock in the dark
  - 90%+ of participants per group said authenticating while sitting was easy
  - Two iPhone participants found Fingerprint Unlock difficult with moisturizer
  - 80%+ found authenticating while walking (with/without bag) easy
Lab study results

- Participants found all schemes usable in all situations **except for** Face Unlock in the dark.
Comparative ranking

• Participants tended to like both phones' PINs
  – iPhone PIN does not require hitting enter

• Participants had polarized opinions of Fingerprint Unlock
  – 6 rated it #1 / 4
  – 4 rated it #4 / 4
Usability issues

- iPhone Fingerprint Unlock registration unclear
  - “The image they were showing me didn’t make sense to me, so I was like I’m not sure which way. I’m supposed to be like turning my finger. So that was kind of difficult”
Usability issues

• Android Face Unlock doesn't show what screen looks like when authenticating
  – One participant left the phone on the table

• Participant required to fail at Face Unlock before falling back to PIN
Survey methodology

• Online survey of owners of compatible phones
  – iPhone 5S or Android 4.0+
  – Verification questions about menus
• Android = Face Unlock questions, iPhone = Fingerprint Unlock questions
• Focus on perceived usefulness and ease of use, as well as adoption decisions
• Recruited on Mturk
  – Compensated $1.00 for ~9 minutes
• Questions branched based on {current user, former user, non-user}
Survey participants

• Initially recruited 100 Android and 100 iPhone
  – 1 current and 15 former Face Unlock users
  – Reopened for current/former users of Face Unlock (63 more)

• Android: 163 respondents (109 pass validation)
  – 47 female, 61 male, 1 decline to state
  – Relatively young (54% age 20-29)

• iPhone: 101 respondents (89 pass validation)
  – 35 female, 54 male
  – Relatively young (55% age 20-29)
Android results

• Few people with compatible phones seem to use Face Unlock

• Current users feel that Face Unlock has increased convenience and security vs. PIN
  – “…it ensures ONLY I can unlock it unless someone knows my pin code as well - which hopefully no one does”

• Former users felt it less convenient

• Former users found it unreliable (in the dark)

• Non-users expected hassle and low security
iPhone results

• Many people with compatible phones seem to use Fingerprint Unlock

• Both current and former users feel that Fingerprint Unlock is more secure than PIN

• Current users find it more convenient than PIN, whereas former users do not

• Some non-users did not trust Apple with their biometric data
Convenience

Convenience of Face Unlock vs. PIN

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<th>Current User</th>
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Convenience of Fingerprint Unlock vs. PIN

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Convenience

Convenience of Face Unlock vs. PIN

Former User
Current User

# Participants

A lot more | A little more | Equally | A little less | A lot less

Convenience of Fingerprint Unlock vs. PIN

Former User
Current User

# Participants

A lot more | A little more | Equally | A little less | A lot less
Convenience

Convenience of Face Unlock vs. PIN

Former User

Current User

Convenience of Fingerprint Unlock vs. PIN

Former User

Current User

# Participants

A lot more  A little more  Equally  A little less  A lot less

A lot more  A little more  Equally  A little less  A lot less
Convenience

Convenience of Face Unlock vs. PIN

- Former User
- Current User

Convenience of Fingerprint Unlock vs. PIN

- Former User
- Current User
Security

Security of Face Unlock vs. PIN

Former User
Current User

Security of Fingerprint Unlock vs. PIN

Former User
Current User

# Participants

A lot more  A little more  Equally  A little less  A lot less
Security

### Security of Face Unlock vs. PIN

- **Former User**
  - A lot more: [Bar chart visualization]
  - A little more: [Bar chart visualization]
  - Equally: [Bar chart visualization]
  - A little less: [Bar chart visualization]
  - A lot less: [Bar chart visualization]

- **Current User**
  - A lot more: [Bar chart visualization]
  - A little more: [Bar chart visualization]
  - Equally: [Bar chart visualization]
  - A little less: [Bar chart visualization]
  - A lot less: [Bar chart visualization]

### Security of Fingerprint Unlock vs. PIN

- **Former User**
  - A lot more: [Bar chart visualization]
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Security

Security of Face Unlock vs. PIN

Former User
Current User

# Participants

A lot more  A little more  Equally  A little less  A lot less

Security of Fingerprint Unlock vs. PIN

Former User
Current User

# Participants

A lot more  A little more  Equally  A little less  A lot less
Usability Issues

- Authenticating in the dark difficult for many Android Face Unlock users
- Authenticating with wet or dirty hands difficult for many iPhone Fingerprint Unlock users
- Authenticating with Face Unlock perceived as uncool due to “selfie” perception
- iPhone Fingerprint Unlock noted as particularly convenient while driving an automobile
Limitations

• Small-scale lab study with convenience sample
• Online survey was observational
  – Android and iPhone populations are not statistically comparable
  – Convenience sample
Conclusions

• Mix of successes and failures
• Fingerprint unlock far more promising for large-scale adoption
• Users' perceptions of security contrasted with manufacturers' statements
  - Users perhaps overly optimistic
• Low-hanging fruit among usability issues
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