

“I am uncomfortable sharing what I can’t see”: Privacy Concerns of the Visually Impaired with Camera Based Assistive Applications

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Visual impairment is not total blindness

It is sight loss that cannot be **fully corrected** using glasses or contact lenses



Low Vision/Cataract

Source: cs.utah.edu



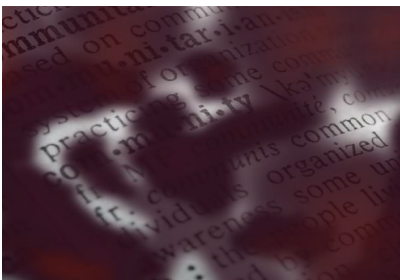
Retinitis Pigmentosa

Source: Wikipedia



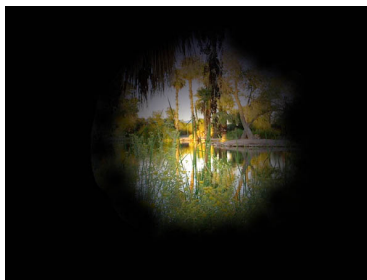
Macular degeneration

Source: Wikipedia



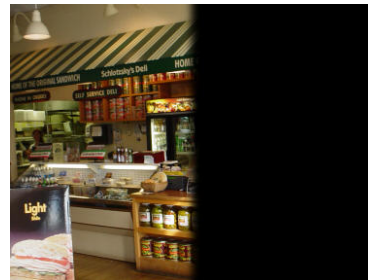
Diabetic Retinopathy

Source: CNIB



Glaucoma

Source: ACBVI



Hemianopia

Source: visionsimulators

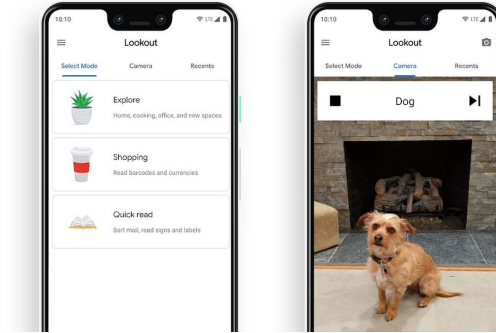


AI-based assistive tools help in everyday tasks



Seeing AI recognizing people

Source: seeingai.com



Lookout recognizing objects

Source: theverge.com



Orcam identifying currency

Source: timesofisrael.com

AI-based tools cannot always infer human intent

Insufficient and inaccurate responses by Seeing AI



probably a sign on a sidewalk



probably a woman sitting on a bench in front of a window

Source: www.dailydot.com/debug/microsoft-seeing-ai-app



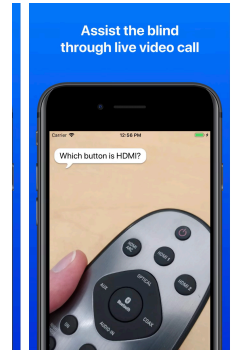
Human assisted technologies are gaining popularity

More than **100,000** people with visual impairments (VIPs) are using human assisted technology



Aira helping in navigation

Source: portseattle.org



Be My Eyes identifying buttons

Source: doyouremember.com



Friendsourcing identifying medicine

Source: hcii.cmu.edu

Privacy and security risks associated with cameras

VIPs can **intentionally** or **unintentionally** share sensitive information with assistive systems



Credit card



Medicine



Photo frame



Bystander

Source: <https://vizviz.org/>



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Bystander

Lasceki et al. (2014), Ahmed et al. (2016), Branham et al. (2017).



We seek to understand the privacy implications of human assisted technologies

Research Question

What are the privacy concerns of people with visual impairments in the context of different of **background objects** (credit cards, people, prescriptions) and **human assistants** (friends, family, volunteers or crowd-workers)?



Experiment design (online survey)

We studied three types of human assistants in three different scenarios

Between subjects (3 types of human assistants)

Assistants Scenarios	Family	Friends	Volunteers
Home			
Office			
Restaurant			

We considered one foreground object per scenario



Matching dress
(home)



Distinguish medicines
(office)

Source: <https://vizviz.org/>



Identify soda can
(restaurant)

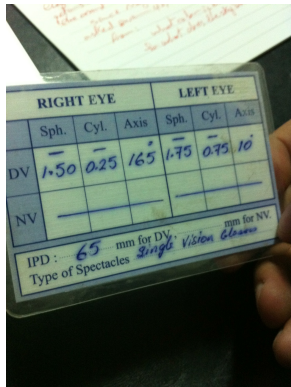


We experimented with ten background objects per scenario

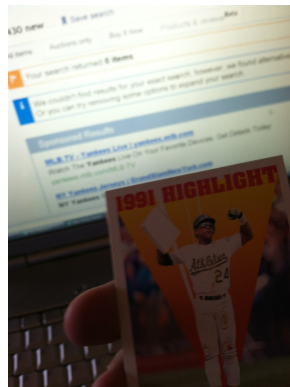
Six background objects were **common** across all scenarios



Body part



Prescription



Laptop screen



Food



Messy area



Credit card

Source: <https://vizwiz.org/>



We used 5-point Likert items to measure comfort (dependent variable, within subjects)

Level of comfort with the list of background objects

Suppose while taking the picture there were some other objects captured along with the [soda/medicine/dress]. How **comfortable** would you feel if the following were present in the photo and **visible** to your [family/friends/volunteers] along with the [soda/medicine/dress]?

5-point Likert item

Extremely uncomfortable	Somewhat uncomfortable	Neither comfortable nor uncomfortable	Somewhat comfortable	Extremely comfortable
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

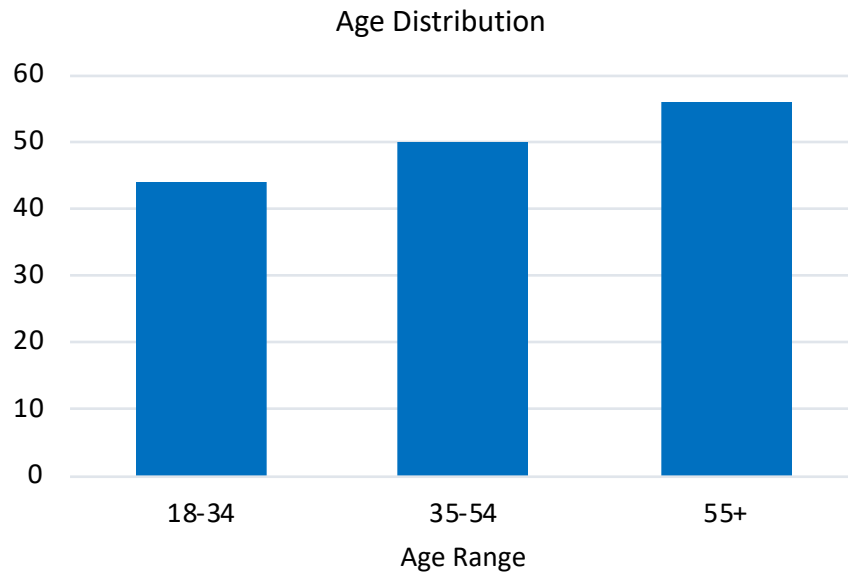
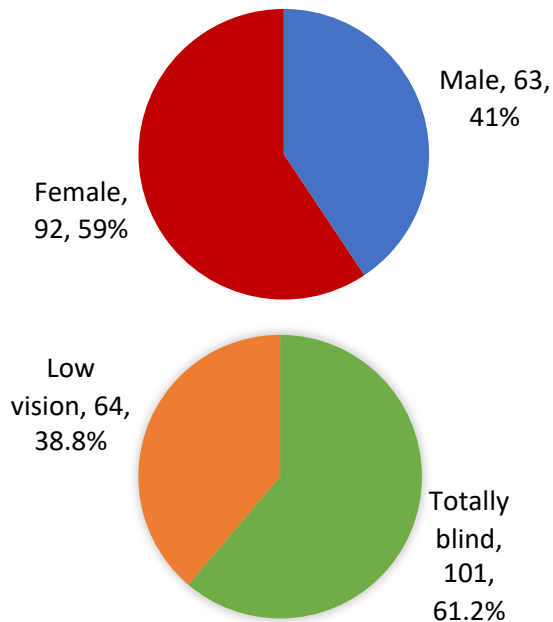
Open text explanation

Can you please briefly explain your selection above?



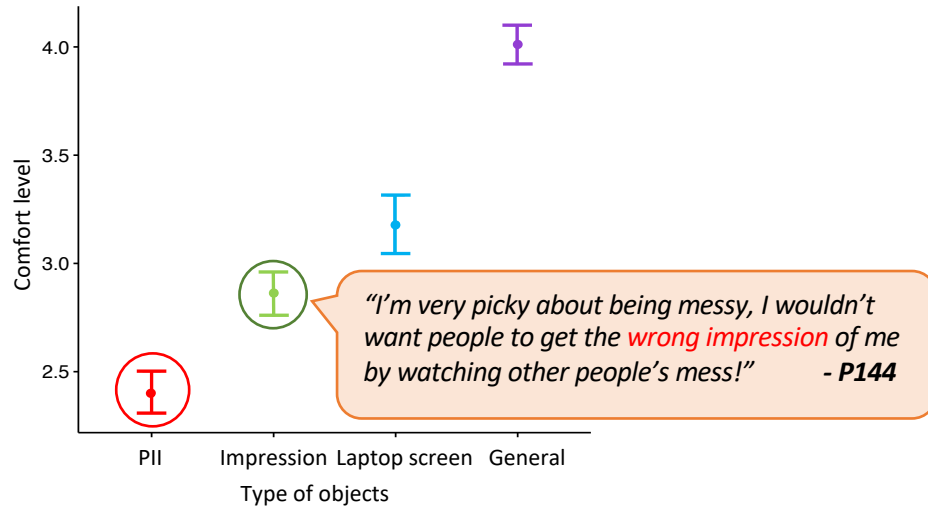
We collected data from 155 participants with visual impairments

Recruited participants through **National Federation of the Blind (NFB)** and **American Council of the Blind (ACB)**

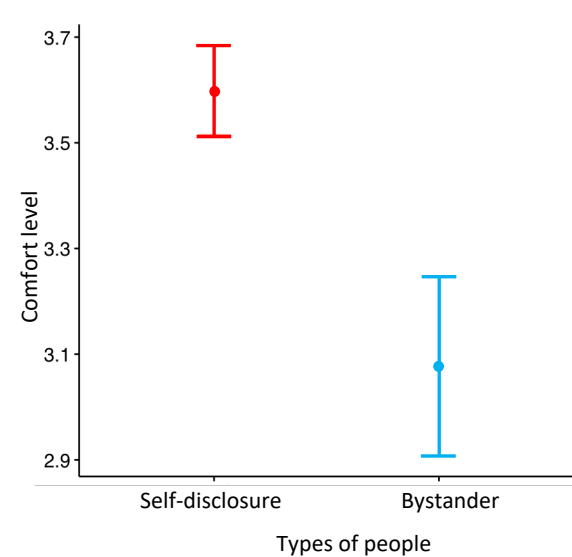


Selective content disclosure

Participants are most concerned about **personally identifiable information (PII)**
Participants are more concerned about **bystanders** than **self**



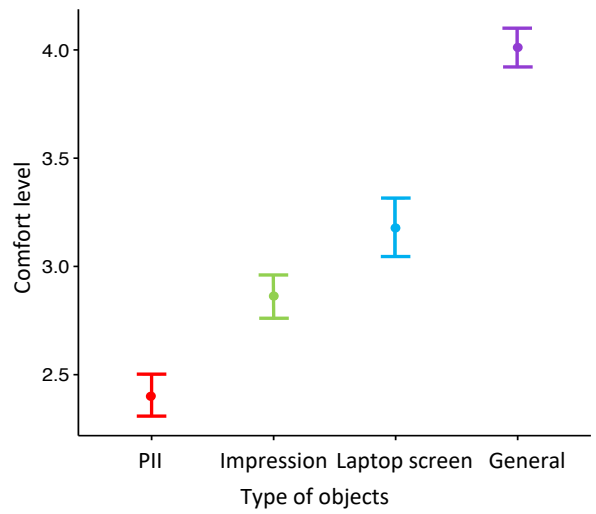
Comfort levels for different group of objects



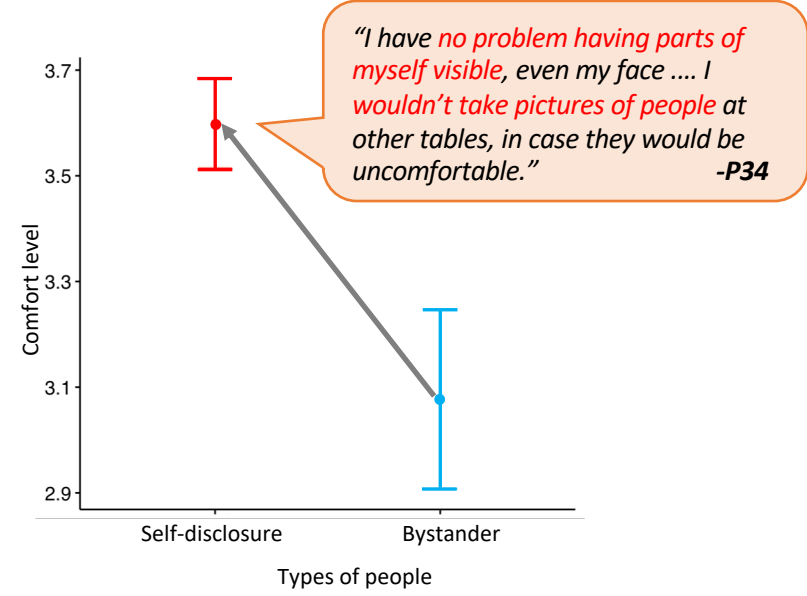
Comfort levels for self and bystander

Selective content disclosure

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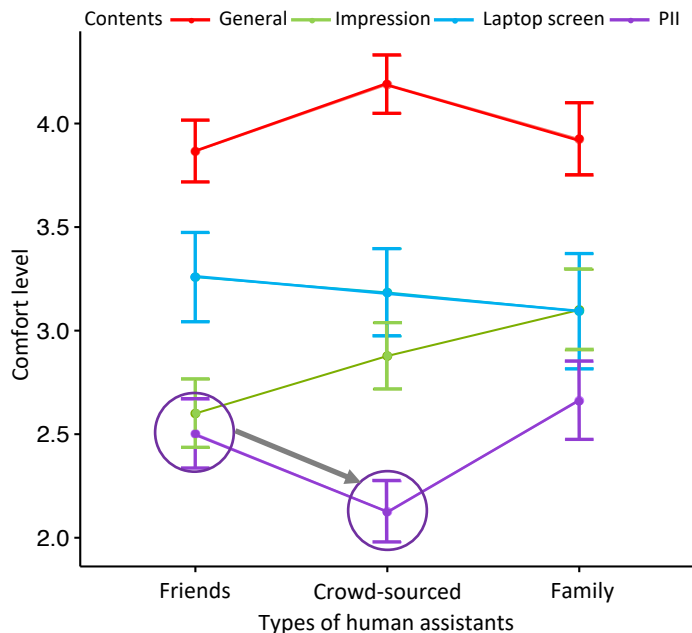
Comfort levels for different group of objects



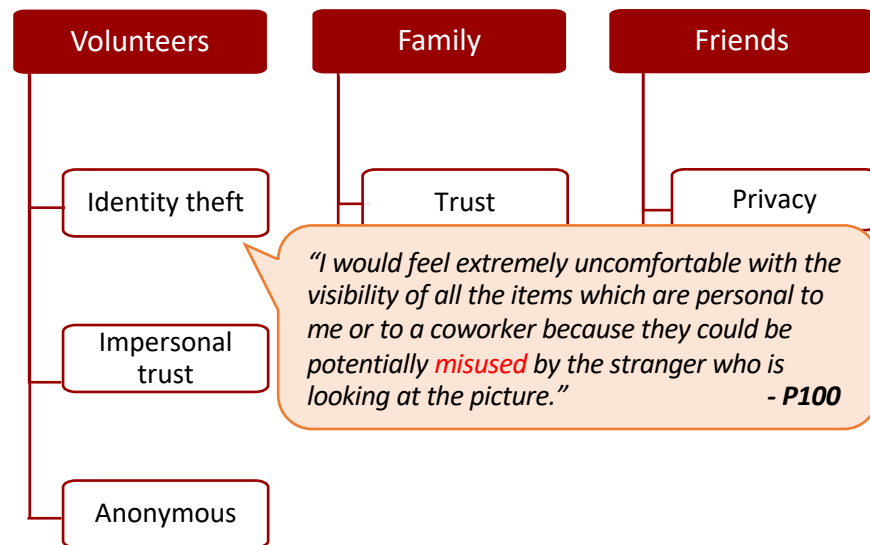
Comfort levels for self and bystander

Interaction between audience and objects

Participants are more concerned sharing PII with **volunteers**



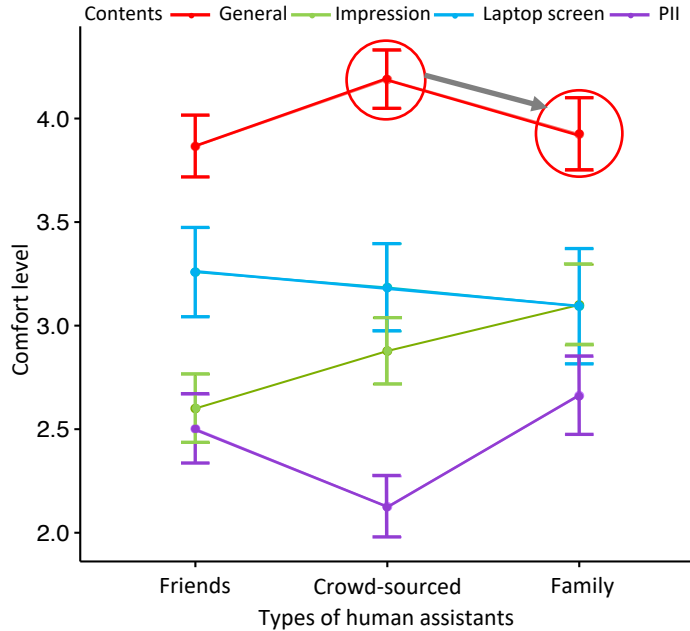
Interaction between objects and human assistants



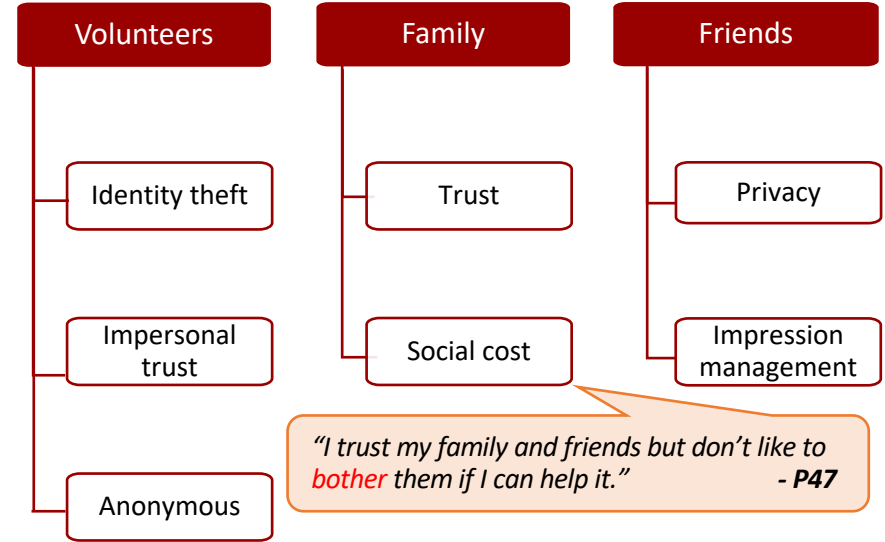
Reasons for selective audience disclosure

Interaction between audience and objects

Participants **trust** family but don't want to be a **burden**



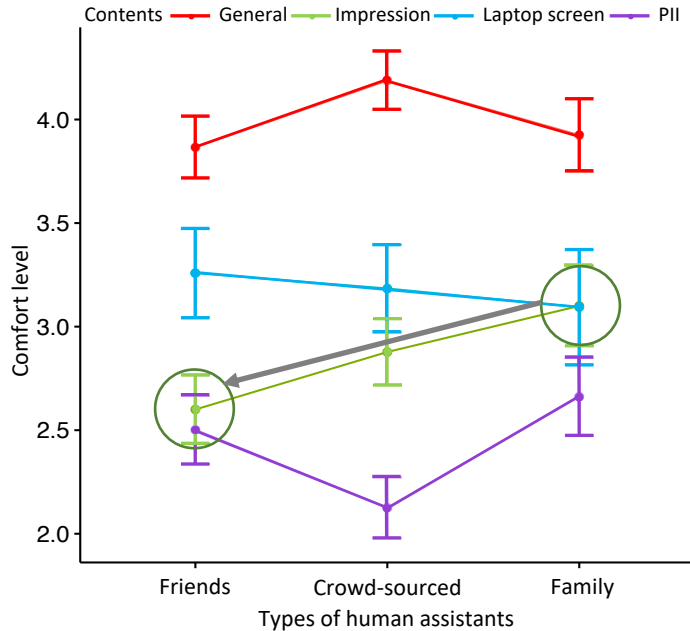
Interaction between objects and human assistants



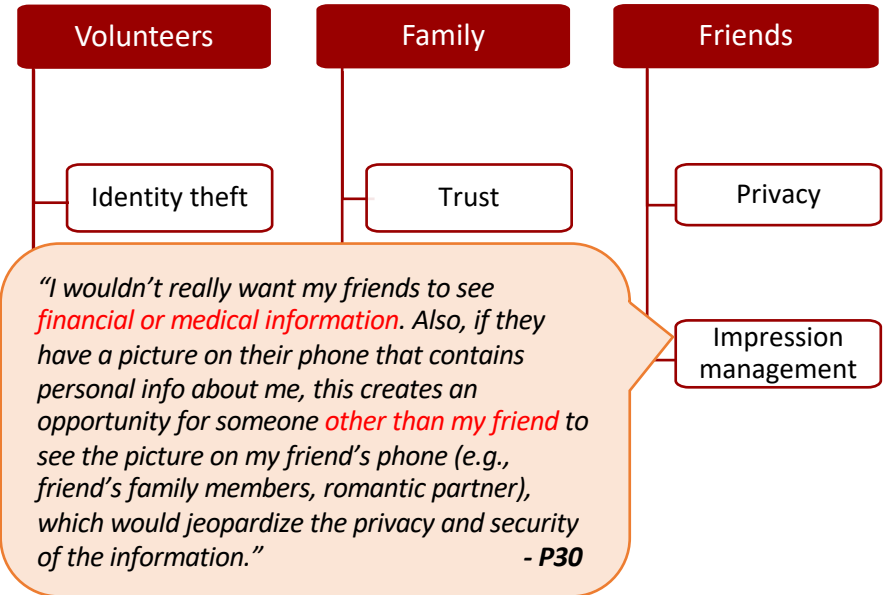
Reasons for selective audience disclosure

Interaction between audience and objects

Participants are concerned about **impression management** with friends



Interaction between objects and human assistants



Reasons for selective audience disclosure

Key Results

Participants were more **concerned** about the privacy of **bystanders** than their own when it came to capturing people in images.

Participants have strong **concerns** about sharing personally **identifiable** information with **crowd-workers** because of concerns about identity theft.

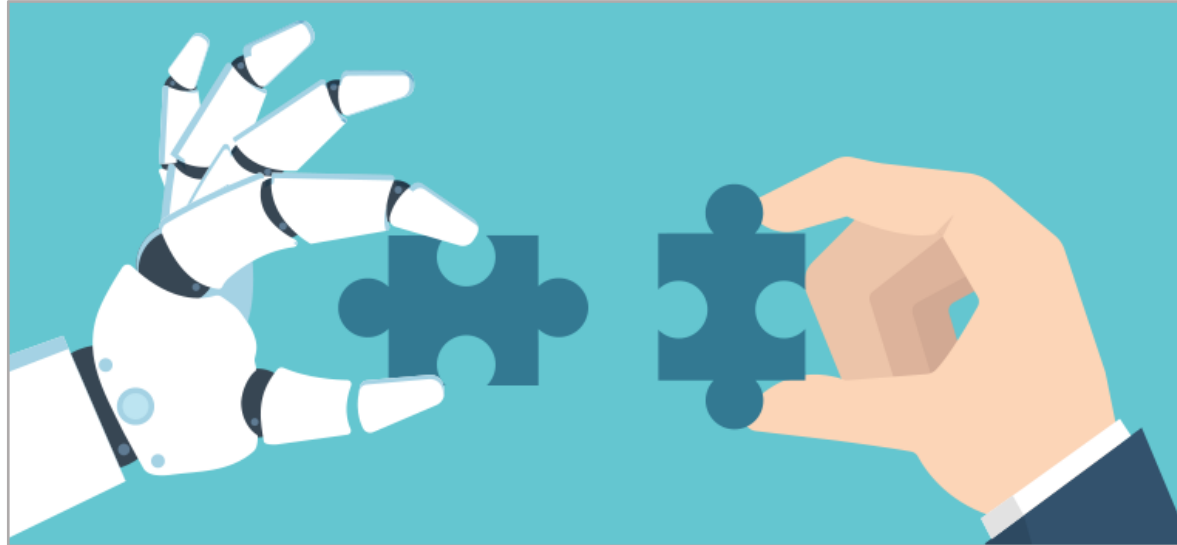
Participants were less **comfortable** sharing about **self-presentation** with **friends**.

The right volunteer depends on the context.



Implications: Humanizing assistive technology

Computer vision algorithms should be **trained** to better understand **context** to serve the human

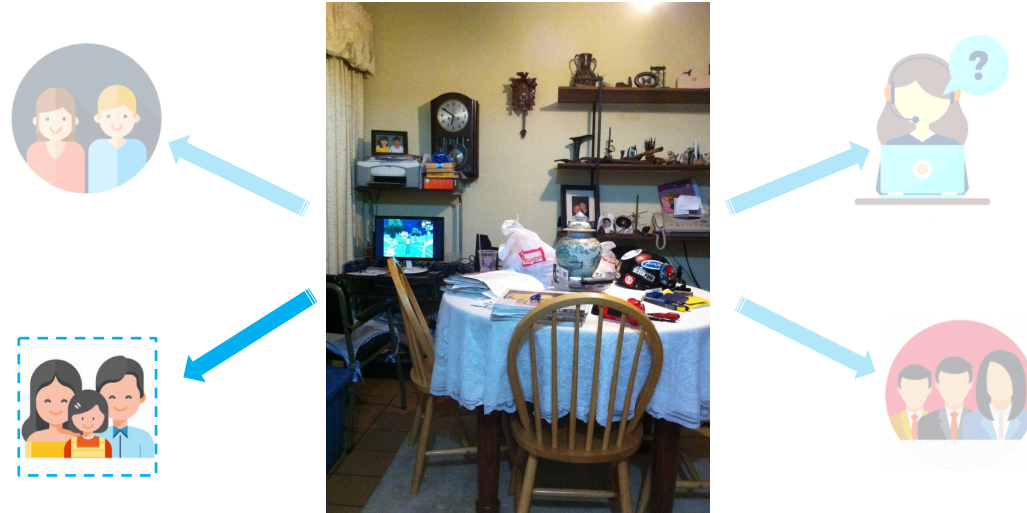


Source: www.gcn.com



Implications: Selecting the right assistant

Appropriate **assistant** selection based on the **context**



Implications: Obscuring sensitive content

Sensitive contents should be **obscured** based on the **audience**

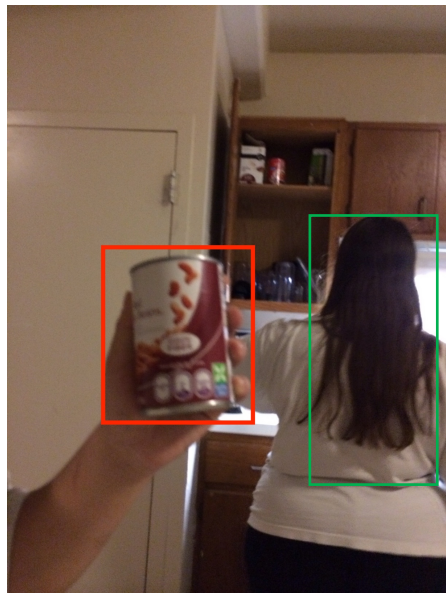


Source: <https://vizwiz.org/>



Implications: Identifying primary objects

Primary objects should be identified **automatically**



Source: <https://vizwiz.org/>



Conclusion

The information **disclosure** preferences of our participants vary according to the **types of objects** and **human assistants**.

Assistive technologies can create a **lack of personal security** in the lives of the people with visual impairments

We identify avenues for technical research to make such systems more **humanistic and empathetic**, to assist rather than harm.



Thank you



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