# A Usability Study of Five Two-Factor Authentication Methods

Ken Reese, Trevor Smith, Jonathan Dutson, Jonathan Armknecht, Jacob Cameron, and Kent Seamons

# Passwords: Everywhere, but…

https://media.giphy.com/media/dxfdvOobztBviVmYbM/giphy.gif

# Two-Factor Authentication

Something you *know*

Something you *have*

Something you *are*

# Five Two-Factor Authentication Methods

- SMS
- TOTP
- Pre-generated codes
- Push notifications
- U2F security keys

# Something you have…

# Goal:

Perform a comparative usability study of five 2FA methods

## 2FA banking studies

- Piazzalunga [2005], Weir [2009, 2010], Gunson [2011]

## Security key setup

- Das [FC 2018]

## Setup of four 2FA methods

- Acemyan [HFES 2018]

## Day-to-day usability

- Krol [USEC 2015], Reynolds [S&P 2018]

# Previous 2FA User Studies

# Study Design

- Compare five factors across a single application
  - Reduce confounding factors
  - Gather timing data
- Examine setup and day-to-day usability independently
  - Avoid bias

# Two Parts

1. Two-week between-subjects usability study
2. Within-subjects laboratory setup study

# Two Week Study Methodology

72 PARTICIPANTS
(6 GROUPS OF 12)

SIMULATED ONLINE BANKING WEBSITE

12 BANKING TASKS

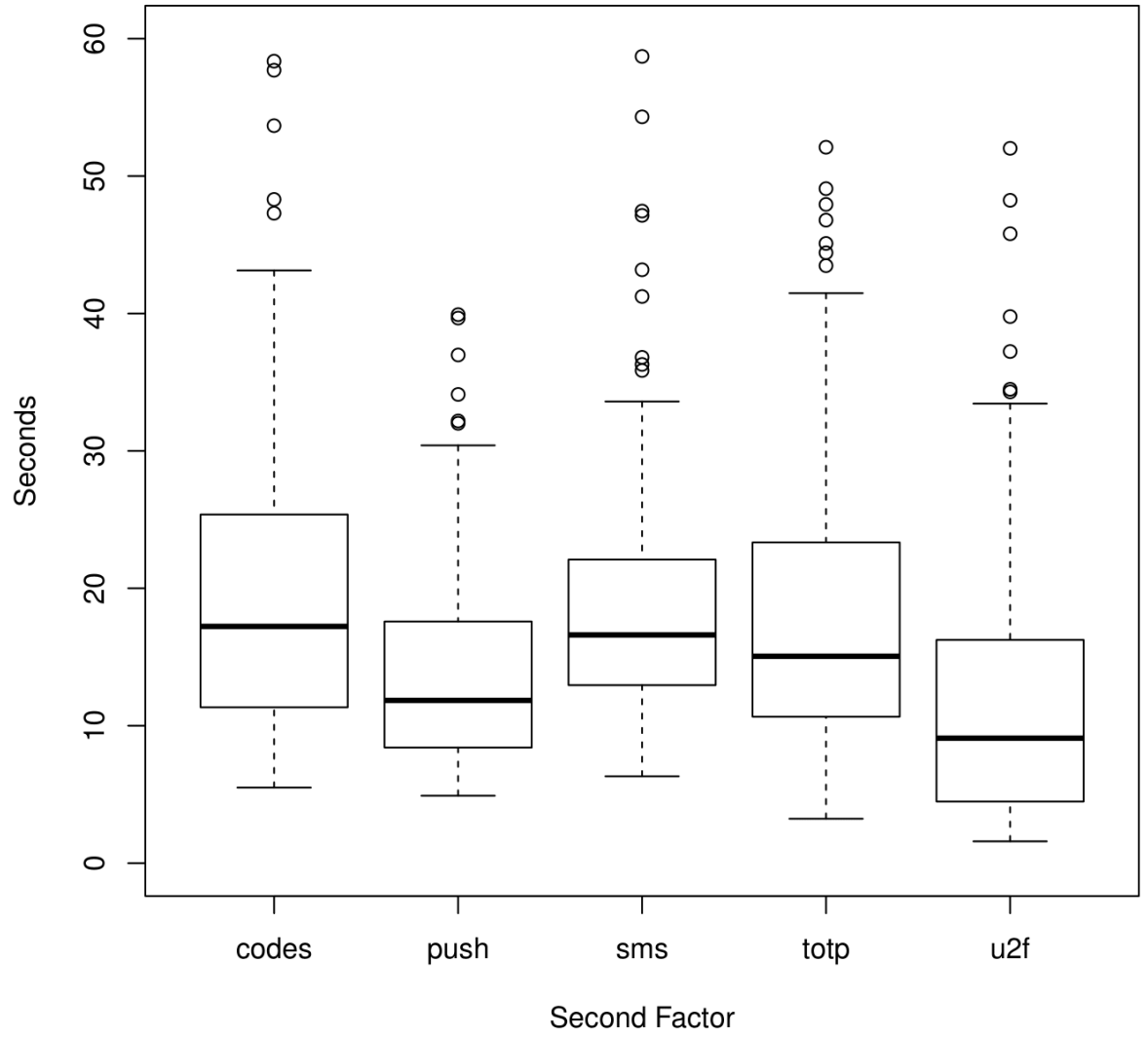
# Findings

Quantitative

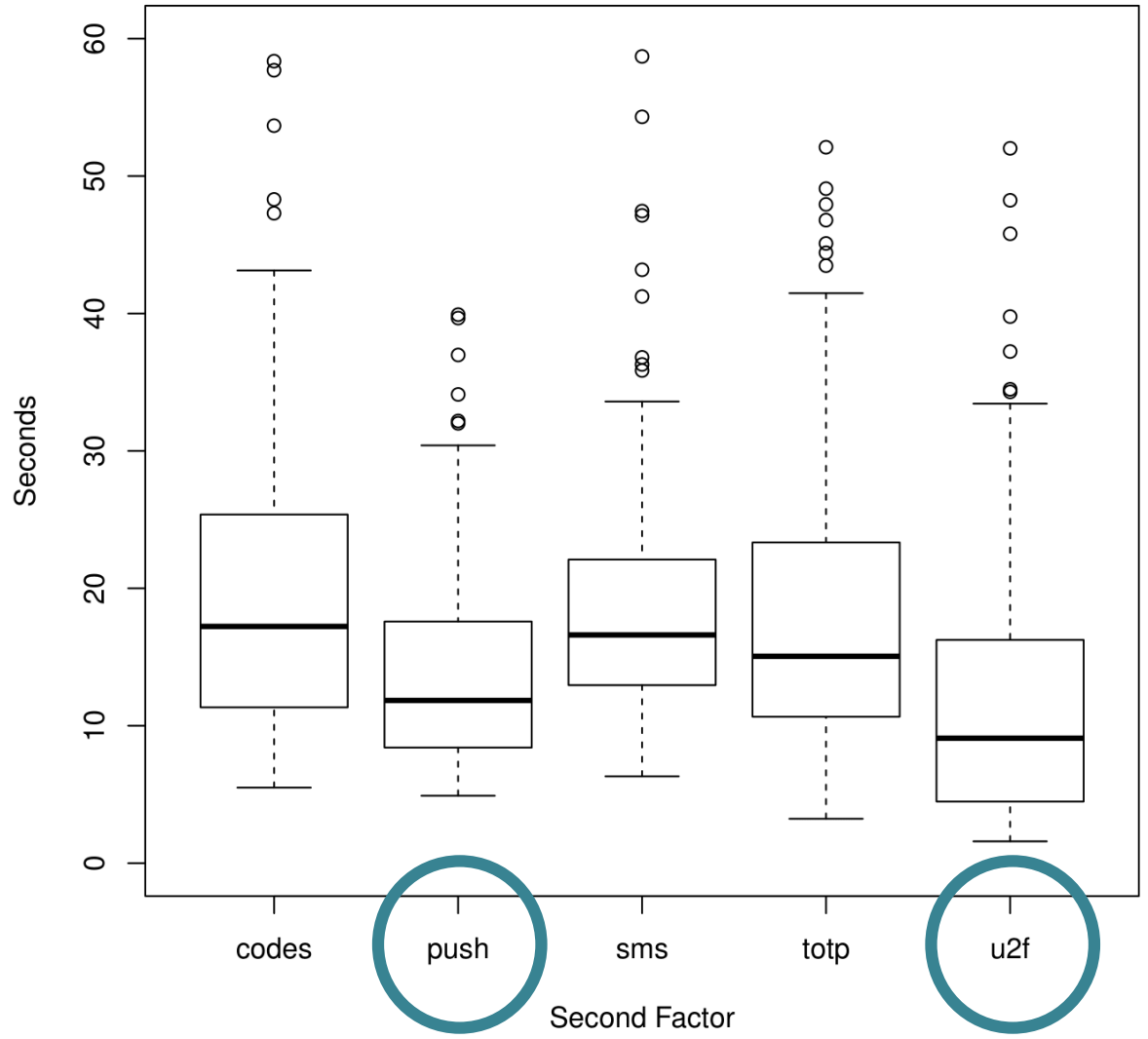
Qualitative

https://media.giphy.com/media/xGlmLbM8sOcSc/giphy.gif

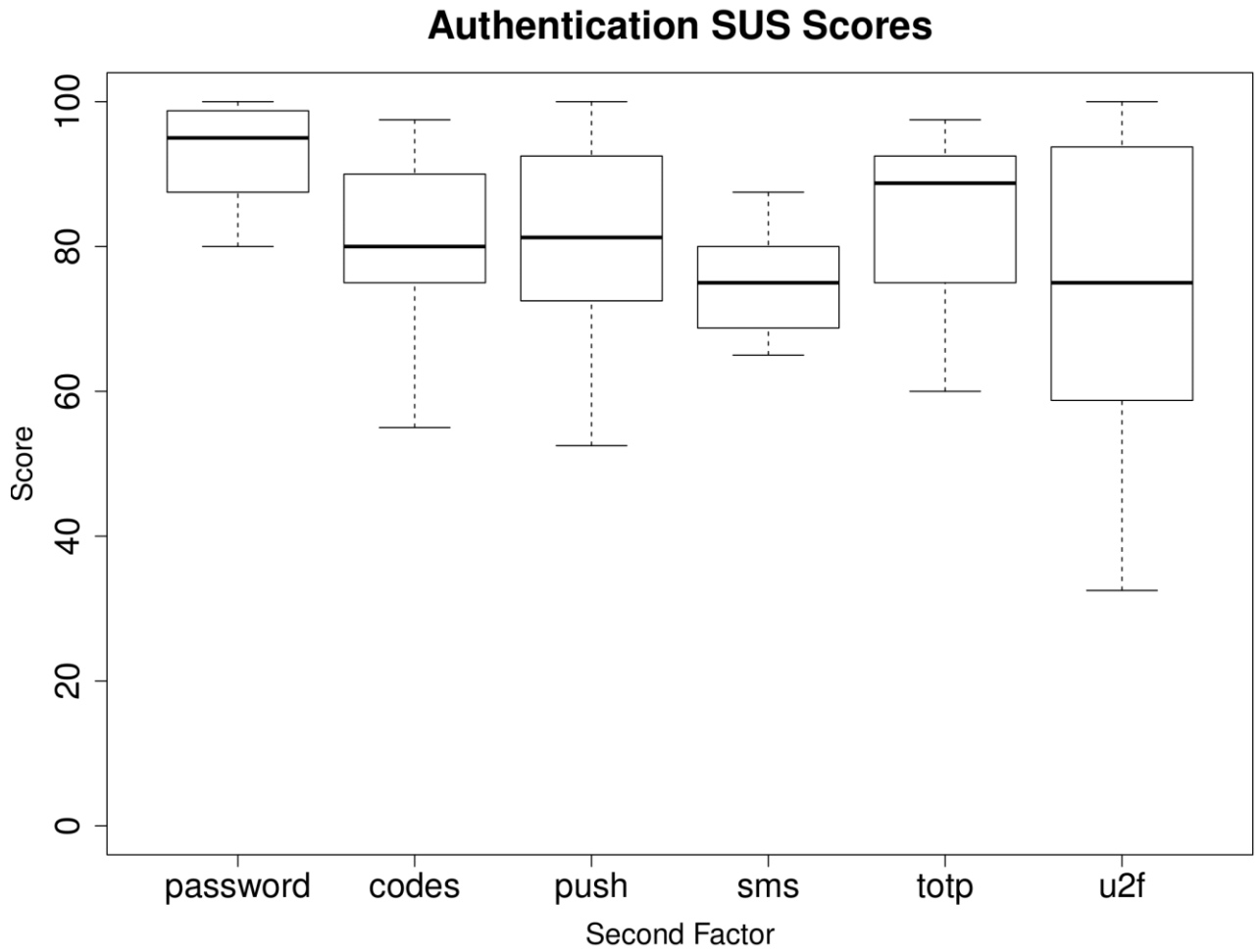
# Timing


Seconds
0
10
20
30
40
50
60
codes
push
sms
totp
u2f
Second Factor

# Timing


Seconds
0
10
20
30
40
50
60
codes
push
sms
totp
u2f
Second Factor

# SUS


Authentication SUS Scores
Score
0
20
40
60
80
100
password
codes
push
sms
totp
u2f
Second Factor

# Qualitative Results

# Security and Inconvenience

**P25:** *"In my opinion, it may be a little obsessive for everything, but for banking it's something that I actually do want some authentication. I almost wish that it was a requirement that the bank said, oh here set [two-factor authentication] up. Because now that I think about it, I don't know how to set up 2FA with my bank. If it were an option I would definitely use 2FA."*

# Availability of Second-factor Device

**P42:** *"Honestly, once I'm home I kind of just set my phone down and forget where I put it sometimes, so that was a little bit hard . . . I needed to go find my phone and pull up the app."*

# Not a Target

**P8:** *"I mean, you hear a lot about stuff being broken into; I just don't think I have anything that people would want to take from me, so I think that's why I haven't been very worried about it."*

# Day-to-day Usability?

https://media.giphy.com/media/cN3TDDF02WCT6/giphy.gif

# Limitations

University population

Simulated banking environment

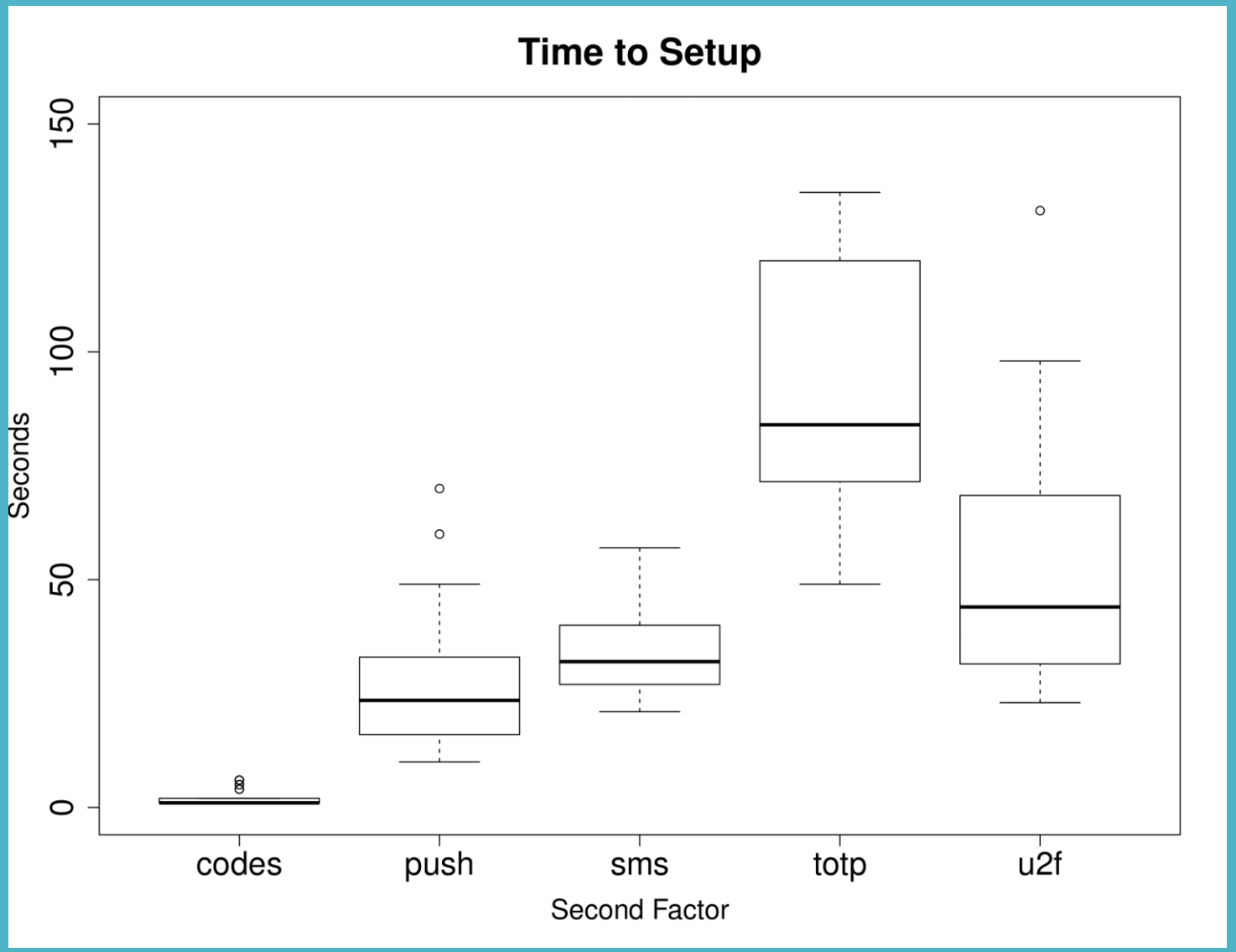
2FA for every authentication attempt

# Setup Study Methodology

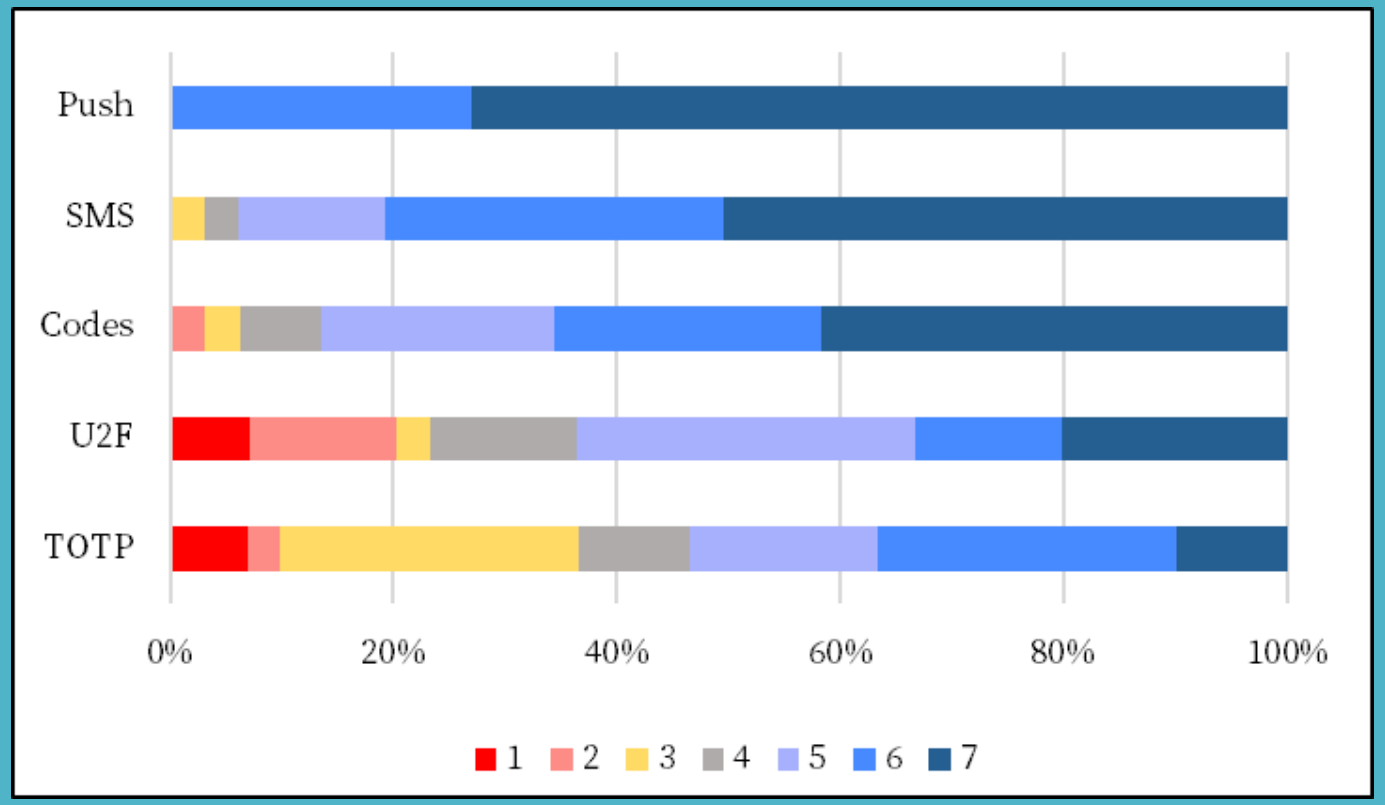
30 participants

Setup each 2FA method

Used counterbalancing to account for ordering effects




# Setup Study: Timing Data




# Setup Study: SEQ Scores

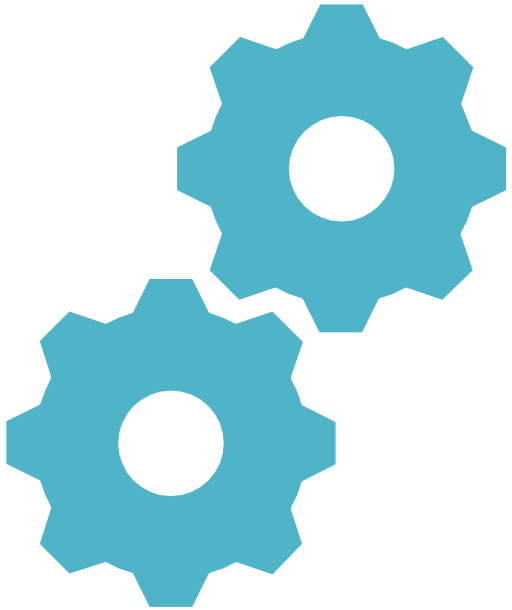
# Setup Failures

TOTP

- Scanning QR code

U2F

- Pop up permission



# Setup Usability?

https://media.giphy.com/media/cXMbxzMdXdVGwDZbyS/giphy.gif

# Limitations

University population

Provider-specific setup implementation

Unfamiliarity with provided phone

# Conclusion

Well-implemented 2FA methods may be set up and used without major difficulty

Home users may not always have access to second-factor device

Users differentiate between high and low value accounts

Time to authenticate decreases with familiarity (U2F, TOTP)

Faster authentication does not necessarily mean higher usability

# Thank you

jonathan@isrl.byu.edu