



Designing Empowering Technologies for and with Marginalized Communities

Experience from Industry to Tech Nonprofits



Shaomei Wu, Ph.D.
Founder and CEO
AImpower.org

March 20, 2023
University of California,
Santa Cruz

Agenda

What I will talk about today

01

Introduction
and overview

02

Technologies
for visual
impairment

03

Technologies
for dyslexia

04

Ongoing work
with people
who stutter

05

Future work
and conclusion

Agenda

What I will talk about today

01

Introduction
and overview

02

Technologies
for visual
impairment

03

Technologies
for dyslexia

04

Ongoing work
with people
who stutter

05

Future work
and conclusion

Hi! I'm Shaomei Wu.



- I am the founder and CEO of [Almpower.org](#), a tech nonprofit that researches and co-creates empowering technologies for and with marginalized communities. I am also [a person who stutters](#).
- I was a staff research scientist and software engineer at Meta for ~9 years at its Core Data Science team, AI Research, and Instagram Equity team, leading various "tech for good" initiatives from [Accessibility](#), [AI for Inclusion](#), to [Racial Equity](#).
- I work at the intersection of [HCI](#), [AI](#), [accessibility](#), and [computational social sciences](#).
I study technological experiences of marginalized users, and design socio-technical interventions to dismantle barriers and seek social justice.

Overview of My Research Approach

Community-oriented Technology Research and Development



Understand the problem

Community and technology research to understand the problem space, needs of the community, and opportunities for tech.



Co-design solutions

Take user-centered design approach to co-create technical and non-technical prototype solutions with the community.



Scale solutions

Refine, productionize, and promote solutions vetted by the community

Agenda

What I will talk about today

01

Introduction
and overview

02

Technologies
for visual
impairment

03

Technologies
for dyslexia

04

Ongoing work
with people
who stutter

05

Future work
and conclusion

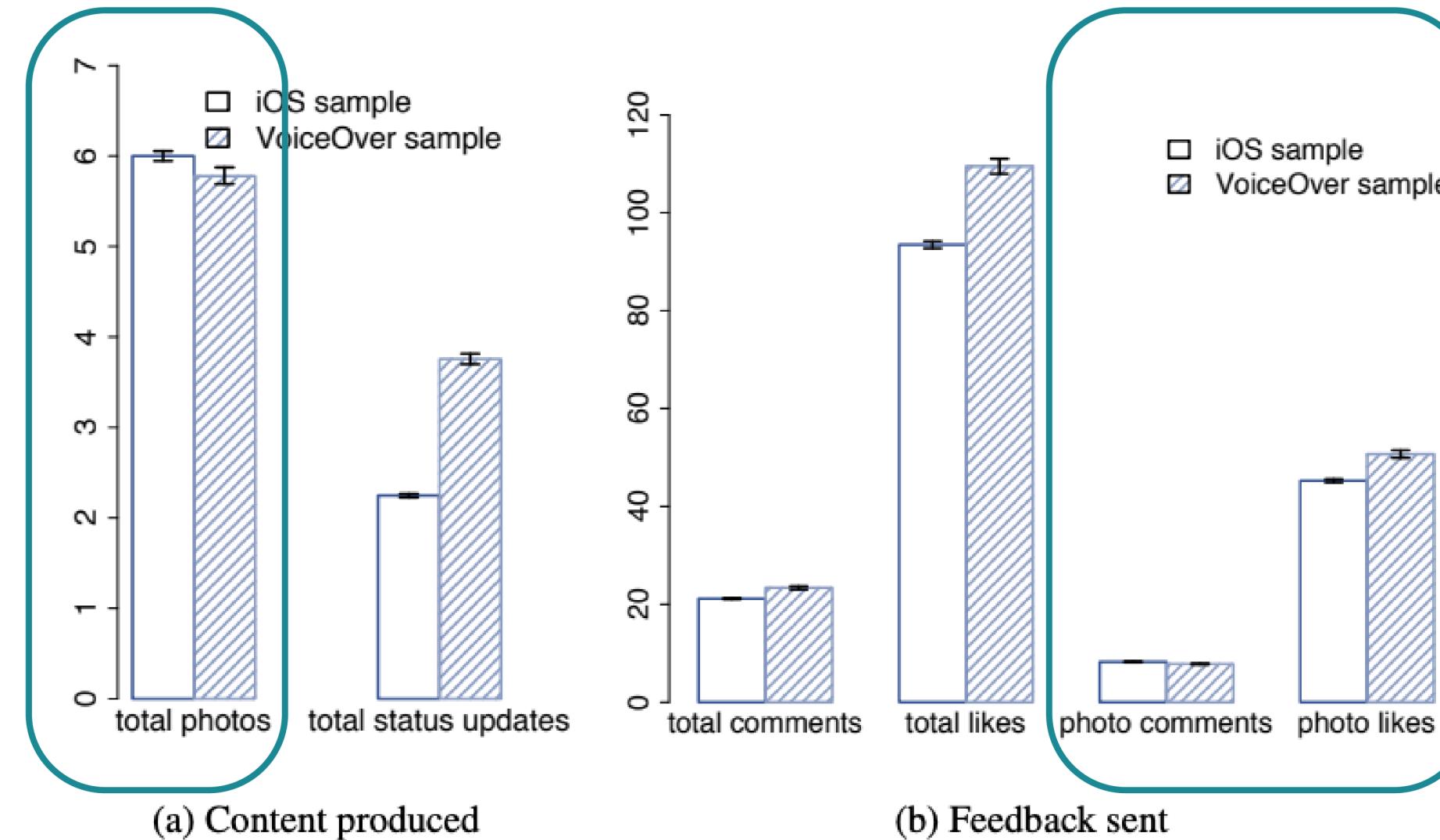


Automatic alt-text on Facebook & Instagram*

*Shaomei Wu, Jeffrey Wieland, Omid Farivar,
and Julie Schiller. *Automatic Alt-text:
Computer-generated Image Descriptions for
Blind Users on a Social Network Service.*
CSCW '17

Visual Content are Important to People with Visual Impairment

Screen reader users **do** engage with photos on Facebook



Current challenges with visual content

"I cannot see the photo, and people rarely describe it. They assume everyone on planet Earth has working eyes. If your eyes happen not to work, too darned bad."

– P40, survey participant [1]

"one of the most frustrating experiences I encounter is [...] to scroll through my tweets and have a few laughs with my friends, only to realize that an article I want to read or a picture or video a friend has tweeted is inaccessible."

– blind participant [2]



1. Violeta Voykinska, Shiri Azenkot, **Shaomei Wu**, and Gilly Leshed. *How blind people interact with visual content on social networking sites*, CSCW'16
2. Meredith Ringel Morris, Annuska Zolyomi, Catherine Yao, Sina Bahram, Jeffrey P. Bigham, and Shaun K. Kane. **"With most of it being picture now, I rarely use it": Understanding Twitter's Evolution Accessibility to Blind Users**. CHI'16

Google Mistakenly Tags Black People as 'Gorillas,' Showing Limits of Algorithms

By ALISTAIR BARR

Jul 1, 2015 3:40 pm ET

Flickr faces complaints over 'offensive' auto-tagging for photos

Auto-tagging system slaps 'animal' and 'ape' labels on images of black people, and tags concentration camps with 'jungle gym' and 'sport'



The famous train tracks leading into Auschwitz, which were labelled "sport" by Flickr's algorithm. Photograph: Christopher Furlong/Getty Images

Off-the-shelf Computer Vision Models Might not Work

They are not designed for visually impaired users, and often contain other biases [1].

[1] Joy Buolamwini, Timnit Gebru. Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification. FAccT '18.

User-centered Design and Prototyping

The image shows a composite of two screenshots. On the left is a Facebook post by Danielle Destefano. The post shows a profile picture of a woman with a rainbow filter applied to her face and hair, set against a background of rainbow roses. The caption reads: "Danielle Destefano changed her profile picture. July 5 at 9:47pm · Edited · Created with facebook.com/celebratepride". To the right of the post is a vertical bar containing text labels and their corresponding descriptions. On the right is a photograph of a person sitting at a desk with multiple monitors, working on a laptop.

Original description:
Danielle Destefano's photo.

People Tags:
There is 1 person, 1 woman, smile.

Object Tags (precision=0.5):
text, woman

Object Tags (precision=0.75):
NA

Share
Casey Shannon Brant, Sandy Kope, Nicole Medina and 17 others like this.

Marie Klemchuk Better late than never!

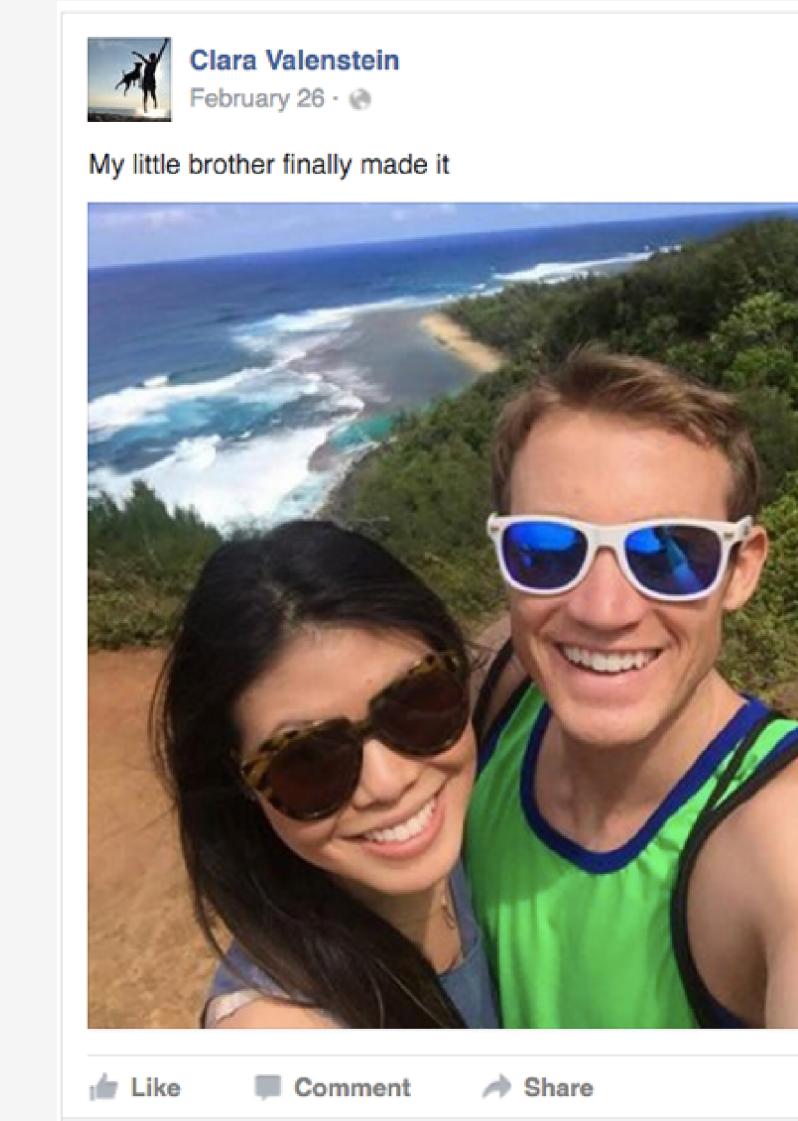
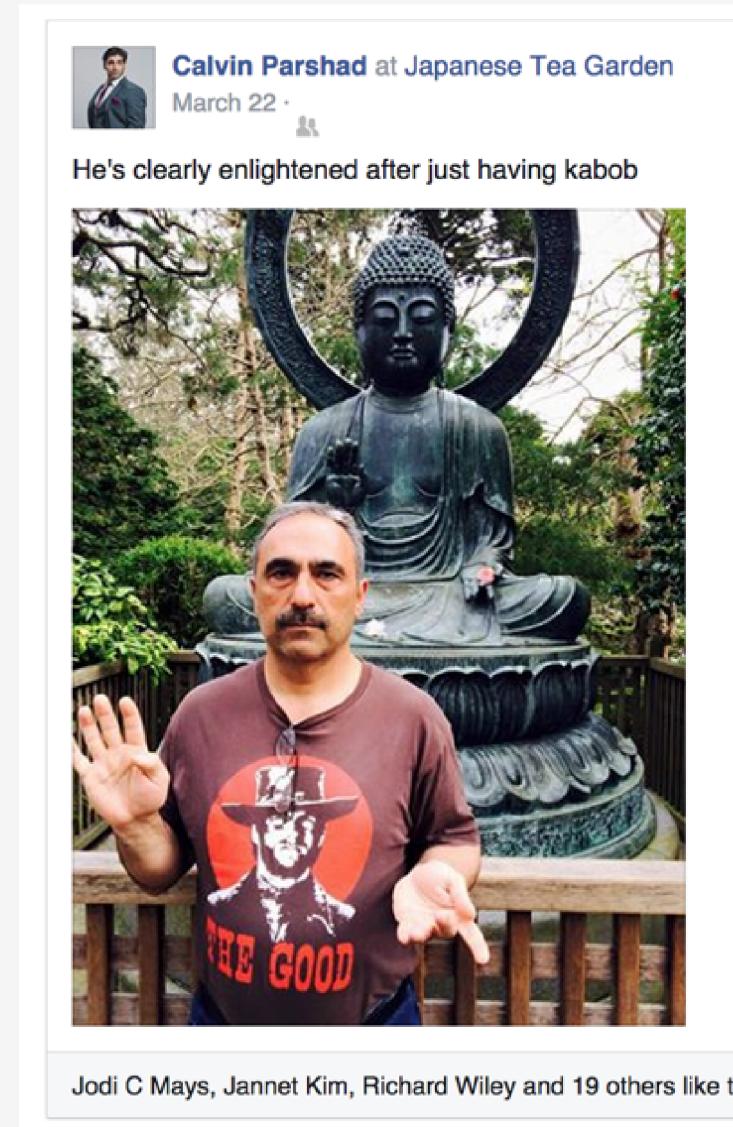
Danielle Destefano Love is love!

Carrie Robinson Missing you my awesome cuz!! Love is love... And on that note- I love you too (but I've got a boyfriend, so not really looking for that kind of love)!! You're the best hope to see you soon!! Carebear

July 6 at 2:30am

ent.

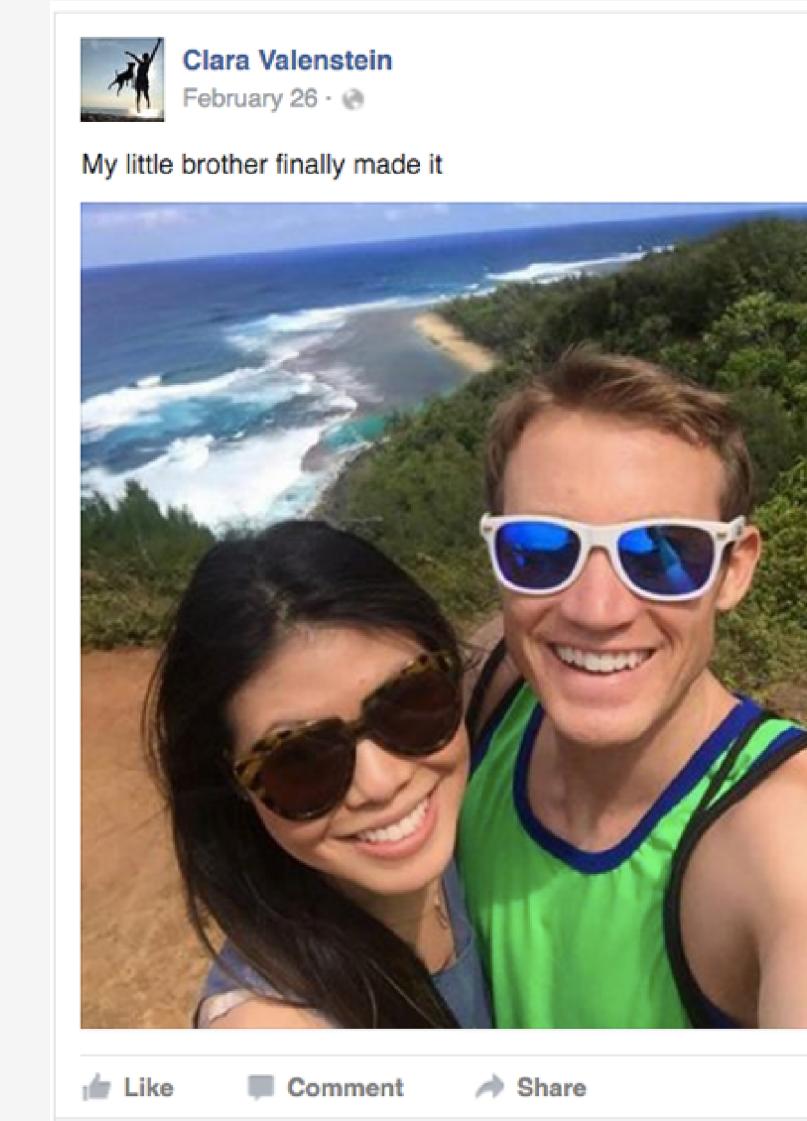
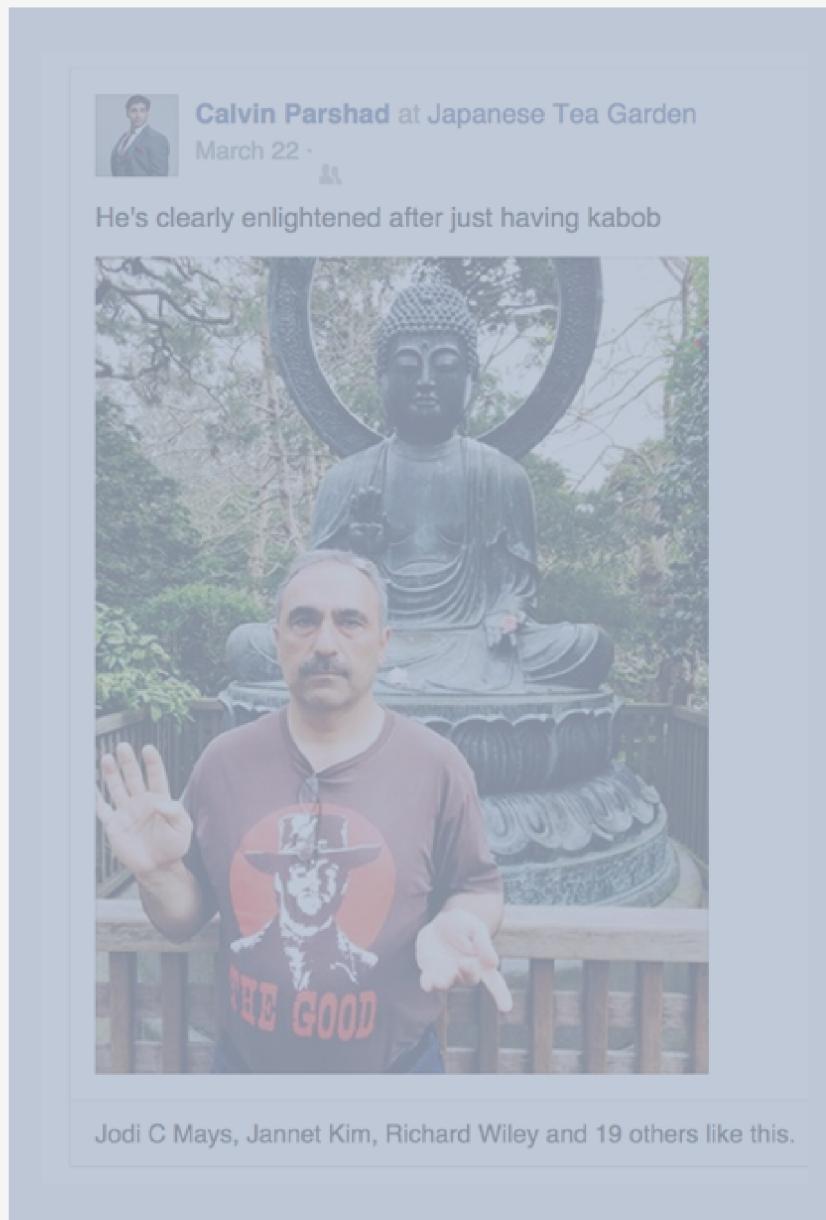
Design Evolution



People Tags: There are 2 people, 2 men.
Object Tags: text, man
Recognized text: good

Image may contain: 2 people, smiling, sunglasses, sky, selfie, outdoor, nature

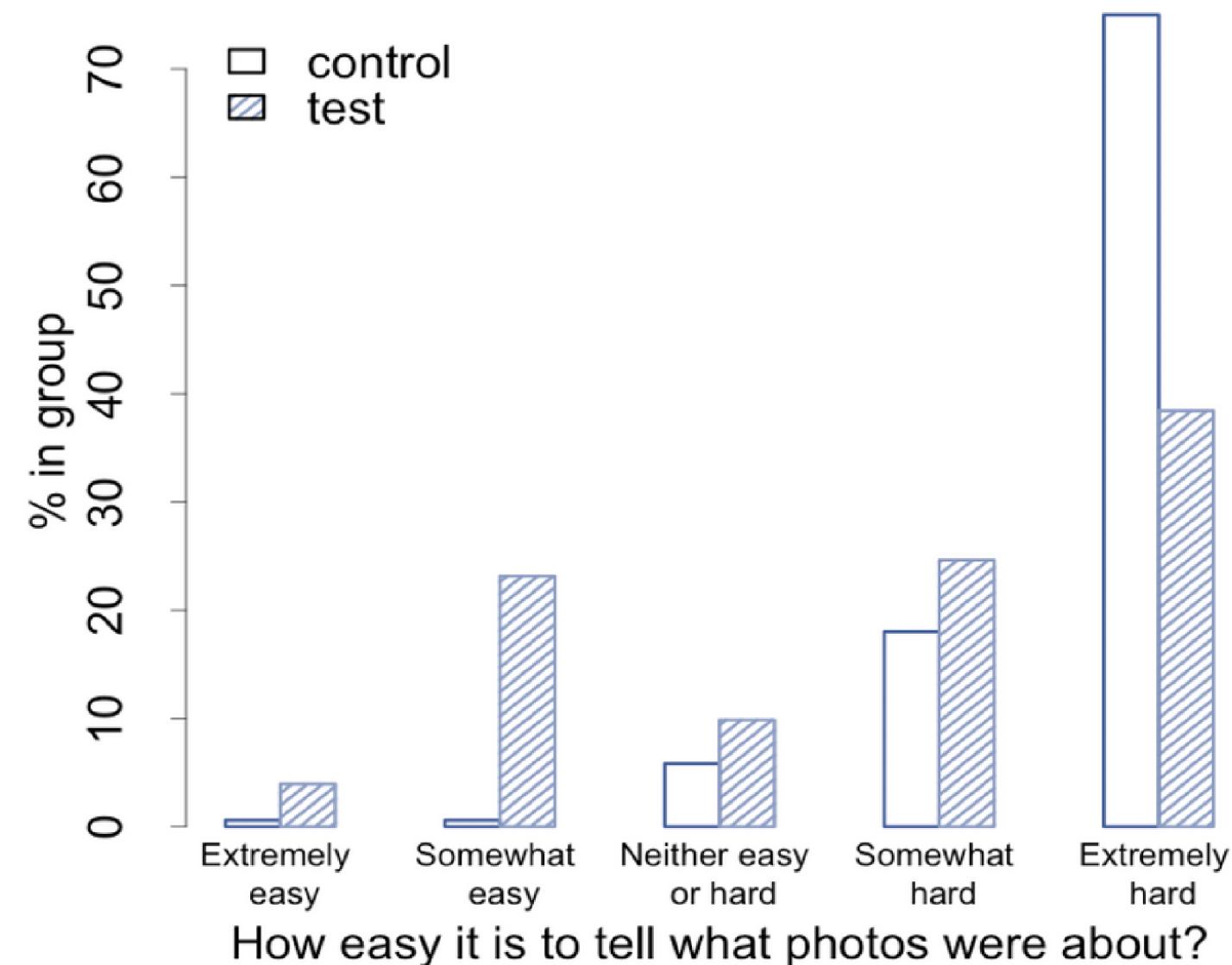
Design Evolution



People Tags: There are 2 people, 2 men.
Object Tags: text, man
Recognized text: good

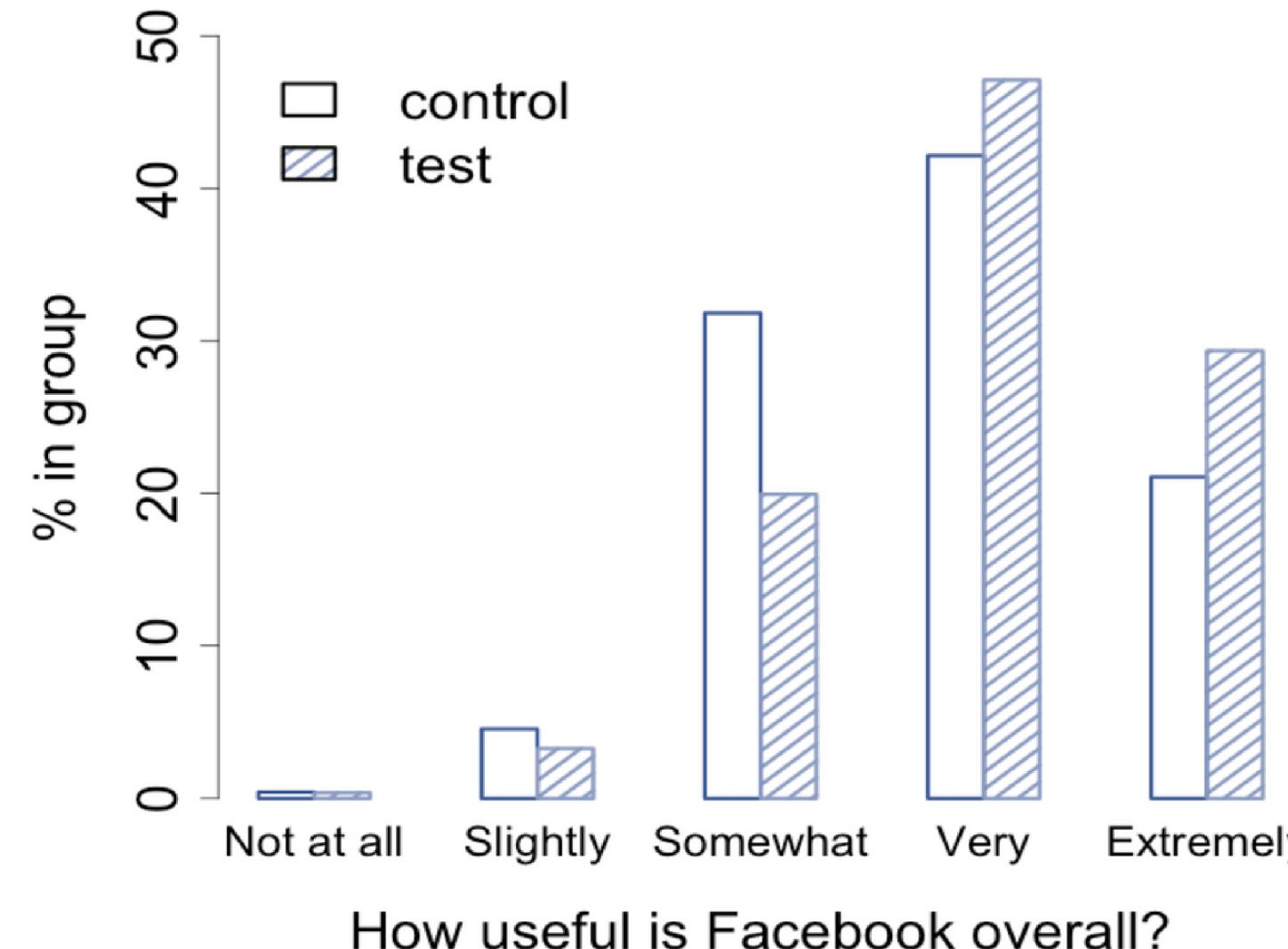
Image may contain: 2 people, smiling, sunglasses, sky, selfie, outdoor, nature

Evaluate Design through Large-scale Field Study

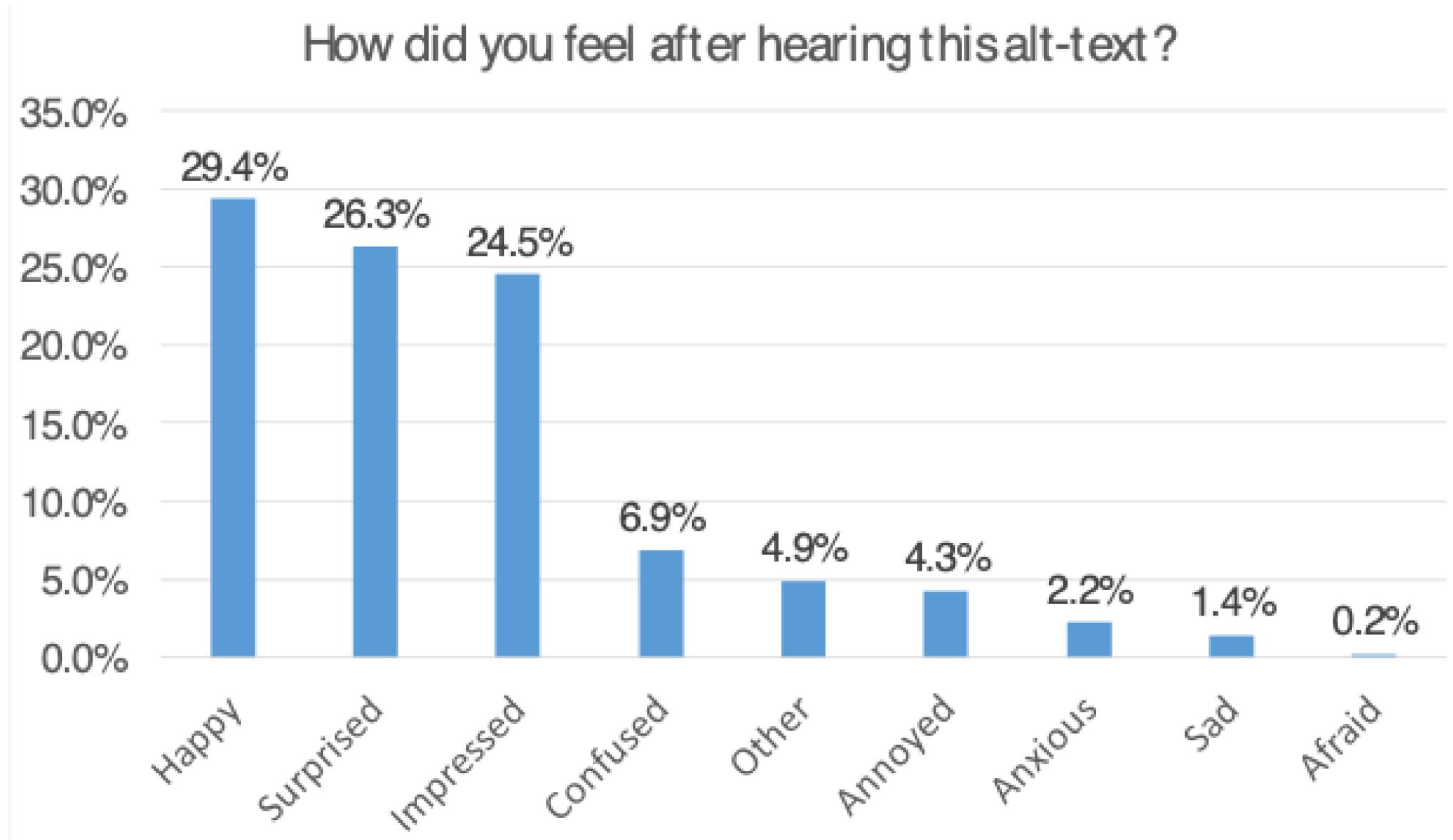


“ I like that I can get a **better understanding** of what friends and others are posting in terms of photos and not have to go looking for a sighted person to describe what is going on. ”

Evaluate Design through Large-scale Field Study



"For the first time, I feel like I can enjoy FB like my sighted friends....
Like I am really **part of the community.**"



Test Users Reported Positive Sentiments

Automatic alt-text brought people not only **utility** but also **delights**

Visually Impaired Users as Content Creators



“ _____
I do wish there was a way to, for a person
who is totally blind, to be able to **take**
good pictures or good videos. There's
sort of a disconnect there.
_____ ”

– Lisa, 28, blind since birth [1]

“ _____
I accidentally **posted the wrong pic** from
my photo album on my phone and didn't
realize it until I read the comments.
_____ ”

- P3, survey participant [1]

[1] Violeta Voykinska, Shiri Azenkot, **Shaomei Wu**, Gilly Leshed. *How blind people interact with visual content on social networking sites*, CSCW'16

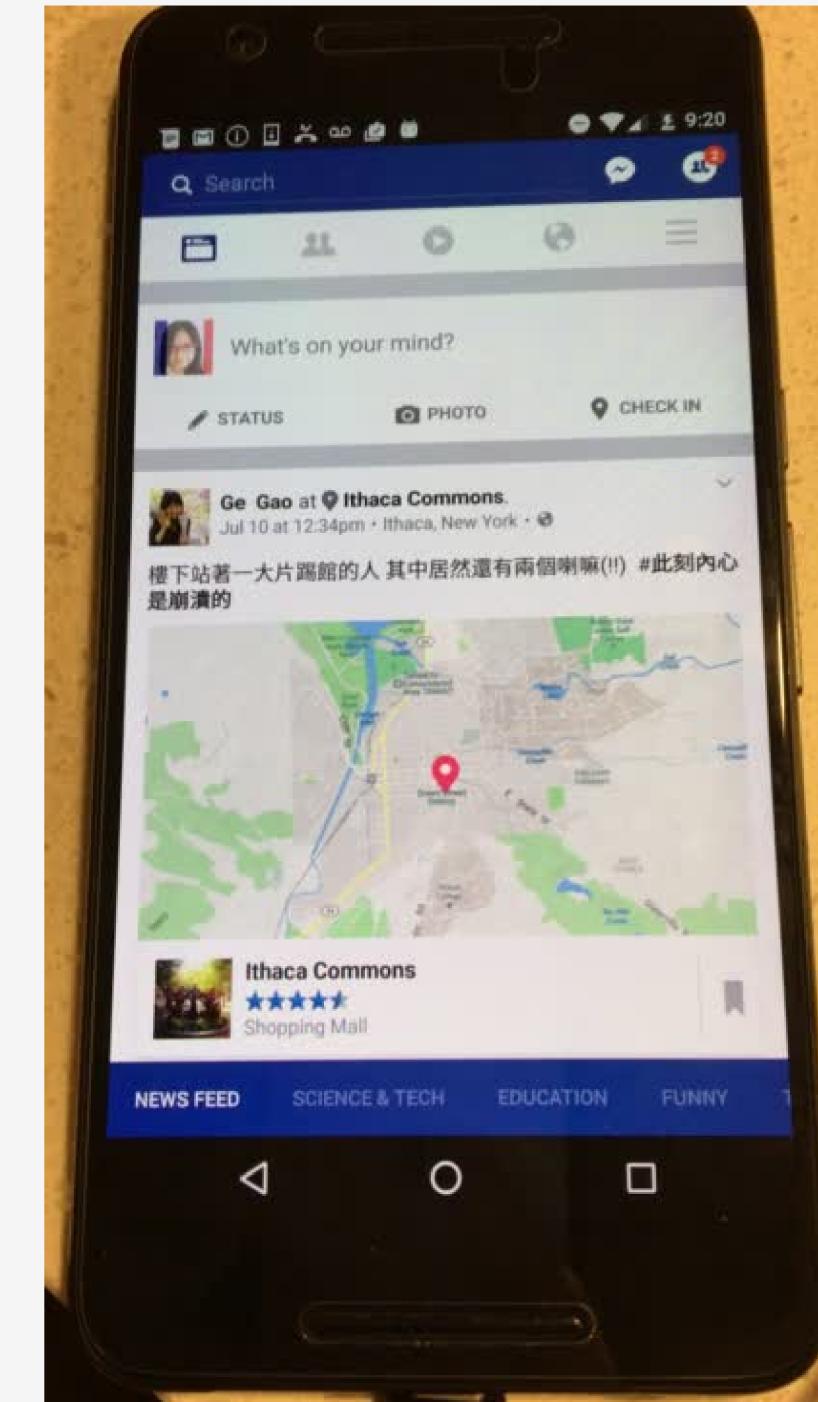
Automatic Alt-text for Photo-Sharing*

Designed to serve information needs

- Key visual elements
- People
- Photo quality

Evaluated by 7-day diary study

- Six participants with visual impairments
- Installed on personal devices to test in the wild



* Yuhang Zhao, **Shaomei Wu**, Lindsay Reynolds, Shiri Azenkot. *The Effect of Computer-Generated Descriptions on Photo-Sharing Experiences of People with Visual Impairments*. CSCW '18

What works:

Information provided is useful

- "Blurry" is the most useful
 - Reappropriate use case to understand photos in device
-

“ I liked it because sometimes I can't tell if a person's eyes are closed. So that was kind of cool to know, my eyes are closed. So that's not a good photo. ”

“ It was really neat because it would tell me where I was, what it looked like, and picked out objects. It told me 'Stadium, outdoor, and baseball. ”

* Yuhang Zhao, Shaomei Wu, Lindsay Reynolds, Shiri Azenkot. *The Effect of Computer-Generated Descriptions on Photo-Sharing Experiences of People with Visual Impairments*. CSCW '18

What does not work:

1. Description not rich enough to support independent posting.

“ _____

All it says for the dog is ‘dog.’ I want to see which direction is the dog looking, and what they do, is their tongue out or something.

_____ ”

2. Reduced accuracy for photos by visually impaired users.

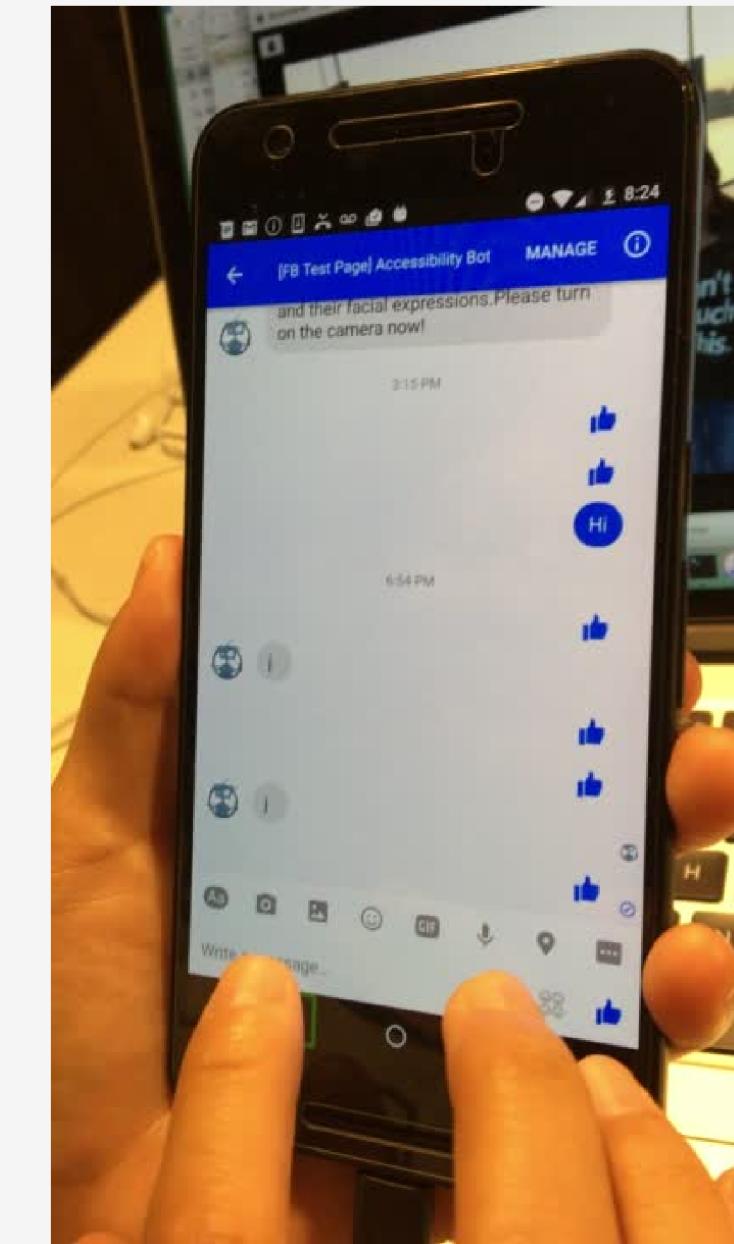
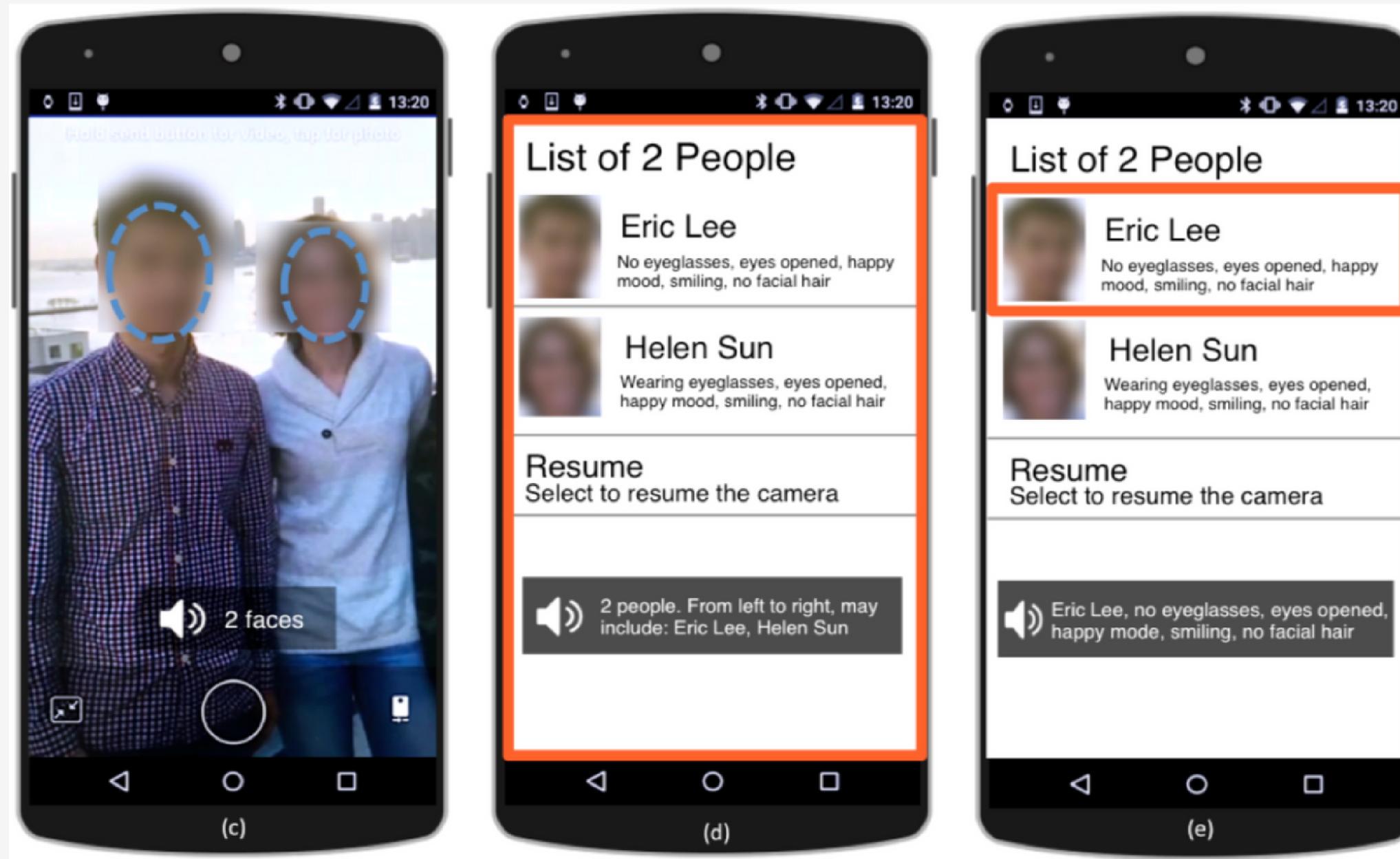
“ _____

I noticed that the accuracy depended on the lighting. It seemed to be the biggest factor affecting the accuracy.

_____ ”

* Yuhang Zhao, Shaomei Wu, Lindsay Reynolds, Shiri Azenkot. *The Effect of Computer-Generated Descriptions on Photo-Sharing Experiences of People with Visual Impairments*. CSCW ‘18

Face Recognition in-situ



Yuhang Zhao, **Shaomei Wu**, Lindsay Reynolds, and Shiri Azenkot. *A Face Recognition Application for People with Visual Impairments: Understand the Use beyond the Lab*. CHI '18

Agenda

What I will talk about today

01

Introduction
and overview

02

Technologies
for visual
impairment

03

Technologies
for dyslexia

04

Ongoing work
with people
who stutter

05

Future work
and conclusion

Dyslexia

THE YOUNG READERS
ARE DESIGNED
TO RECREATE THEM
YOU CAN BE AS YOU
READ TO READ, IF YOU
WERE DYING TO,
DESIGNED TO SIGHTLY
THE FEELING OF READING
WHICH DYING BY
SIGHTLY THE READING
THE FEELING NEVER
COULD TO A SPEED OF
THEM SEEING THEM
WHICH DYING TO
READ

DYING

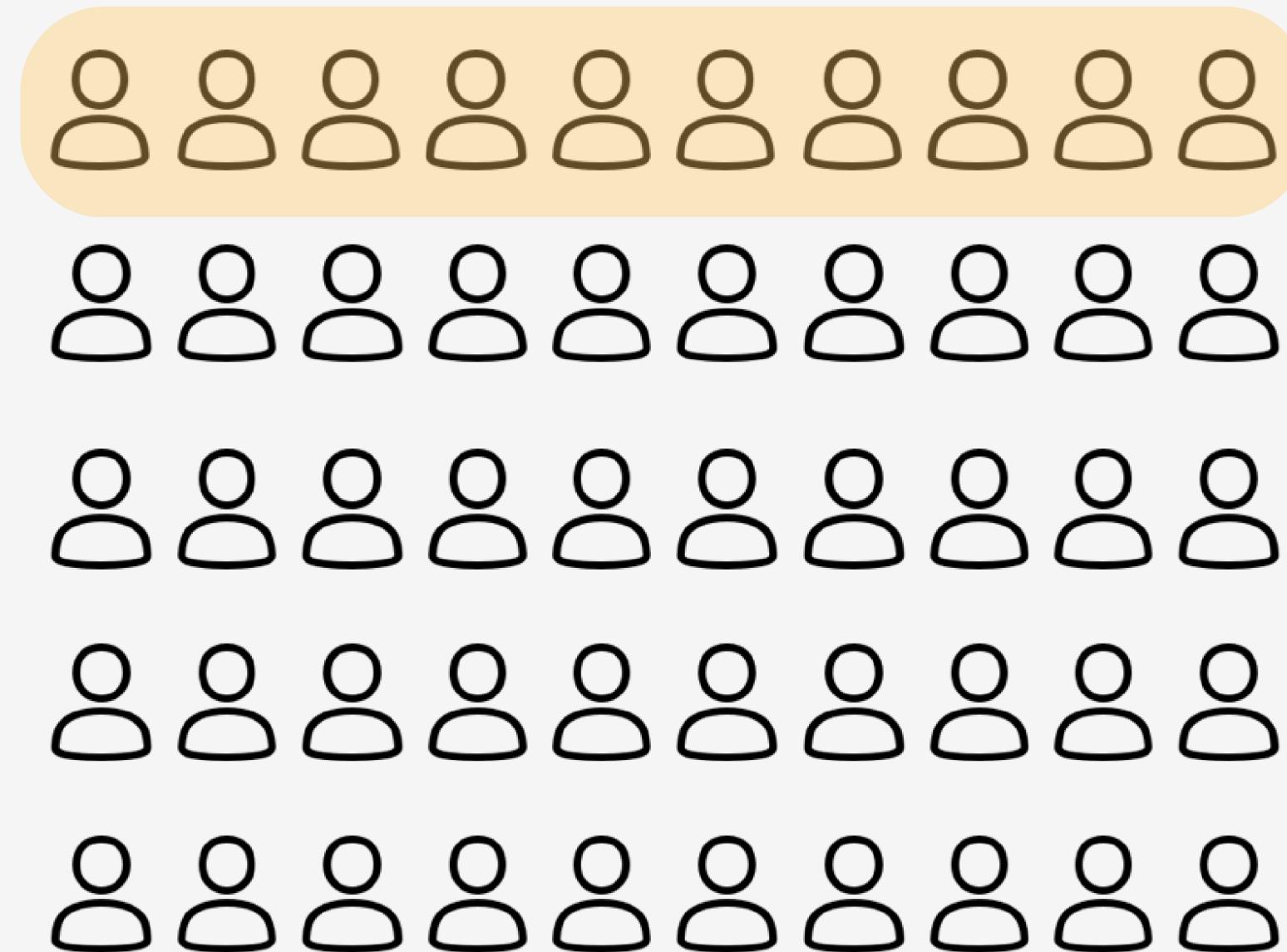


Image courtesy of Daniel Britton

Dyslexia on social media

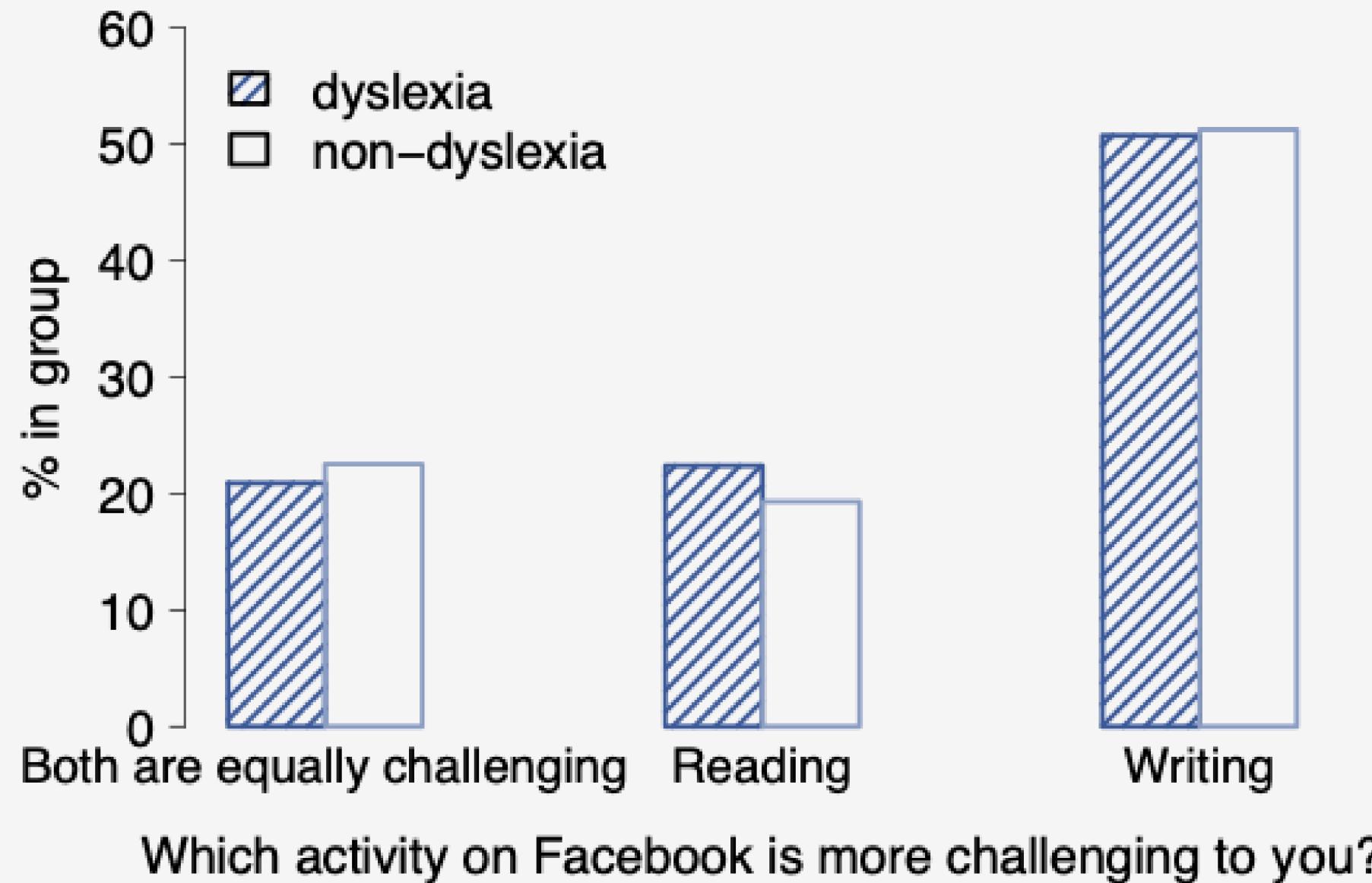


Explorative Research to understand the experience *

- Interviews
 - n=11 participants with dyslexia
- Survey
 - n=67 participants with dyslexia
 - n=404 participants not identified with dyslexia

* Lindsay Reynolds and Shaomei Wu. "*I'm Never Happy with What I Write": Challenges and Strategies of People with Dyslexia on Social Media.*" ICWSM '18 (Best Paper Runner-up)

Results: Writing is a bigger challenge!



* Lindsay Reynolds and **Shaomei Wu**. “I’m Never Happy with What I Write”: Challenges and Strategies of People with Dyslexia on Social Media. ICWSM ‘18

Why is reading easy?

Short

"A lot of the writing and stuff [on Facebook] is **pretty short**... it's generally pretty easy to read."

— Participant P02 *

Low-stake

"I don't end up reading all of [long posts], because, let's be honest, it's gonna take me too much time to read that."

— Participant P11 *

Color coded

"Names are always in blue...non-content that's just information is in gray and then the text is in black. **Segmenting things in colors** is really helpful."

— Participant P07 *

* Lindsay Reynolds and Shaomei Wu. "I'm Never Happy with What I Write": Challenges and Strategies of People with Dyslexia on Social Media. ICWSM '18

What makes writing hard?

Public & archived

"It's in the **public sphere** and I'd really rather [writing] not be incorrect for **however long the internet lasts.**"

— Participant P07 *

Stereotypes

"I don't want to write publicly...that's my biggest fear, of **not sounding as intelligent.**"

— Participant P04 *

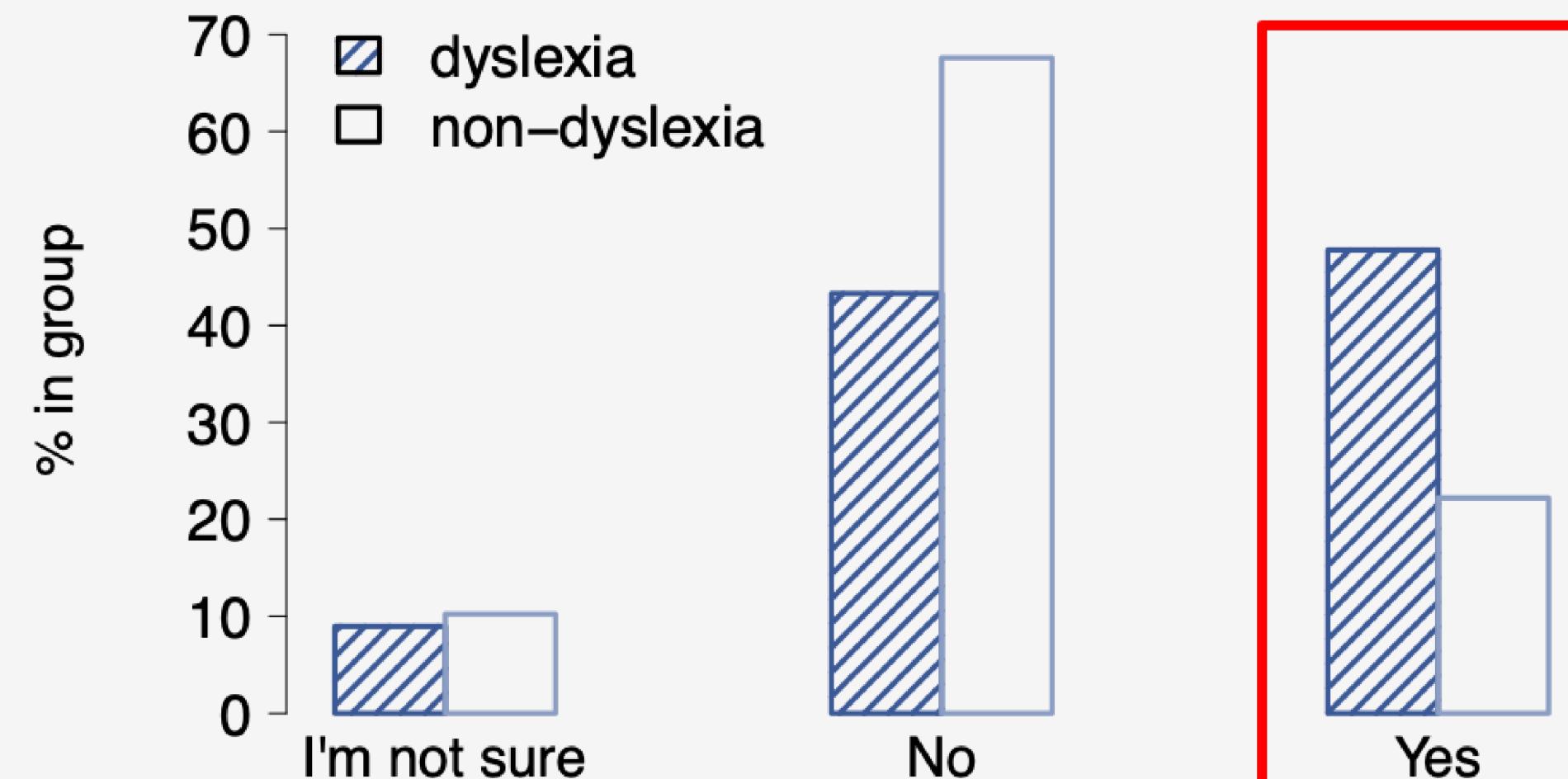
Negative reactions

"They'll instantly **want to autocorrect** and don't understand **it's rude...I hate it.**"

— Participant P03 *

* Lindsay Reynolds and Shaomei Wu. "I'm Never Happy with What I Write": Challenges and Strategies of People with Dyslexia on Social Media. ICWSM '18

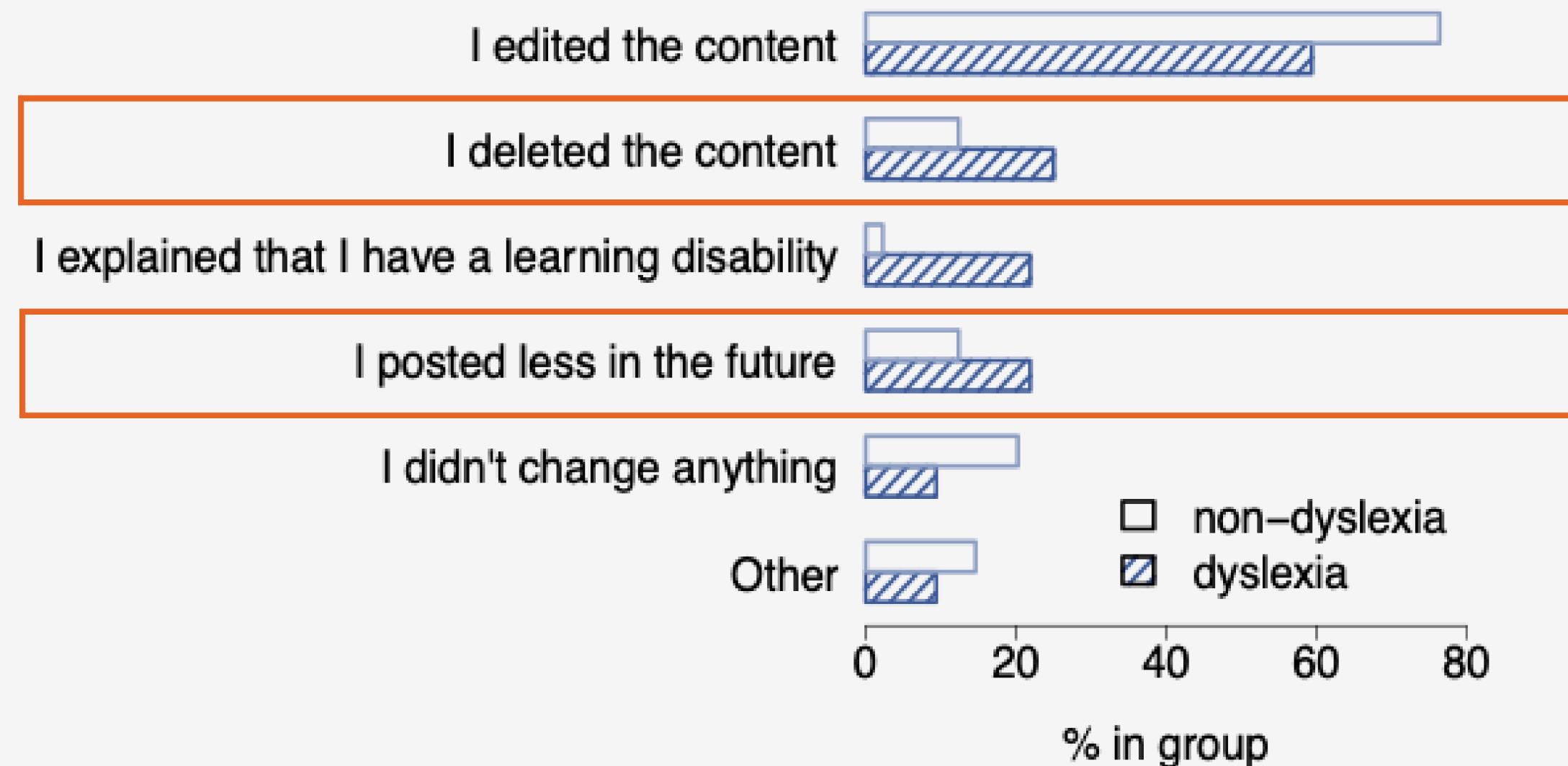
People with dyslexia are more likely to receive negative writing feedback



Has anyone ever corrected or commented negatively
on the spelling or grammar of content you've written on Facebook?

* Lindsay Reynolds and Shaomei Wu. “I’m Never Happy with What I Write”: Challenges and Strategies of People with Dyslexia on Social Media. ICWSM ‘18

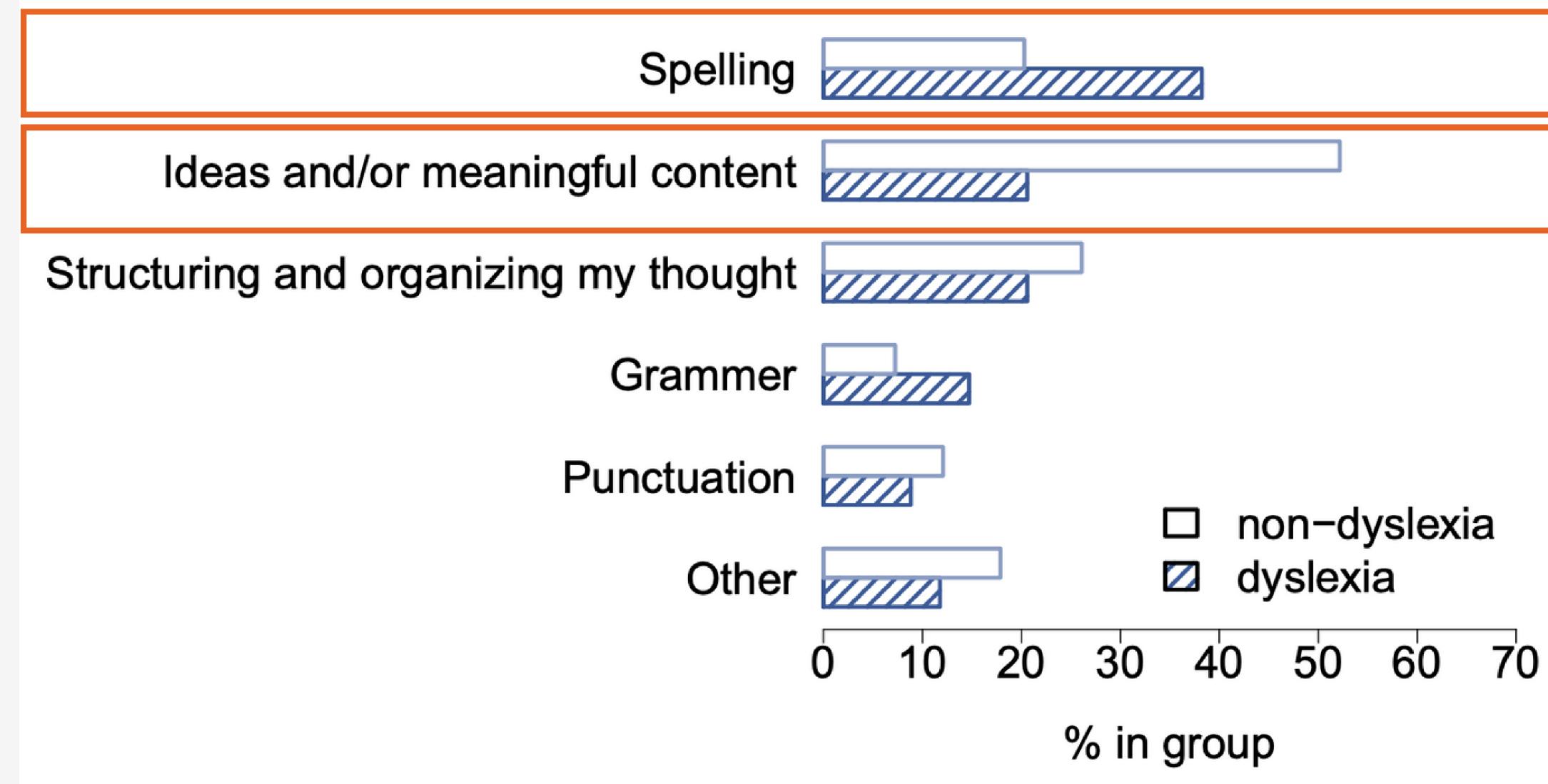
... and more likely to self-censor in response to negative feedback



How have you responded to negative comments or corrections?

* Lindsay Reynolds and Shaomei Wu. “I’m Never Happy with What I Write”: Challenges and Strategies of People with Dyslexia on Social Media. ICWSM ‘18

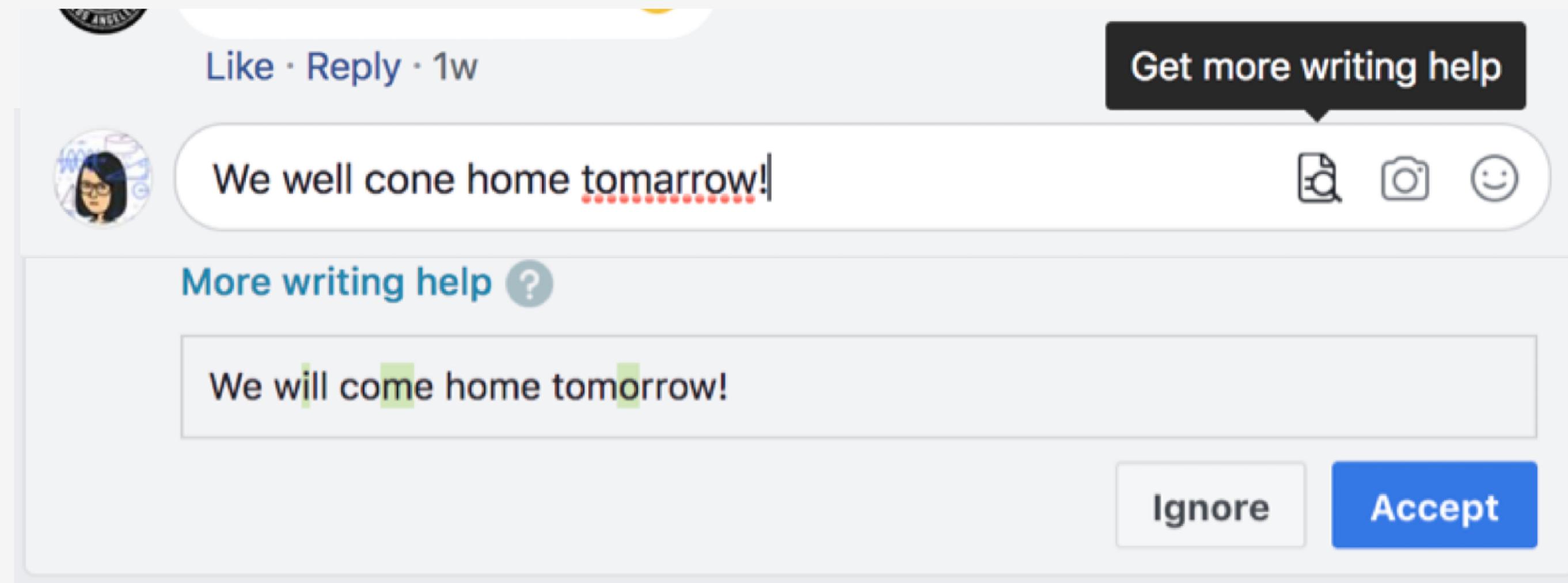
Barrier to writing is different across groups



What is the TOP writing challenge you experienced on Facebook?

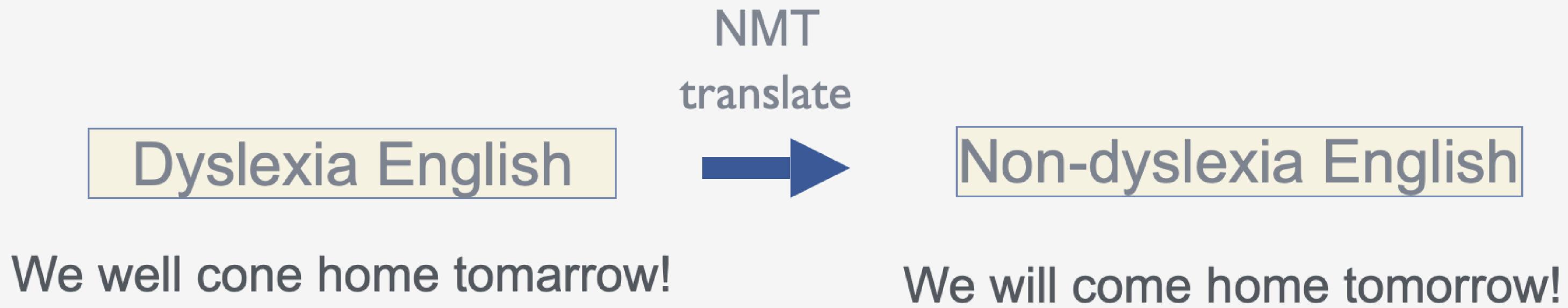
* Lindsay Reynolds and Shaomei Wu. "I'm Never Happy with What I Write": Challenges and Strategies of People with Dyslexia on Social Media. ICWSM '18

Additional Writing Help (AWH) Tool *



* Shaomei Wu, Lindsay Reynolds, Xian Li, Francisco Guzman. *Design and evaluation of a social media writing support tool for people with dyslexia*. CHI 2019

Neural Machine Translation (NMT)



Challenges

Three major challenges when applying NMT to the dyslexia use case

- 1** Lack of massive training data

- 2** Can not fix out-of-vocab (OOV) tokens

- 3** Limitations of default metric (BLEU)

Challenges

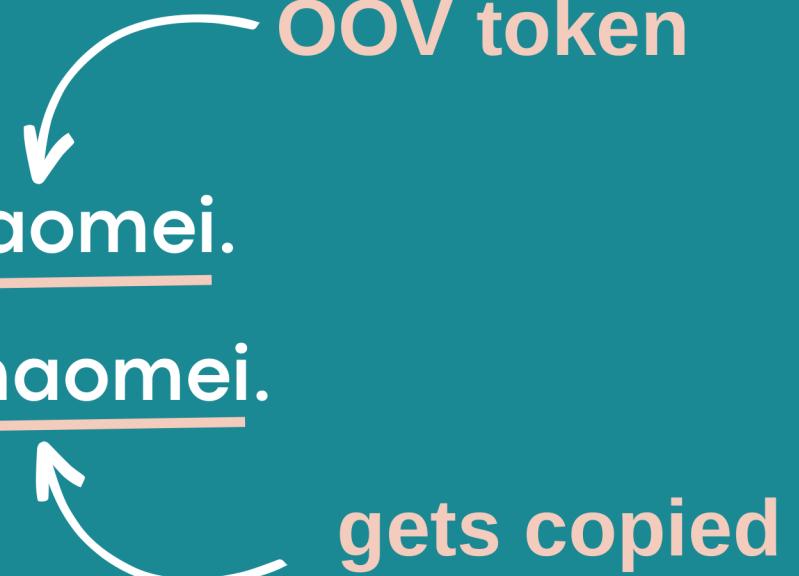
Three major challenges when applying NMT to the dyslexia use case

-
- 1 Lack of massive training data

 - 2 Can not fix out-of-vocab (OOV) tokens

 - 3 Limitations of default metric (BLEU)

Source: This is Shaomei.
Target: Este es Shaomei.



The diagram illustrates the challenge of handling out-of-vocabulary (OOV) tokens. It shows two sentences side-by-side. In the source sentence, the word 'Shaomei' is underlined and has a red arrow pointing down to it from the text 'OOV token'. In the target sentence, the same word 'Shaomei' is also underlined, but a red arrow points up to it from the text 'gets copied', indicating that the model has attempted to reproduce the OOV token from the source.

Challenges with BLEU Score

1. Can not motivate model to make changes

- Changes are small and few
- BLEU score are inflated

2. Can not differentiate different types of model errors

Source: Imk if its okay.

Target: Imk if it's okay.

False positive: Imk **of** it's okay.

False negative: Imk if **its** okay.

Challenges

Three major challenges when applying NMT to the dyslexia use case

- 1** Lack of massive training data
- 2** Can not fix out-of-vocab (OOV) tokens
- 3** Limitations of default metric (BLEU)



Synthetic data with simulated dyslexia mistakes

Generate Synthetic Dyslexia Training Data

	<i>Type of corrections made</i>	%
Spelling	Spacing and apostrophes	37
	Omitting letters	33
	Confusing homophones or similar soundings words	19
	Inserting letters	18
	Swapping order of letters/syllables	9
	Confusing letters visually	5
	Foreshortening words	4
	Similar looking words spelled with similar letters	3
	Omitting or misusing prefixes or suffixes	3
	Misusing small and common words	2
Punctuation	Other	34
	Missing ending punctuation	51
	Missing comma	38
	Extra or missing spaces without creating spelling error	15
	Other	17
Capitalization	Improperly over-capitalized in the middle of a sentence	10
Grammar	Sentence structure	48
	Misuse of verb tense or missing verb	18
	Misuse or missing articles	10
	Misuse of singular or plural	8
	Misuse or missing preposition	4

Letter confusion

My best friend. → My pest friend.

Homophone confusion

Here we go! → Hear we go!

Word confusion set

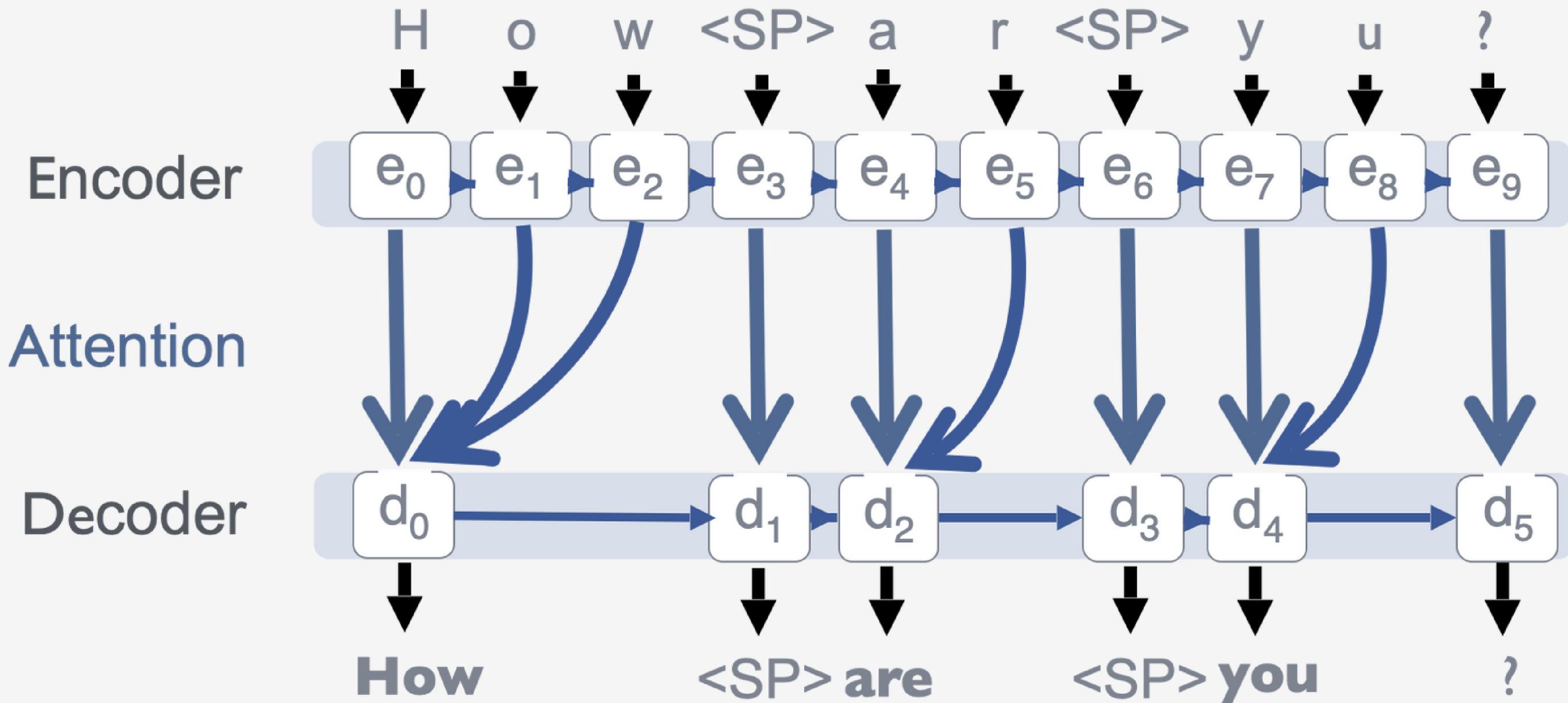
You're welcome. → Your welcome.

Challenges

Three major challenges when applying NMT to the dyslexia use case

- 1** Lack of massive training data → **Synthetic data with simulated dyslexia mistakes**
- 2** Can not fix out-of-vocab (OOV) tokens → **Character-based encoder**
- 3** Limitations of default metric (BLEU)

Character-based Encoder

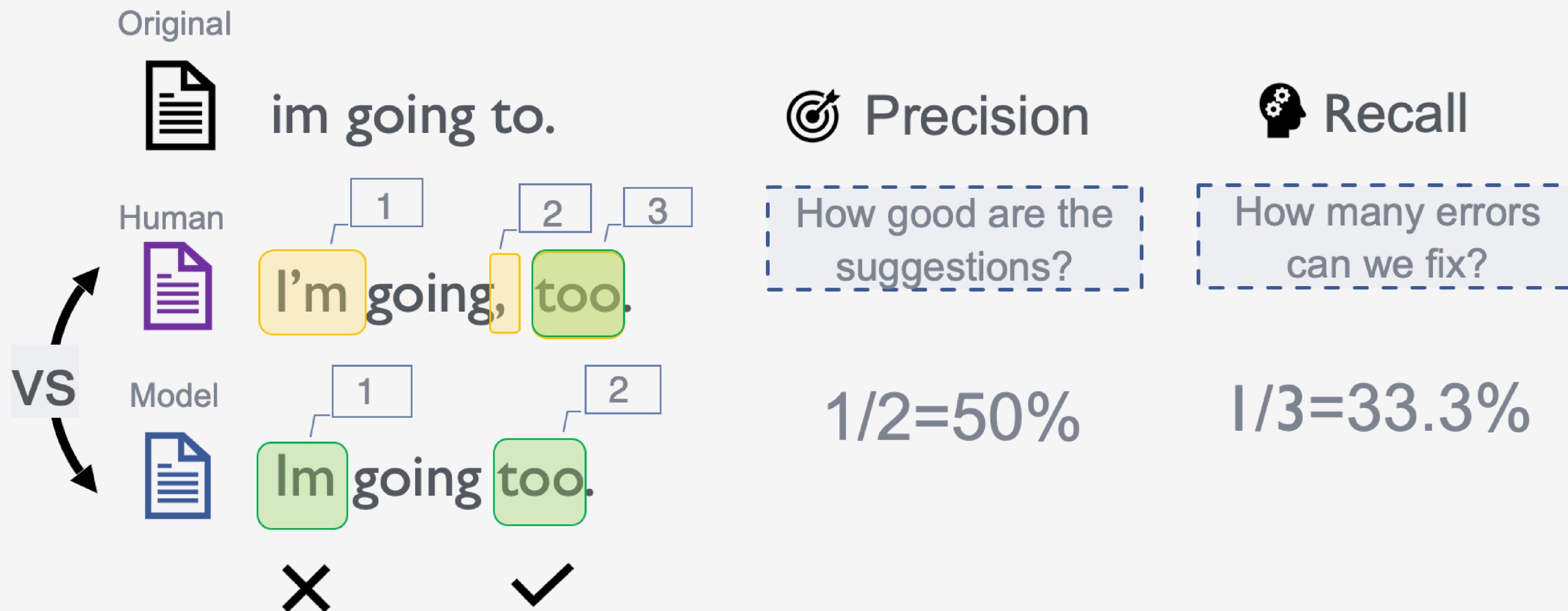


Challenges

Three major challenges when applying NMT to the dyslexia use case

- 1** Lack of massive training data → **Synthetic data with simulated dyslexia mistakes**
- 2** Can not fix out-of-vocab (OOV) tokens → **Character-based encoder**
- 3** Limitations of default metric (BLEU) → **Customized metrics**

Customized Evaluation Metrics



Can AWH Empower People with Dyslexia in Writing on Social Media?

- **One-week diary study with 19 dyslexia participants**

- Initial survey before study starts
- Daily survey during the study
- final day survey

- **Follow-up interviews with 11 participants**

- A few weeks after the diary study



vs.

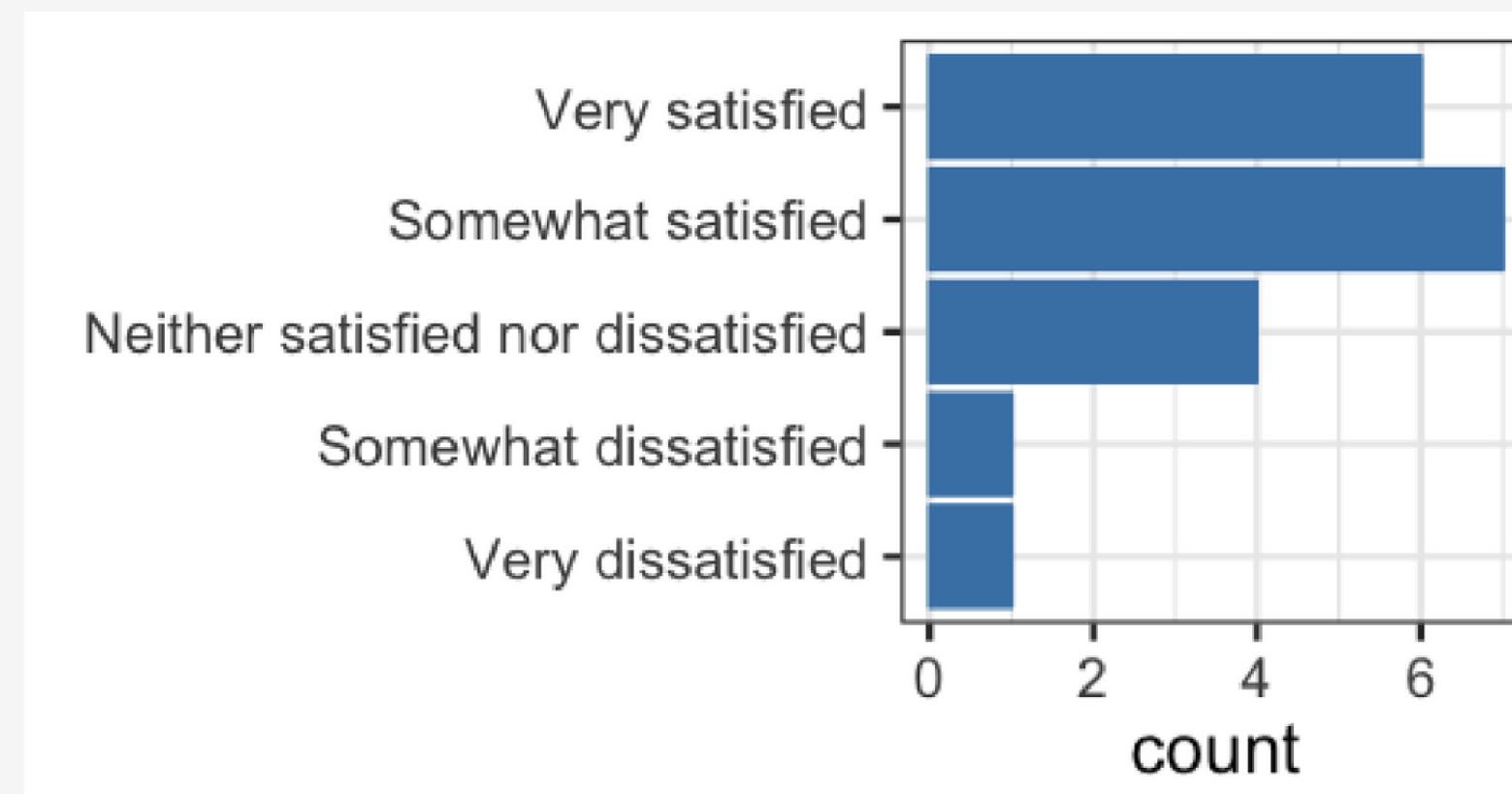


Empowerment

Engagement

Dyslexia Users Liked the Experience with AWH

Overall, how satisfied or dissatisfied were you with the tool?



I actually **really enjoyed using the tool**, and I didn't think I was going to. [...] A lot of times being in the disabilities community, they're always coming up with new, shiny things to make everybody's life better, but **lots of times those shiny things are just kind of crappy at the end of the day**.

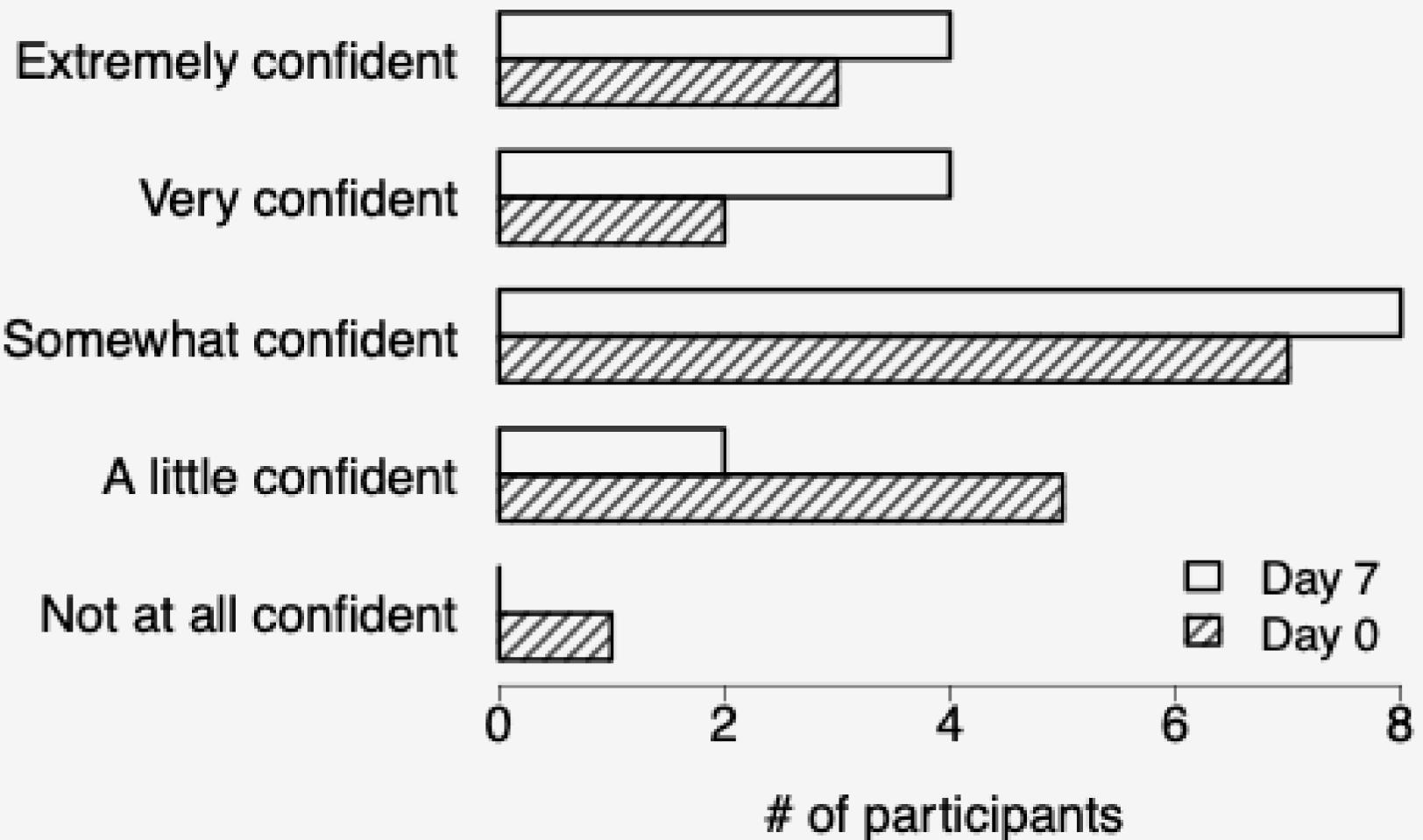


-- P1 *

* Shaomei Wu, Lindsay Reynolds, Xian Li, Francisco Guzman. *Design and evaluation of a social media writing support tool for people with dyslexia*. CHI 2019

Increased Confidence in Writing

How confident are you in your ability to write clearly?



* Shaomei Wu, Lindsay Reynolds, Xian Li, Francisco Guzman.
Design and evaluation of a social media writing support tool for people with dyslexia. CHI 2019

“ I just felt good to know there was this **safety net** behind me. -- P2 *

“ I will say I really do love the feature and am using it all the time. It's very user friendly, helpful and **makes me feel better about posting things**. People do judge you on your wording and how you write. This feature has **given me more confidence in my posts** and I am getting my points across in an educated manner when I am engaging in discussions. -- P3 *

Future directions

1. Correct-ness vs. authenticity

- Letter casing
- Slangs and regional words
- Abbreviations

2. Sustained self-efficacy

- crutch or building block?

* Shaomei Wu, Lindsay Reynolds, Xian Li, Francisco Guzman. *Design and evaluation of a social media writing support tool for people with dyslexia*. CHI 2019

“ I’m from Florida, so I do use **words like ain’t and y’all**...and it wants to change it to ‘**you all**.’ What good is that? ” -- P5 *

“ **Once the tool was gone and I knew it was gone**...sometimes discussions have come up and I’m like, ‘Gee, I don’t know if I’m going to able to convey this,’ **so instead of saying something I don’t say anything**, and that’s just been kind of a bummer. ” -- P1 *

“ I’m fine with having a crutch. If it’s for my son, I want more for him, and I think if **it’s a building block it gives you more of a capability to be independent**. ” -- P4 *

Agenda

What I will talk about today

01

Introduction
and overview

02

Technologies
for visual
impairment

03

Technologies
for dyslexia

04

Ongoing work
with people
who stutter

05

Future work
and conclusion



Stuttering is a complex **neurodevelopmental** disorder that is estimated to impact

1-3% of the world population.

- Neuroimaging from people who stutter shows a **malfunction** in cortico-basal ganglia-thalamocortical loop [1].
- Stuttering in adulthood is **incurable** and highly **stigmatized** [1].
- Stuttering is associated with **higher mental health risk**, **under-employment**, and **20-35% reduced earnings** [2].

[1] Xiaofan Lei. *What causes stuttering? A speech pathology researcher explains the science and the misconceptions around this speech disorder.* TheConversation, 2022.

[2] Gerlach H, Totty E, Subramanian A, and Zebrowski P. 2018. Stuttering and Labor Market Outcomes in the United States. *J Speech Lang Hear Res.* 61, 7 (2018), 1649–1663

Stuttering and Videoconferencing

An interview study with 13 adults who stutter from the US and UK.

**Shaomei Wu, "The World is Designed for Fluent People":
Benefits and Challenges of Videoconferencing Technologies
for People Who Stutter. CHI 2023**



Benefits of VC for people who stutter



Reducing mental barrier to "show up"

I can **manage my energy a little bit better on VC**, because you are in your own environment. For people who stutter, going to a bar is very challenging, the office can have a similar effect. You just have **more control on VC** than in-person environment.

-- P6 *



Easier to "mask" stutter

I felt a little guilty that **I spoke very fluently during the interviews by using the DAF app**, but showing stutter afterwards.

I don't want my supervisor to think that I cheated. I wanted to be an honest person, but ...I was also worried that my stutter would impact whether they give me the offer.

-- P4 *



Increased public empathy

Even fluent speakers have difficulties on Zoom, **having challenges of being heard is more understood now**.

-- P3 *



On Zoom, your voice is so important for you to communicate than before. They can not see your body, your gestures. Your words carry more meaning. You have to impress people with your words. **For someone who stutters, videoconferencing is a disadvantage.**

A teal-colored graphic element consisting of two curved, open quotes facing each other, used to enclose a quote.

-- P5 *

* Shaomei Wu, "The World is Designed for Fluent People": Benefits and Challenges of Videoconferencing Technologies for People Who Stutter. CHI 2023

Challenges of VC for people who stutter



Stressed by self-view

“

[Self-view] is a curse.. you have to face your worst fear as a person who stutters. Before, when you talk to a person, you don't necessarily see your own face; seeing your own face puts the person who stutter in a direct confrontation with your stuttering”.

”

-- P5 *



Difficulty in turn taking

“

As a stutterer, it is harder to get your first sound out. Body language is more visible in person. That's particularly challenging. I am trying to say something but before I can say something, somebody also already got the word out.

”

-- P6 *



Limited channels for emotional support

“

I like to shake hands, I will give people a hug if I know them. I will talk with my hands, I will lean back on my chair, I will think out loud, try to model that this is a space where I hope you can be yourself... It's much more noticeable when I am in person.

”

-- P11 *

Agenda

What I have talked about today

01

Introduction
and overview

02

Technologies
for visual
impairment

03

Technologies
for dyslexia

04

Ongoing work
with people
who stutter

05

Future work
and conclusion

Future Work

Community-oriented Technology Research, Development, and **Advocacy**



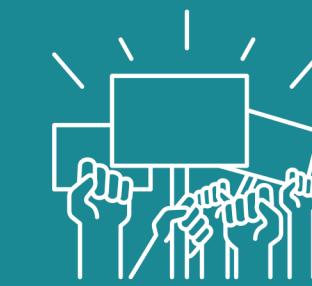
New Communities and Problem Spaces

Work with different communities that have been voiceless in technologies to explore new problem spaces that were overlooked.



Empowering Technologies

Design and develop innovative technological experiences to foster self-efficacy and community empowerment.



Social Advocacy and Activism

Amplify community's agency to push for structural changes beyond technology.