

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...



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

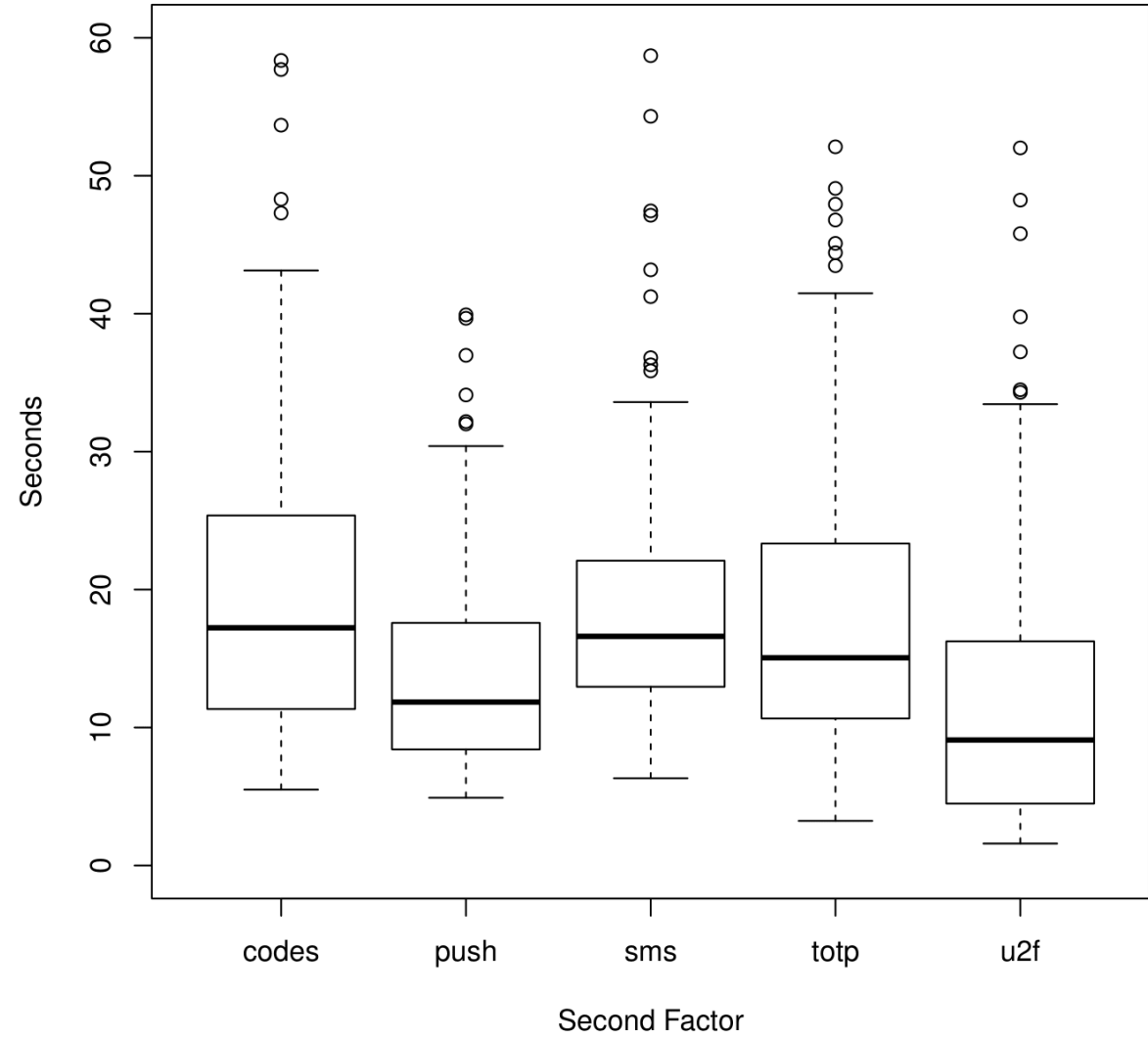


Quantitative

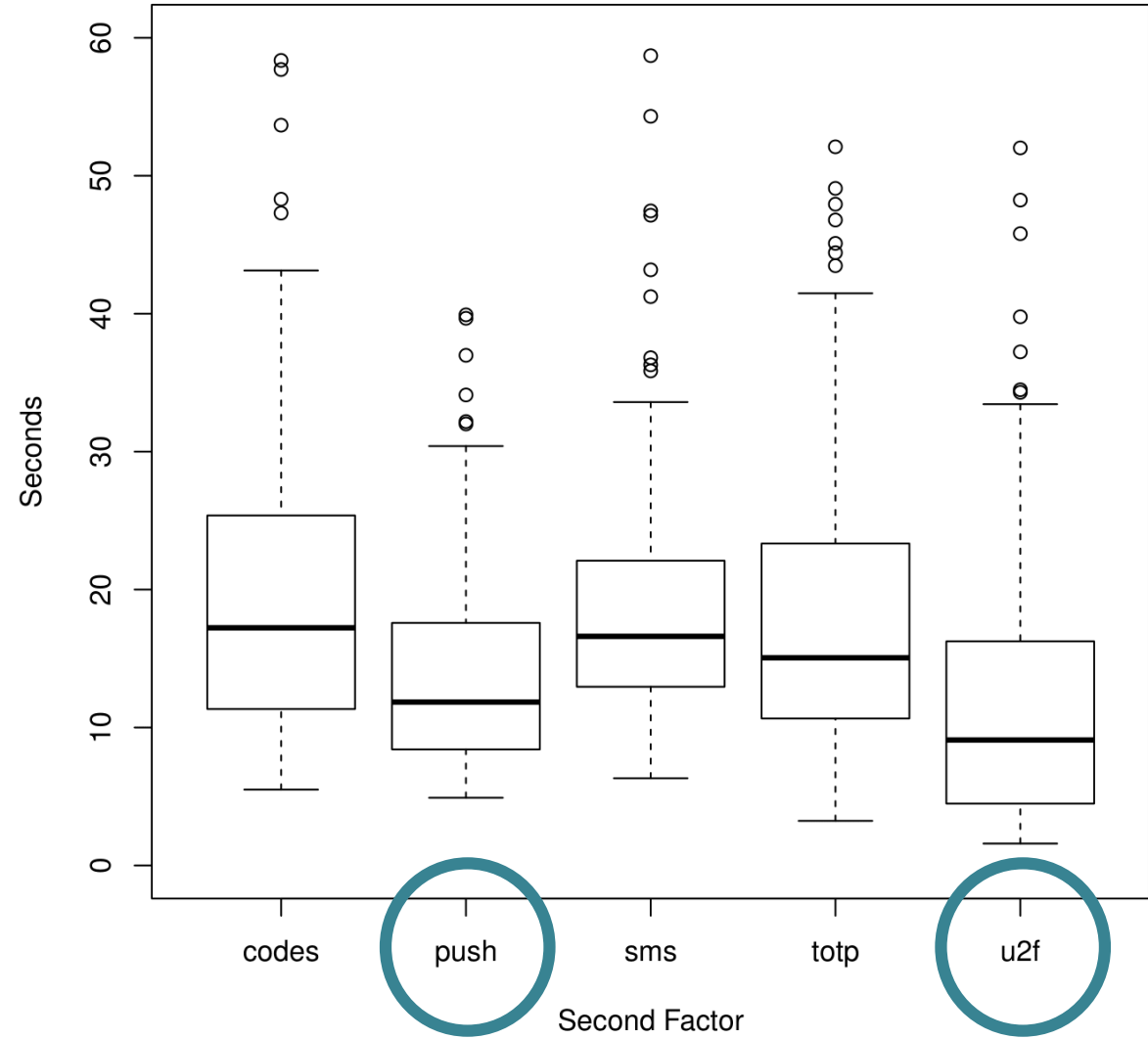


Qualitative

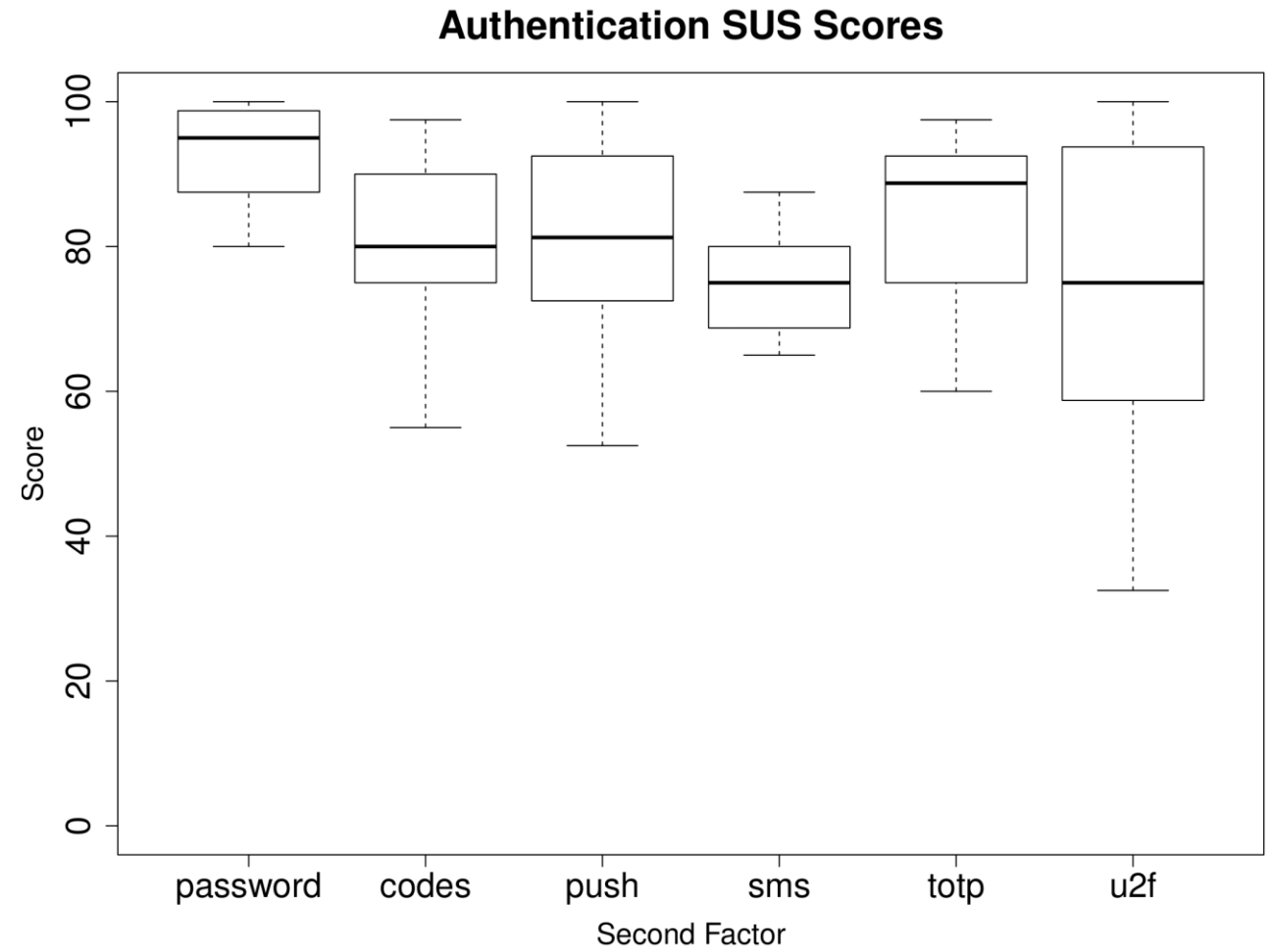
Timing



Timing



SUS



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?



Limitations



University population



Simulated banking environment



2FA for every authentication attempt

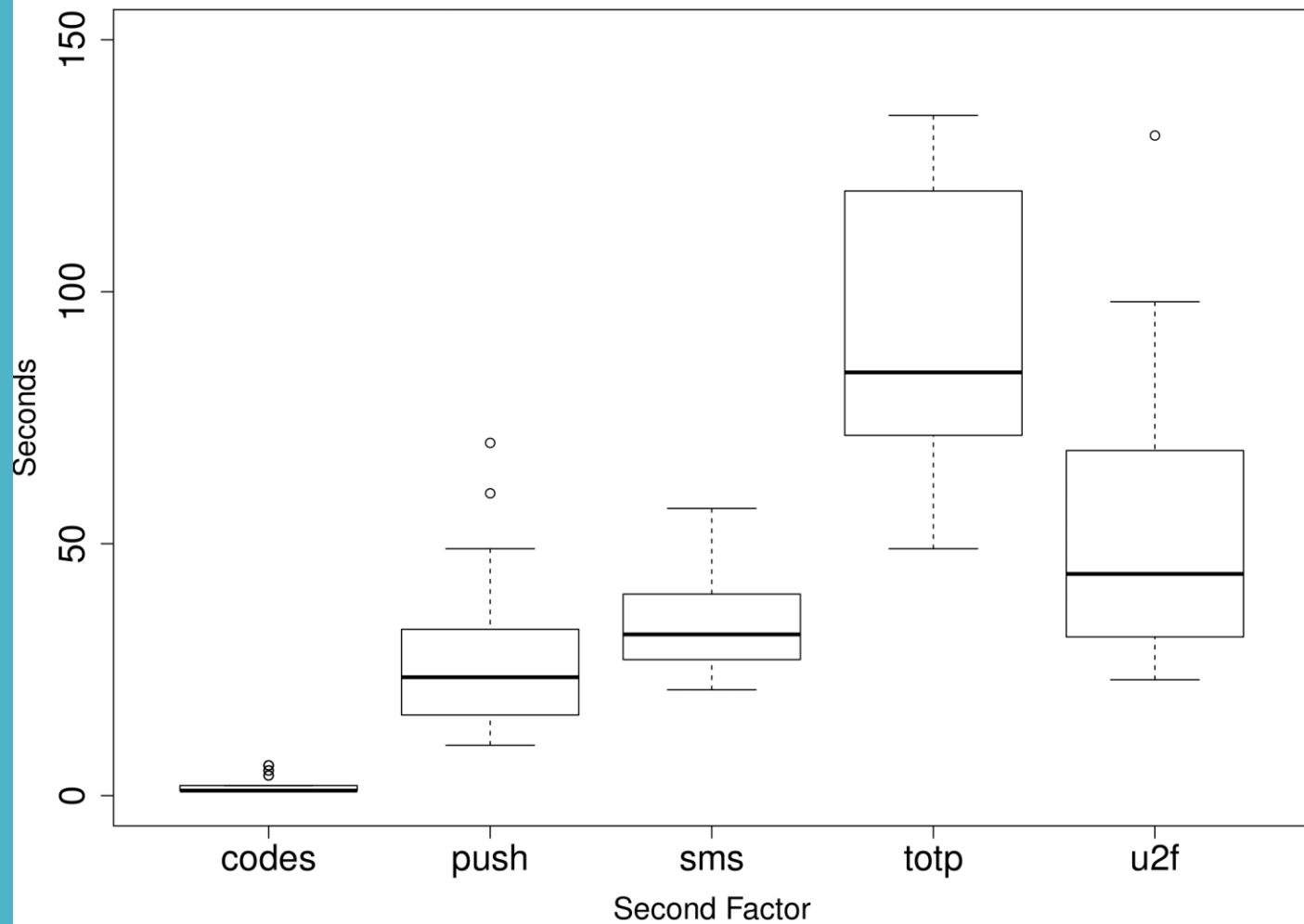
Setup Study Methodology

30 participants

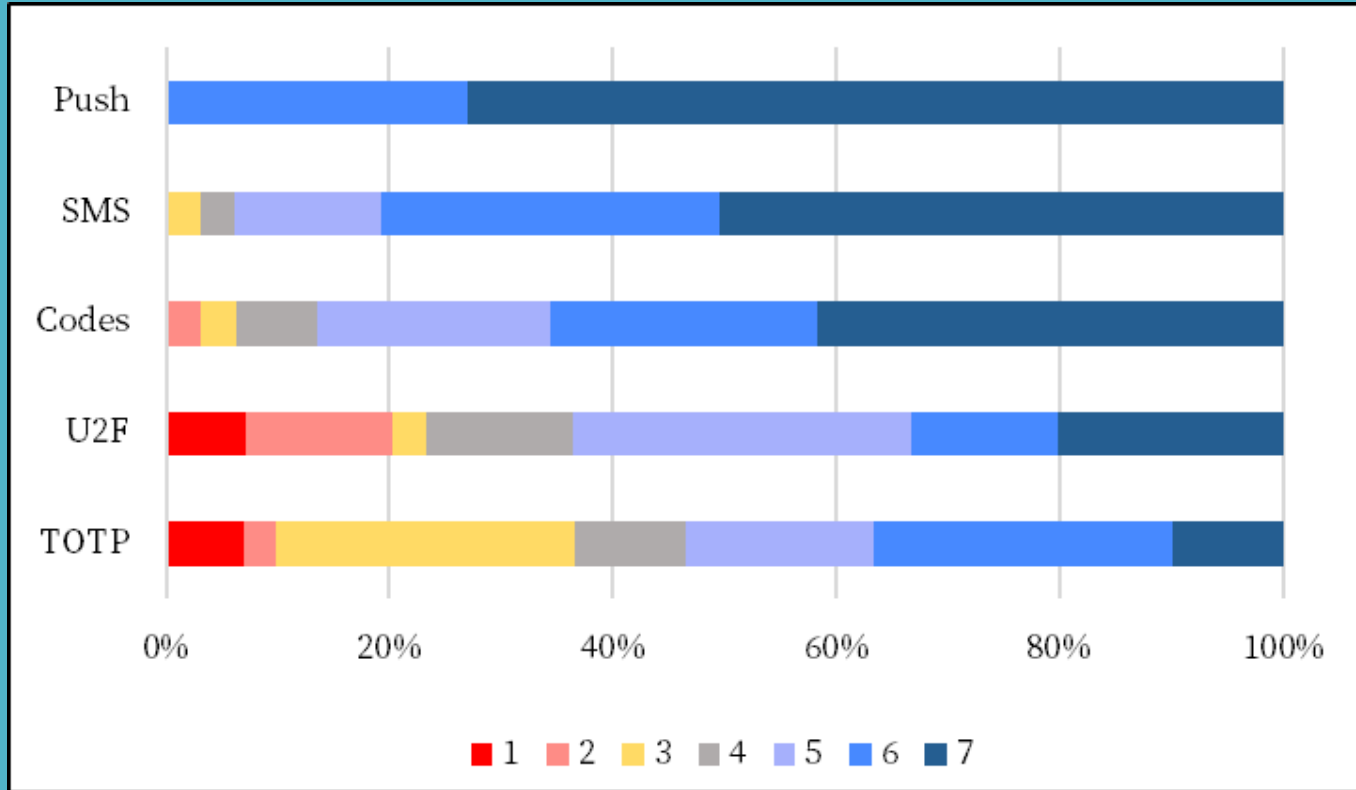
Setup each 2FA method

Used counterbalancing to account for ordering effects

Time to Setup



Setup Study:
Timing Data



Setup Study: SEQ Scores

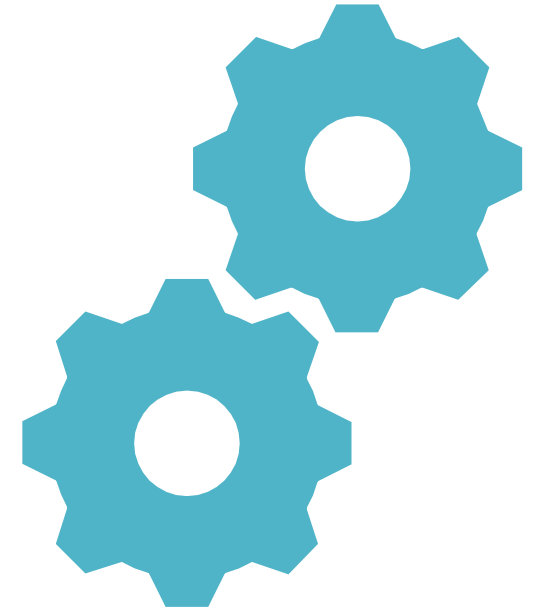
Setup Failures

TOTP

Scanning QR code

U2F

Pop up permission



Setup Usability?



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