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Understanding How People with Upper Extremity Impairments Authenticate on their Personal Computing Devices

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Accessible Security and Safety Technologies Group
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Upper Extremity Impairment (UEI)

People with UEI experience reduced

Range of motion

Strength

Endurance

Speed

Accuracy

Associated with movement in the shoulders, upper arms, forearms, hands, and/or fingers

Upper Extremity Impairment (UEI)

Over 20 million people in the US have conditions that lead to UEI

Cerebral Palsy

Amputation

Quadriplegia

Arthritis

Computing Device Use by People with UEI

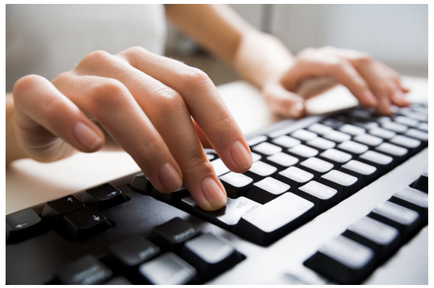
Common, including on multiple devices

Sometimes receive help from caregivers

Often use assistive technology (AT)

Authentication to a computing device

- Authentication to personal computing devices (e.g. laptops, smart phones, tablets) typically require users to perform complex actions with their arms, hands, and fingers
  - For example: complex passwords, positioning a camera accurately for facial recognition



- This can create barriers for people with upper extremity impairment (UEI)

Background and Related Work

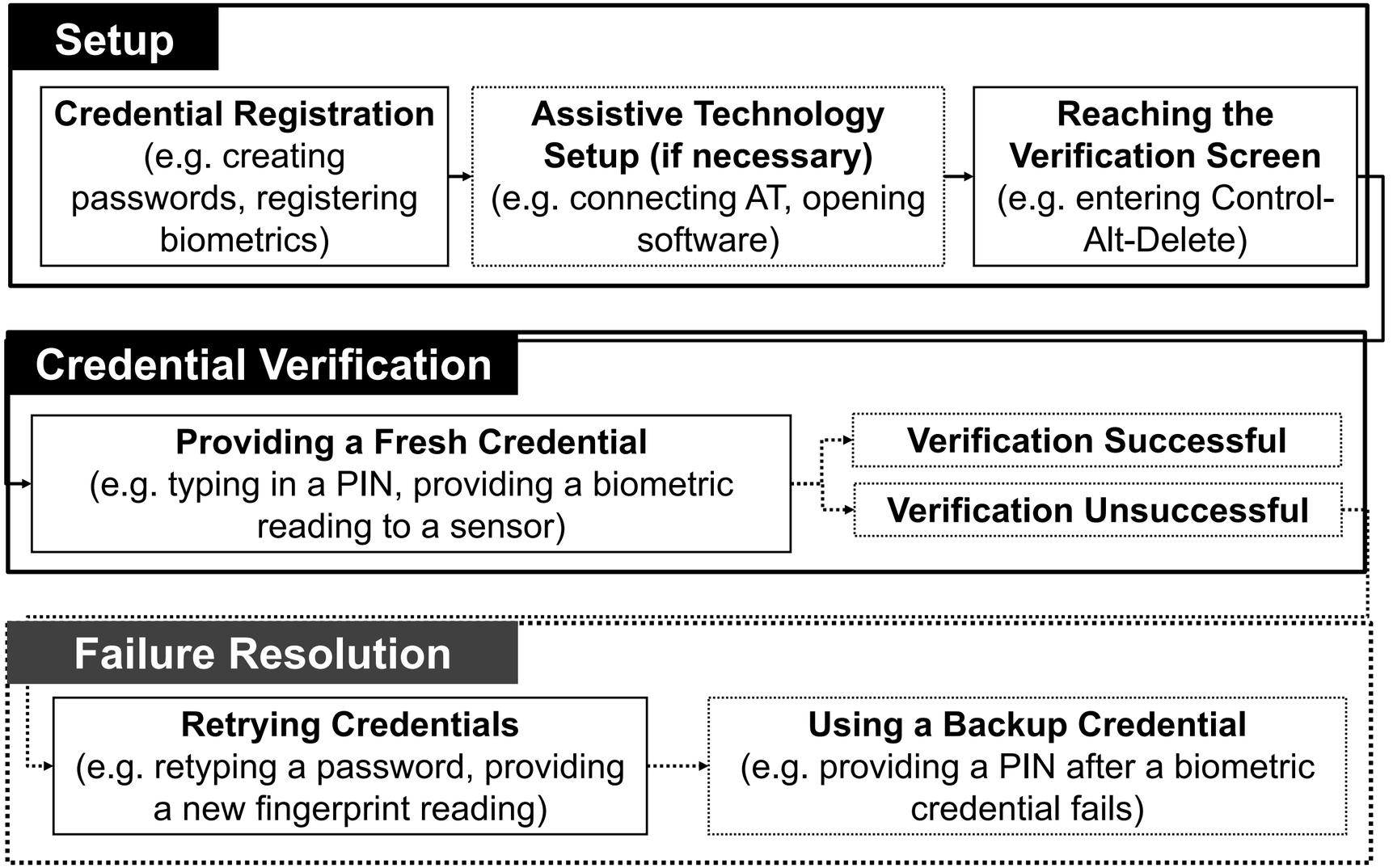
Authentication presents challenges to people with UEI, however, research into the experience of authentication for people with UEI has thus far been limited

Studies on use or interaction with various forms of authentication for people with disabilities including some with UEI
(Blanco-Gonzalo et al. 2018, Helkala 2012, Kane et al. 2020, Renaud 2018, Singh et al. 2007)

Various work has begun to create better authentication for people with UEI. Our work can help inform future work in this area

Studies on novel credentials and credential verification for people with UEI
(Johnson et al. 2013, Lewis et al. 2020, Shen 2008, Damopoulos and Kambourakis 2019, Fuglerud and Dale 2011, Zhu et al. 2009, Fenner 2018)

Authentication Process



Research Question 1

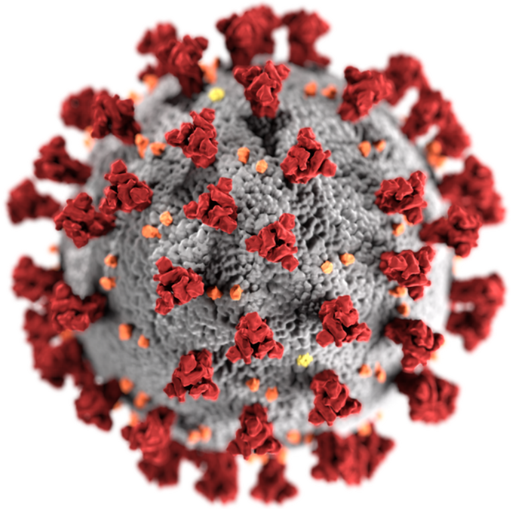
How and why do people with UEI use (or not use) authentication with their personal computing devices?

Research Question 2

Where (if anywhere) in the authentication process do barriers arise and how do people with UEI work around those barriers (if at all)?

Research Question 3

How has authentication use changed for people with UEI during COVID-19?



Methods

- Semi-structured interviews with 8 participants with UEI
- Interviews were conducted at a location chosen by the participant
- Each interview lasted between 30-50 minutes

ID	Age	Gender	Disability
P1	58	Man	Multiple sclerosis
P2	21	Woman	Cerebral palsy
P3	76	Woman	Quadriparesis from Guillain-Barré syndrome
P4	59	Man	Spinal cord injury
P5	65	Woman	Amputation due to complications from virus
P6	50	Woman	Cerebral palsy
P7	37	Woman	Cerebral palsy
P8	46	Man	Cerebral palsy

Most of our participants used passwords and PINs for authentication

Only two of our participants did not use authentication

- Most of our participants used authentication
  - Only two participants had disabled authentication on all their current devices
  - All participants who used authentication used passwords or PINs on at least one device
  - Only two participants used biometrics

Passwords and PINs are still commonly used

- All our participants who used authentication used a password or a PIN on at least one device
  - Only two participants used biometrics

ID	Credentials used
P1	PINs
P2	None
P3	Passwords, PINs
P4	Passwords
P5	Passwords
P6	Passwords, Fingerprint
P7	None
P8	Passwords, Facial Recognition

"I thought of Dragon Dictate and other voice command systems, but while I can use my arms, I'd rather do that to keep some strength and mobility." (P4)

Participants might not have been aware of all of the credential options on their devices

“I didn’t know there were [other credential options] that existed.” (P1)

People with UEI use authentication for several reasons including and beyond securing their devices

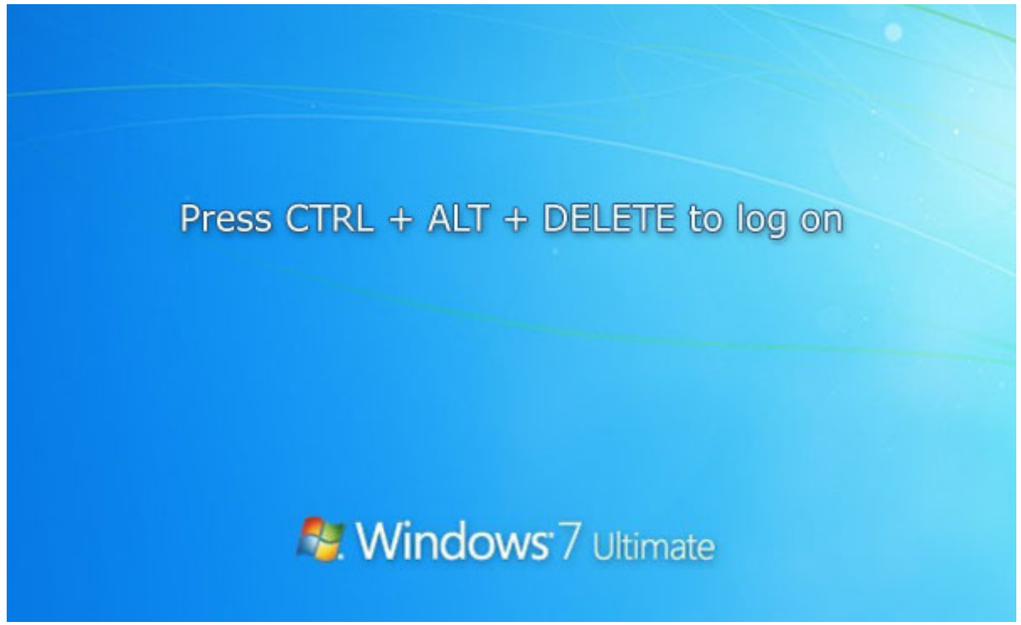
- Security
- Mandated Authentication Use
- Social pressure

"[I was using authentication] because everybody else was doing it...which is bad." (P2)

Each stage of the authentication process presents barriers, and people with UEI often use work-arounds that prioritize usability over security

Setup Phase

- Challenges choosing passwords/PINs and registering biometrics can discourage their usage.
- Setting up assistive technology (AT) can interfere with authentication
- Security measures for reaching the verification screen may not be usable.



"I was trepidatious of [PINs]. And I couldn't come up with a passcode that I could easily remember. So that's why I didn't do it." (P4)

Credential Verification Phase – PINs and Passwords

Long, complex, secure passwords/PINs are difficult for people with UEI to use

"[Passwords] require...many different digits...You need to press more buttons...[You had to] press Shift at some point because you had to do [capital letters]. You had to do numbers and whatnot. So they're much more complicated [and] it's much more unforgiving." (P6)

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Credential Verification Phase - Biometrics

Biometrics are not always well suited to the abilities of someone with UEI

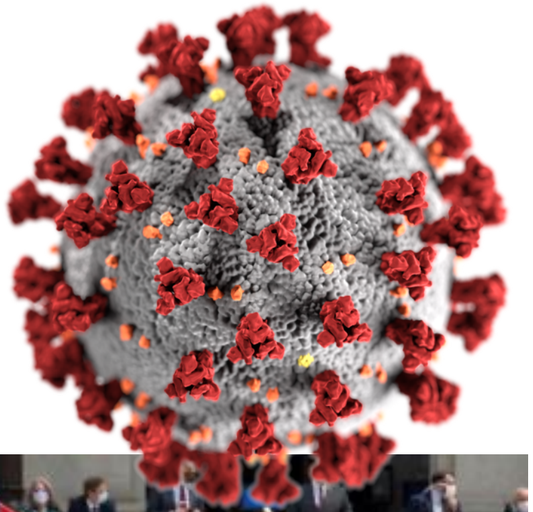
“I...got my nose print. But it wasn’t accurate.” (P2)

Failure Resolution Phase

Insufficient retries and too few options for backup credentials can induce frustration and create lockouts

“So usually my strategy for that is [if] I log in twice incorrectly, if that happens, then I power down the computer, and then I have to wait for it to kick up again.” (P6)

COVID-19 Follow-up study



- Despite COVID-19 vaccines, the pandemic remains a **threat**:
  - Vaccine hesitancy
  - Variants (i.e., the delta variant)
- This necessitates **safety precautions**
  - Social distancing
  - Use of personal protective equipment (PPE)
  - Cleanliness and sanitation

Impact on computing device use

- The influence of COVID-19 has caused our computing device use to increase including our use of authentication

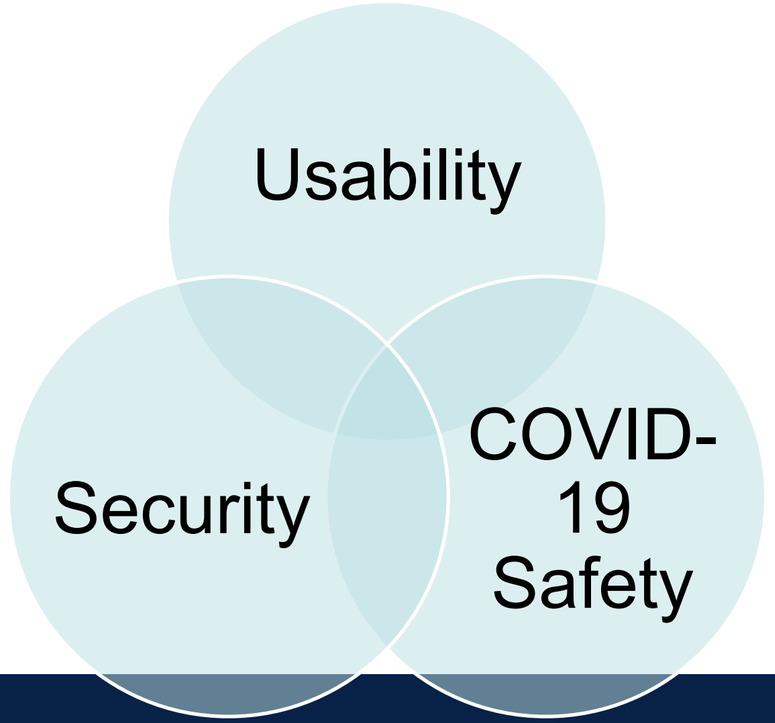
- This can create barriers for people with UEI who already face barriers during authentication

Methods

- Semi-structured interviews with 6 participants with UEI
- Interviews were conducted remotely using Zoom
- Each interview lasted between 30-50 minutes

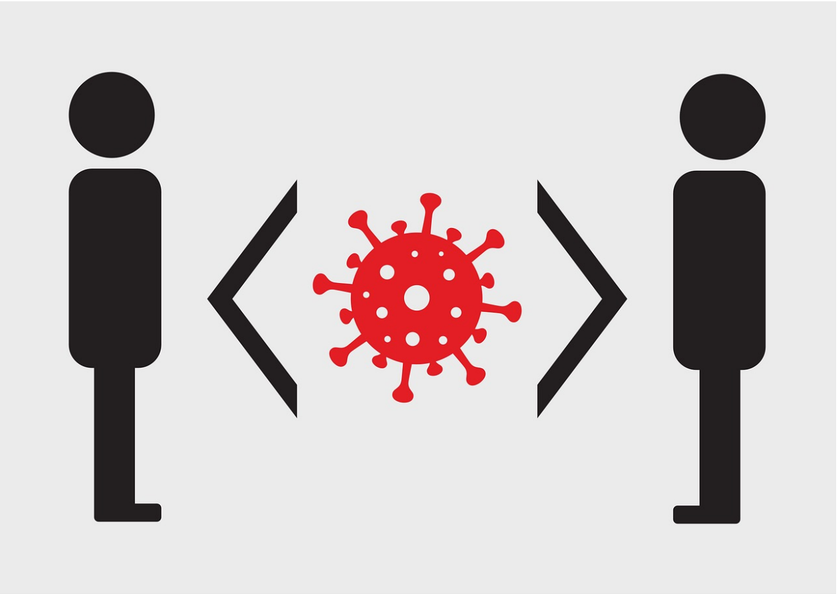
ID	Age	Gender	Disability
P1	20	Man	Muscular dystrophy
P2	59	Man	Spinal Cord Injury
P3	59	Man	Multiple sclerosis
P4	66	Woman	Amputation
P5	51	Woman	Cerebral palsy
P6	74	Woman	Spinal cord injury

COVID-19 Safety Precautions Introduced New Accessibility Barriers For People With UEI That Cause Them To Tradeoff Usability, COVID-19 Safety, And Security



Social Distancing

Social distancing increases computing device and authentication use, causing more frequent encounters with existing barriers during authentication



"With a VPN, I often have to repeat the process because I make a mistake in translating the...text passcode...into the computer's login screen. So that can be tedious...It's almost like you have it sign in twice. I'm already putting in my system password...But then it wants another password on top of that. And I can't copy and paste because it's on my cell phone." (P5)

Use of PPE

PPE can interfere with authentication, to compensate, some people sign in ahead of time instead

“Facial recognition doesn’t really work with a mask on....In the beginning of the pandemic...I wore a face shield and gloves as well. And that didn’t really work with a phone. So it was just very inconvenient.” (P1)

Opportunities for Future Research

Evaluating AT in a security context for password/PIN entry

Promoting interdependence through shared credentials with caregivers

Improving biometrics

Improving the failure resolution process

Enabling physical rehabilitation through authentication

Designing authentication that works with PPE

Developing accessibility conscious corporate security policies for remote workers for UEI

Conclusions

- The current authentication process on computing devices is inaccessible to people with UEI
- COVID-19 has further exacerbated inaccessibility as well as presenting new barriers
- Currently, barriers occur across the entire process and cause people with UEI prioritize safety and usability over security
- Future research is necessary to make authentication accessible to people with UEI

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Questions?

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"Sometimes I feel that I'm being left behind": Exploring Computing Device Use by People with Upper Extremity Impairment During the COVID-19 Pandemic

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Background and Related Work

Some work has approached changes in accessibility for people with disabilities during COVID-19, although none has focused on people with UEI

Works focused on accessibility for people with disabilities during COVID-19
(Gleason et al. 2020, Neece et al. 2020, Fernanda et. al. 2020, Rice and Oritz 2020, Holloway et. al. 2020, Duval et. al. 2021, Uzor et al. 2021)

A few COVID-19 studies have addressed security and privacy during computing device use. None have focused on the challenges people with UEI face during COVID-19 with computing device use or authentication.

COVID-19 related studies which address security and privacy during computing device use

(Loey et al. 2021, Tseng et al. 2021, Zhang et al. 2021)

COVID-19 Safety Precautions

1. Social distancing
2. Use of personal protective equipment (PPE) (e.g., face masks, gloves, etc.
3. Cleanliness and sanitizing

Research Questions

1. How has COVID-19 affected computing device use for people with UEI?
2. Has COVID-19 increased accessibility barriers during computing device use, and, if so, how have people with UEI worked around those barriers?

During this presentation we will focus on the security implications of this work

Covid-19 Has Increased Computing Device Use For People With UEI In Both Remote And In-person Interactions

- Computing device use has increased dramatically also increasing the need for people with UEI to authenticate to their devices more frequently

“There’s a reservation system for all the dining halls, and...you have to verify that you’ve reserved electronically. So my phone is always out when I do that.” (P1).

Opportunities for Future Research

- Authentication should be designed so that it works with PPE so that people with UEI can remain both safe and secure
- Corporate security policies should be crafted to be accessibility conscious for remote workers for UEI