Accessibility

Accessible systems help everyone, not just people with disabilities

- Well structured text is easier to read and easier for computers to parse

- Flexibility in inputs improves accessibility and makes it easier for everyone else

Curb Cuts

Dips in the sidewalk so that a pedestrian does not need to step up or cross uneven terrain to reach the sidewalk.

Defining accessibility

- Refers to all people (with or without a disability)

"Access by everyone regardless of disability is an essential aspect." (Tim Berners-Lee, W3C Director and inventor of the World Wide Web*)

- Two models when discussing about accessibility:
  - ○ ***Medical model*** – people are disabled by the impairments that they have
  - ○ ***Social model*** – people are disabled by society and their surroundings

*https://www.w3.org/standards/webdesign/accessibility#examples

Accessibility

- Encompasses impairments that may be:
  - o Permanent
  - o Temporary
  - o Situational

Accessibility Factors*

- *User Impairments* – issues in body function or alteration in body structure.

- *Activity Limitations* – difficulties in executing activities.

- *Participation Restrictions* – problems exist in taking part in activities due to issues such as discrimination.

- *Environmental Factors* – facilitators or barriers in the environment impact on the user.

- *Personal Factors* – aspects such as motivation and self-esteem can influence an individual's participation.

*Crabb, M., Heron, M., Jones, R., Armstrong, M., Reid, H., & Wilson, A. (2019, April). Developing Accessible Services: Understanding Current Knowledge and Areas for Future Support. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (p. 216). ACM.

Accessibility in large companies

- **BBC**: http://www.bbc.co.uk/guidelines/futuremedia/accessibility/
- **Google**: https://www.google.co.uk/accessibility/
- **Microsoft**: https://www.microsoft.com/en-us/accessibility
- **IBM**: https://www.ibm.com/able/
- **Oracle** https://www.oracle.com/corporate/accessibility/

Methods to assist

- raising awareness of accessible policies and guidelines

  https://www.w3.org/TR/WCAG21/

  https://www.ideasforears.org.uk/hearing-access-protocol/

- the development of tools to assist in accessible design

  https://www.semanticscholar.org/paper/Using-Automated-Tools-to-Improve-Web-Site-Usage-by-Ivory-Mankoff/7bb9856bb44e56fb117efa9625ae728986adf1ba

- coordination with the (disabled) community

  https://dl.acm.org/citation.cfm?doid=2661334.2661361

- conducting accessibility self assessment

  https://g3ict.org/publication/g3ict-ict-accessibility-self-assessment-framework

Challenges with accessibility*

- based on an interview with 20 academics from US universities who taught a module or topic focused on accessibility

  - lack of student and/or administrative awareness of the importance of accessibility

  - difficulty in recruiting participants

  - lack of an appropriate textbook

  - difficulty in engaging students

  - avoiding the idea that accessibility is for charitable reasons.

*Putnam, C., Dahman, M., Rose, E., Cheng, J., & Bradford, G. (2016). Best practices for teaching accessibility in university classrooms: cultivating awareness, understanding, and appreciation for diverse users. *ACM Transactions on Accessible Computing (TACCESS)*, *8*(4), 13.

# Walking in Another's Shoes: Aphasia Emulation Software (AES)

by Joshua Hailpern, Marina Danilevsky, Karrie Karahalios Department of Computer Science University of Illinois at Urbana Champaign

Hypothesis:
A system could be created that would emulate the effects of aphasia through distortion of written text.

AES IM Chat Window and Conversation

An IM conversation between the user and Eliza (the original message from the user is converted to one that appears like a message sent or spoken by an individual with aphasia
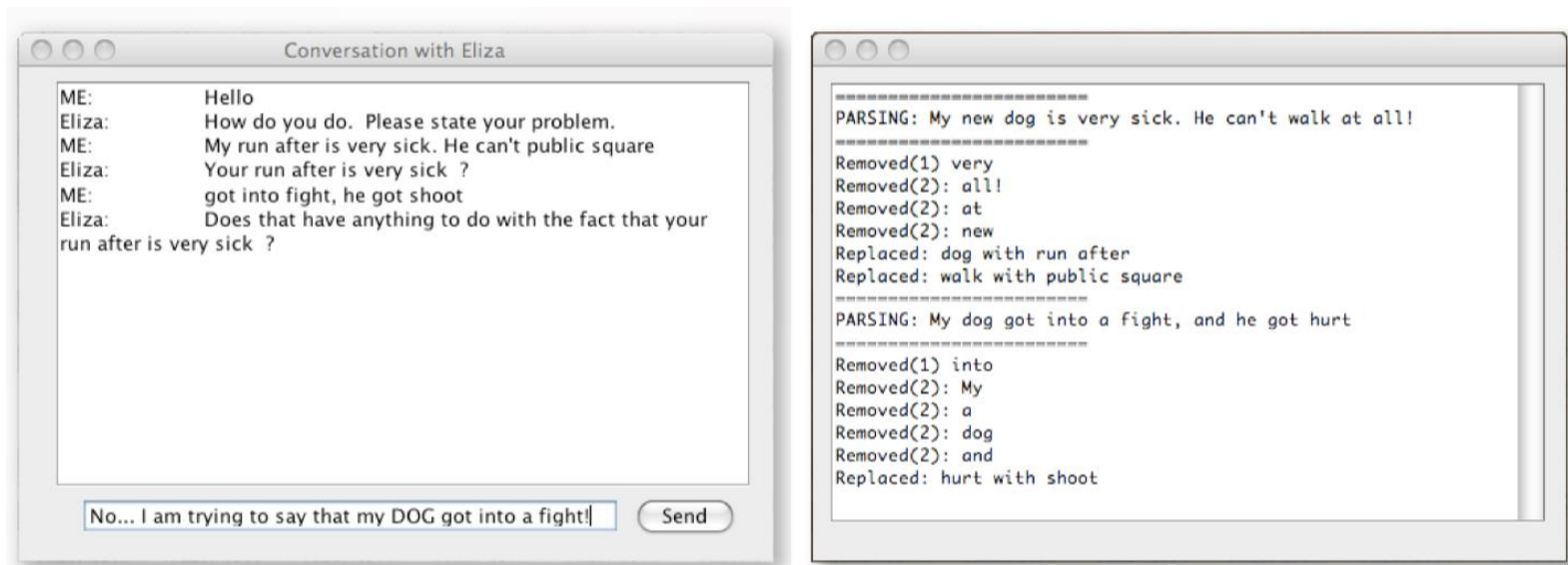
Notice how the participant's text is hard to decipher after it has been distorted by the Aphasia Model. Removed (1) is a dropped Function word, Removed (2) is a random word drop and Replaced is when a word is substituted.

AES initial evaluation

- Participants: 10 (students, faculty staff, and professionals)
  - average age: 34.6
  - average of years of experience in aphasia: 10.3

- Protocol:
  - Short training
  - Free dialogue with Eliza using AES
  - Questionnaire
  - Short semi-structured interview

- Duration: 40 minutes

Results - AES initial evaluation

- Potential to increase understanding and empathy of those who live and work with individuals with aphasia.
- Could be used by: family, clinicians and professionals, undergraduate students
- Benefits:
  - Improve quality of life for people with aphasia and those who live or/work with them
  - Improve quality of care

ACES: promoting empathy towards aphasia through language distorted emulation software

by Joshua Hailpern, Marina Danilevsky, Andrew Harris, Karrie Karahalios, Gary Dell2 Julie Hengst

"It is through empathy that we learn to understand each other."

User impairments

22% of all people in the UK have some form of disability (19% for working-age adults)*

- Visual impairment

- Hearing impairment

- Physical impairment

- Speech impairment

- Dyslexia

- Autism

- Learning disability

- Age groups (older, younger)

* https://fullfact.org/health/how-many-people-have-disability/

Think-pair-share

	Visual (blindness, low-vision, colour blindness)	Physical (related to fine-grained and gross motor skills)
Permanent		
Temporary		
Situational		

Think-pair-share

	Visual (blindness, low-vision, colour blindness)	Physical (related to fine-grained and gross motor skills)
Permanent	Age-related macular degeneration (AMD)	Parkinson's disease
Temporary	Eye infection	Broken arm
Situational	Sun-glare	Wearing gloves

Visual impairment

- 2006 - 37 million blind and 124 million low-vision people in the world (World Health Organization)

- Most people experiencing sight loss are not blind and most previously had good sight

- 2015 - over two million people in the UK are living with sight loss*.

- One in five people aged 75 and over are living with sight loss*.

*http://www.rnib.org.uk/professionals/knowledge-and-research-hub/key-information-and-statistics

Basic approaches

- larger text, larger buttons, magnify options
- text to speech engines (including OS level tools such as Narrator*)
- Alt text for non-text elements
- significant contrast between your text and background
- enable scanning by putting important words at the front of paragraphs and links
- use a "Skip to Main Content" link at the beginning of each page
- headings are clear and a computer could identify them as headings (<h1>title</h1>)
- beware keyboard traps where someone with only a keyboard can get in but not out

*https://support.microsoft.com/en-gb/help/22798/windows-10-complete-guide-to-narrator

Microsoft Soundscape

- https://www.youtube.com/watch?time_continue=97&v=fiu4eecCqTY&feature=emb_logo

Examples of assistive technologies*

BrainPort V100: a non-surgical assistive device that aids blind people in seeing with their tongue

*Assisted Vision project*: award winning augmented reality smart glass developed at University of Oxford

FingerReader: a small finger-worn form factor from the MIT Media Lab that assists blind users with reading printed text on the go

3-D smartphone for aerial obstacle detection for the visually impaired and blind individuals developed by University of Alicante

*Bhowmick, A., & Hazarika, S. M. (2017). An insight into assistive technology for the visually impaired and blind people: state-of-the-art and future trends. *Journal on Multimodal User Interfaces*, *11*(2), 149-172.
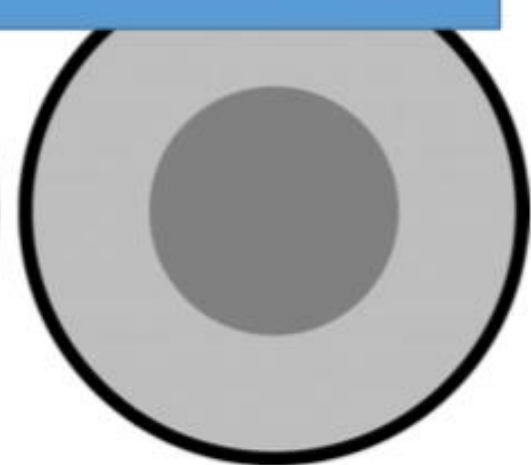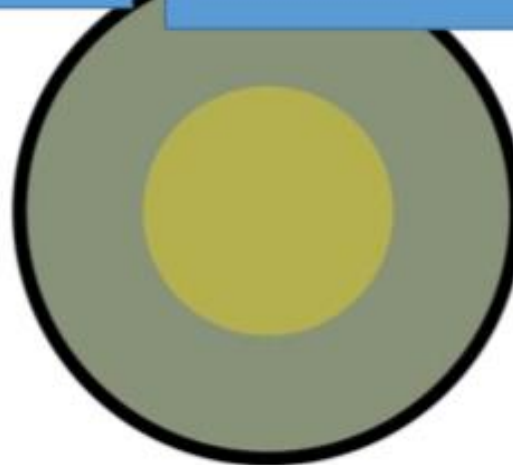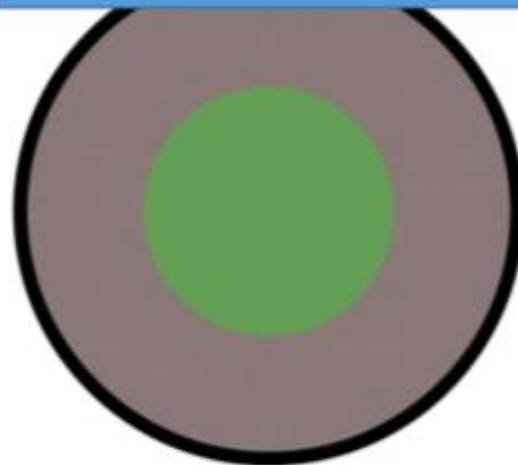
Color is a huge issue
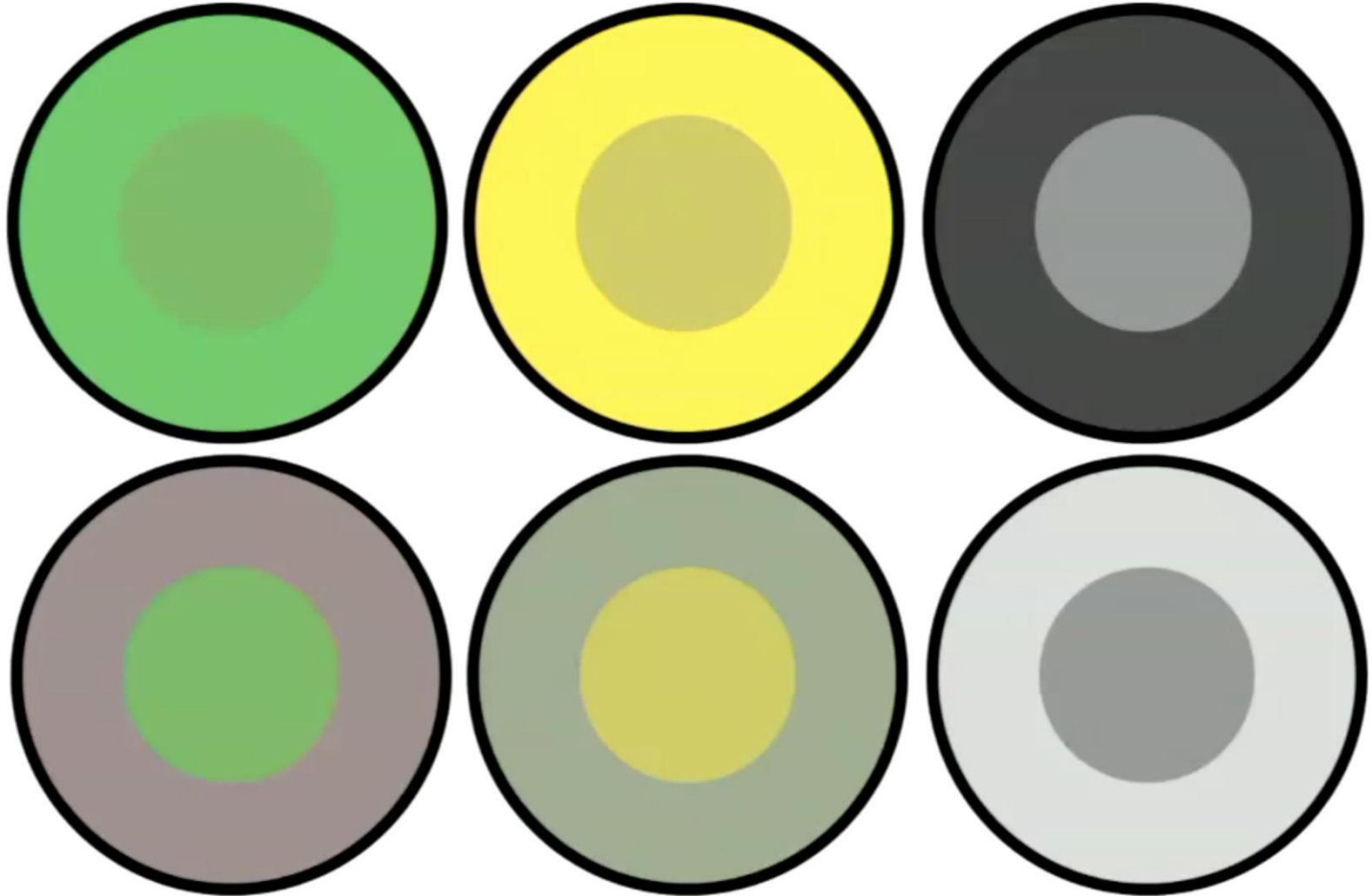
Color is a huge issue

The centers of the circles are all the same color.

The human eye is complicated which makes color blindness non-trivial to handle.

https://deepview.cs.st-andrews.ac.uk/overview/

Hearing impairment

- Audio commonly used for feedback and situational awareness

- Gesture-based interfaces

- Increase in video without captions means less accessibility

- Computers can help people with hearing loss through auto transcription (STT)
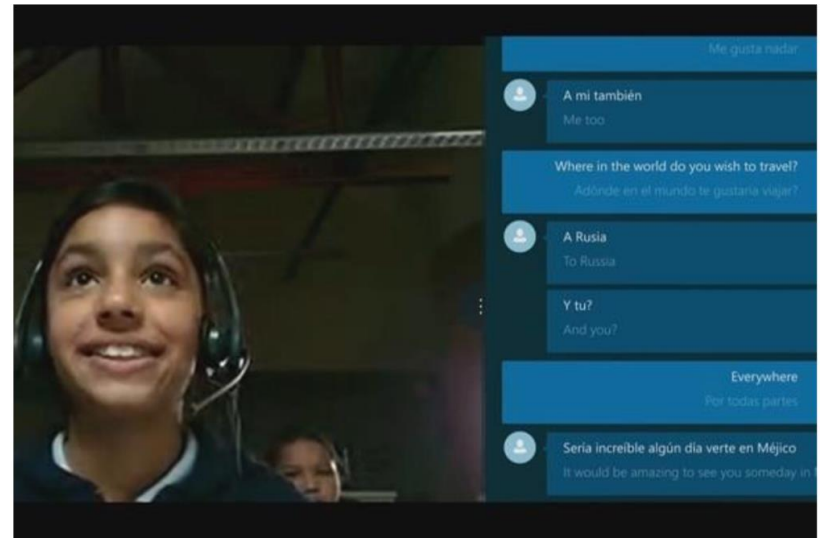
Physical impairment

- Limited control over movement
- Fine and gross motor skills impaired
- Difficulties with:
  - fine mouse movements
  - precise motions
- Hard to reach and/or push buttons

http://parkinsonsdysarthria.weebly.com/aac-assessment.html

Physical impairment

- limited number of interactive objects
- creating simpler layouts that make items easier to reach
- using larger buttons that will reduce error rates.
- touch targets in easily accessible places (on lower half of a (mobile) screen
- alterations to mouse sensitivity, speech control and alternative input types

Examples of assistive technologies

- Speech or eye tracker input an option
- Motorised gloves
- Smart wheelchairs
  - Self-driven wheelchairs
- Self-driven cars
- Brain-computer interface (BCI)

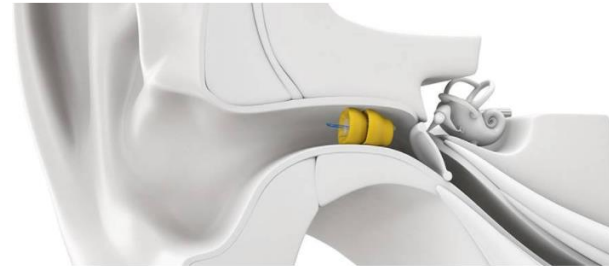https://www.sciencenewsforstudents.org/article/new-devices-coming-assist-disabled

https://www.youtube.com/watch?v=7t84lGE5TXA

Speech impairment

- Caused by: developmental disorders, neurological disorders, genetic syndromes, hearing loss, illness
- Difficulties:
  - articulation, or making sounds
  - phonological processes, or hearing and repeating sound patterns
- Accents (Scottish), non-native speakers, or people with hearing loss
- Spoken communication is much faster than typing

Examples of assistive technologies

- Augmentative and alternative communication (AAC)

- Hearing aids

- Computing technologies quite helpful for:
  - Synthesized speech, helping a user speak
  - Typing instead of speaking

The Lyric Hearing Aid - "Contact lens for the ear"

https://www.thehearingclinicuk.co.uk/lyric-invisible-hearing-aid/

DynaVox Compass

https://apps.apple.com/us/app/dynavox-compass/id692773734?ign-mpt=uo%3D4

Dyslexia

- Cognitive disability which impacts reading, writing, and spelling
- Understand spoken content, but struggle with same content written
- "It's estimated that up to 1 in every 10 to 20 people in the UK has some degree of dyslexia." (NHS)
- Spelling correction is helpful, but most spell checkers are not trained on dyslexic's spelling patterns
- Dyslexic person may have difficulty pulling the correct spelling from a list

http://edition.cnn.com/2017/07/18/health/dyslexia-technology-apps-students/index.html

Autism

Individuals with autism have difficulties with:
1. Social interaction – issues relating to others
2. Communication – issues understanding verbal
   3. and textual language including expressions
4. Imagination – problems with rigidity of thought processes leading to repetitive behaviour

- Computers help because they are often consistent, predictable, and impersonal.

- User is in control allowing management of the repetitive behaviour and inflexibility

- Information that might distract attention from the main task can be eliminated.

- Text-to-speech, or speech-to-text help with language issues

Autism

- Rigid interfaces (Heuristic: Flexibility)
- Sounds that cannot be controlled
- Lack of explanation (Heuristic: Help)
- Tend toward literal interpretation of content
- Jokes or "funny" descriptions can be confusing

Examples of assistive technologies

- Autism Speaks https://www.autismspeaks.org/technology-and-autism
- Tablet apps
- Virtual reality
- Augmented reality
- Auditory prompting
- Tactile prompting
- Robotics

Otsimo app
https://otsimo.com/en/

Robots teach communication to children with ASD

https://www.youtube.com/watch?v=lm3vE7YFsGM

Learning disability (LD)

- Difficulties associated with:
  - Perception
  - Memory
  - Cognition
  - Communication
- Wearables
  - to support people with LD, e.g. tools to detect so-called 'stranger danger'
  - for family support – help ease worries
  - for health support – e.g. detect low/high heart rate, extreme stress, seizures and perform an action accordingly, e.g. notifying co-workers and family
  - for productivity – help with reading and spelling

Age groups (older)

- Older population may have a series of difficulties, including:

    o Communication (e.g. aphasia)

    o Physical mobility (e.g. work-related injuries, Parkinson's disease)

    o Eye-related problems (e.g. cataract, AMD)

    o Hearing problems (e.g. presbycusis)

Age groups (younger)

- Child Developmental Sequence – Piaget's developmental stages

- Challenges include:
  - Comprehension
    - Reading comprehension problems
  - Gross and fine motor skills (very young children)
  - Motivation issues:
    - *"Computers for kids need to be fun like a friend, but can make me smart for school. They should also be friendly like my cat. The real thing is that they shouldn't make me have to type since I don't like that. I can talk much better!"* (Researcher Notes April 3, 1999, Quote from an 8 year-old child).

- The myth of "digital native generation"

*Druin, A. (2002). The role of children in the design of new technology. *Behaviour and information technology*, *21*(1), 1-25.

Situational impairment

- technology developed in support of people with disabilities proves beneficial to a broader population

- able-bodied individuals can be affected by both the environment in which one is working and the activities in which that person is engaged, resulting in situationally-induced impairments.
  - in a cold environment an individual's typing performance may decrease
  - spasm (a sudden, involuntary contraction of a muscle) can cause unwanted diversions or mouse clicks during pointing movements.

Think-pair-share

- Think about a situational hearing impairment

  - What are the specific difficulties encountered by the user in that situation?
  - What technological solutions do you envisage?

- Pair with your neighbor

- Share your thinking with your partner

AI Technologies

- ***Cognitive systems*** - through advances in machine learning, cognitive systems are rapidly improving their ability to see, to hear, and to interact with humans using natural language and gesture.

  - o   self-driving vehicles

  - o   "Smart home" sensors

  - o   image description – Facebook

- possibilities for cognitive technology to support greater autonomy for people with disabilities are endless.

Questions?