

User Centered Design

[11] Universal Design

Dr. Agnes Lisowska Masson
Human-IST Institute, University of Fribourg
December 4th, 2018

Universal Design

“...the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.”

- Ron Mace, Center for Universal Design,
North Carolina State University

Principals of Universal Design

- Equitable use
 - the design is useful and marketable to people with diverse abilities
- Flexibility in use
 - the design accommodates a wide range of individual preferences and abilities
- Simple and intuitive use
 - use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level
- Perceptible information
 - the design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities

Principals of Universal Design

- Tolerance for error
 - the design minimizes hazards and the adverse consequences of accidental or unintended actions
- Low physical effort
 - the design can be used efficiently and comfortably with a minimum of fatigue
- Size and space for approach and use
 - appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture or mobility

User Interface Design and Evaluation, Stone et al. Morgan Kaufmann 2005.

Some potential user groups...

Children

Older Adults

**Those with
Disabilities**

**Those from Different
Cultures**

Designing for Children

Children

- Emphasis on entertainment and education
- Need balance between children's desire for challenge and parents requirements for safety
- Kids like tangible interfaces – like being able to touch and manipulate things, can more actively participate in discovery process
- Physical props and large input devices encourage collaboration
- 3 development areas
 - Cognitive
 - Physical
 - Social/emotional



Image: NIKVision

Children – What Changes

- 0-2 Sensorimotor
 - Little interaction expected
 - Cognition heavily dependent on what senses perceive
- 2-7 Pre-operational (<3, 3-5, 6-8)
 - Attention span brief
 - Hold 1 thing in memory at a time
 - Abstraction difficult
 - Can't understand another person's point of view
 - Pre-literate
 - Can click on large targets
 - Keyboard usually avoided



Image: Communications
of the ACM, 52(12)



Images: <https://www.amazon.com/LeapFrog-Clickstart-My-First-Computer/dp/B000NRVFV8>

Children – What Changes

- 7-11 (9-12)
 - Can't formulate a hypothesis
 - Abstract concepts still difficult
 - Can group and categorize (start to use menus...)
 - Simple keyboard use
 - Relatively fine motor control
- 12+ thinking generally similar to adults, but interests different

Children – What changes

- Reading
 - Need larger fonts
 - Need age appropriate vocabulary
- Speech
 - Recognizers need special training
- Background knowledge
 - Kids can learn unfamiliar metaphors if they are clear and consistent
(harder for adults)
- Interaction
 - Children are easily distracted
 - More likely to work in groups

Designing for Children - Guidelines

- Feedback and guidance
 - Constant auditory and visual feedback expected
 - Children are impatient – need immediate feedback or will repeat action
 - Interfaces should rely on visuals and avoid text
 - System should be useable without instructions
 - ✓ If instructions are necessary then
 - age appropriate format (e.g. pictures, audio...)
 - make them easy to understand and remember
 - Allow for expanding complexity
 - Provide scaffolding and guidance to help remember how to do things
 - Icons should be visually meaningful to children

Designing for Children - Guidelines

- Feedback and guidance
 - Use roll-over audio, animation and highlighting to show where functionalities are
 - Track and display exploration (if kids need to know where they were before)
- Interaction
 - Direct manipulation interfaces are best – actions should map directly to actions on the screen
 - Make mouse interactions as simple as possible – one-click interfaces are best (limit dragging and double-clicks)
 - Young children have problems with targeting small objects – make items large enough and leave space between them

Designing for Children - Guidelines

- Interaction

- 3 button mouse too big for small hands
- All mouse buttons should have same functionality
- Avoid making children hold down mouse buttons for long periods of time, especially if moving mouse at the same time
- Marquee selection – choose an initial area first and then adjust it by expanding edges
- Can't reliably tell difference between left and right

Designing for Older Adults

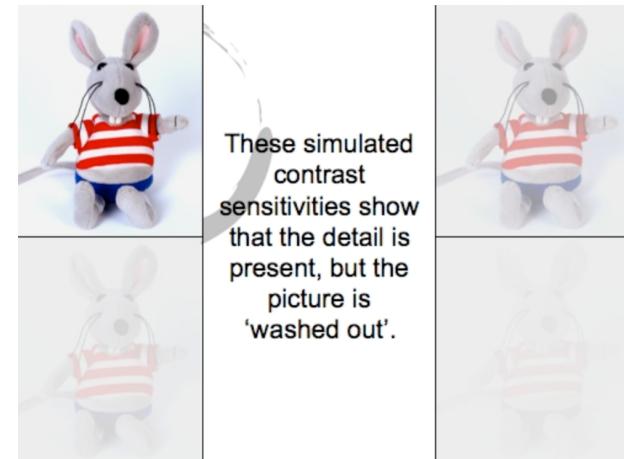
Older Adults

- Some myths about older adults and technology
 - Older adults don't want to use technology and are afraid of it
 - Older adults don't need computers and have a hard time learning to use them
- Common reasons older adults use technology
 - Communication with friends, family, healthcare providers, other older people
 - Continuing education
 - Improve chances of productive employment
 - Access to info about healthcare, community services
 - Facilitate financial management
 - Facilitate shopping

Older Adults – What Changes

■ Visual decrements

- Harder to perceive small icons on toolbars, read email, locate info on computer screens and websites
- Loss of static and dynamic visual acuity (sharpness)
- Loss of contrast sensitivity
- Decreases in dark adaptation
- Declines in colour sensitivity
- Heightened susceptibility to problems with glare
- Decline in peripheral vision



Scottish Sensory Centre

Older Adults – What Changes

- Hearing

- Loss of sensitivity for pure tones
- Difficulty understanding speech (esp. if speech is distorted)
- Problems localizing sounds
- Problems with bi-aural listening
- Increased sensitivity to loudness

Older Adults – What Changes

- Motor skills

- Slower response times
- Decline in ability to maintain continuous movements
- Disruptions in coordination
- Loss of flexibility
- Greater variability in movement
- Moving, clicking, fine-positioning and dragging a mouse are all more difficult
- Manual dexterity decreases

Older Adults – What Changes

- Decline in cognitive abilities
 - Attentional processes
 - Working memory
 - Discourse comprehension
 - Problem solving and reasoning
 - Inference formation and interpretation
 - Encoding and retrieval in memory
 - Information processing speed

Designing for Older Adults - Guidelines

- Maximize contrast between characters and screen background
- Minimize screen glare
- Avoid small targets
- Minimize irrelevant screen information
- Present screen information in consistent locations
- Adhere to principles of perceptual organization (ie. grouping)
- Highlight important screen information
- Avoid colour discriminations among colours of the same hue or in the blue-green range

Designing for Older Adults - Guidelines

- Clearly label keys
- Maximize the size of icons
- Give control over font sizes and audio levels
- Provide easier to use pointing devices
- Provide clear navigation paths
- Use icons that are easily discriminated and meaningful
- Label icons if possible
- Provide sufficient practice on the use of input devices such as a mouse or trackball

Designing for Older Adults - Guidelines

- Provide sufficient practice on window operations
- Minimize demands on spatial memory
- Provide information on screen location
- Minimize demands on working memory
- Avoid complex command languages
- Use operating procedures that are consistent within and across applications
- Provide easy-to-use, online aid and supporting documentation

Designing for Those with Disabilities

Disabilities

- Types of disabilities
 - Visual
 - ✓ Low vision -> complete blindness
 - Movement
 - ✓ Poor muscle control or weakness
 - Hearing
 - ✓ Partial -> profound deafness
 - Cognitive and language
 - ✓ Dyslexia, memory difficulties, problem solving difficulties, language use difficulties
 - Seizure disorders
 - ✓ Epileptic seizures caused by certain light and sound patterns

Disabilities

- Sources of disability
 - Natural ➤ Injury
 - Illness ➤ Aging
- Dimensions of disability
 - Temporary -> Permanent
 - Intermittent -> Continuous
 - Static (no change over time), regressive (less severe with time) or progressive (more severe with time)
 - Mild -> Severe
 - Highly specific -> Diffuse

Disabilities

- Examples of errors due to motor impairments
 - Long key presses
 - Nearby keys activated by accident
 - Insufficient force to activate a key press
 - Multiple keys pressed at same time
 - Bounces

Disabilities

- Examples of problems due to cognitive impairments
 - Decoding of layout and organization
 - Impaired memory (verbal, iconic etc.)
 - Slower reaction time (sensory-motor speed)
 - Selective attention more difficult
 - Multitasking more difficult

Assistive Technologies

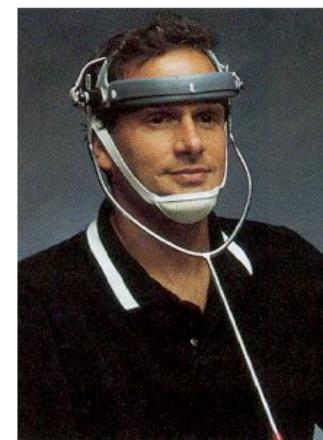
- Alternate input devices
 - Sip-and-puff
 - Head pointer
 - Vision based
 - ✓ head movement, gaze, blinking
 - Foot mouse
 - Switch
 - Braille translation
 - Touch screen



Head mouse



Gaze detection



Head pointer



Foot mouse



Switch



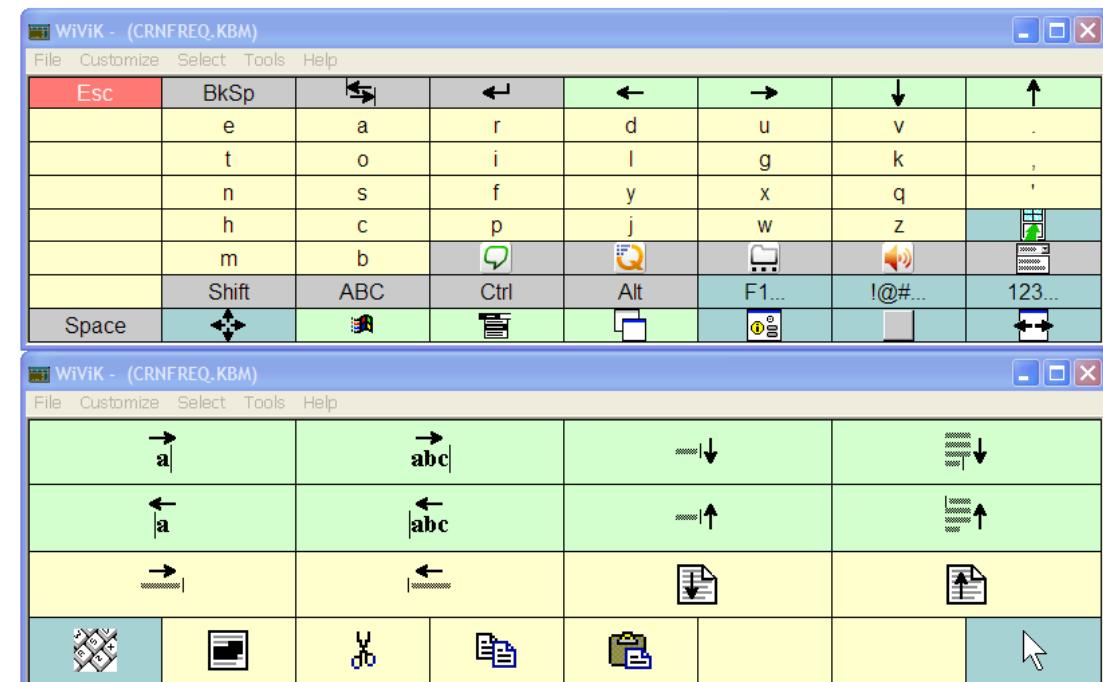
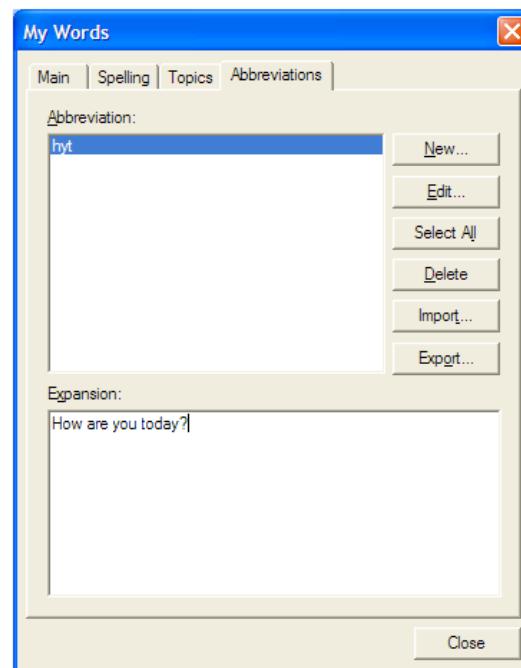
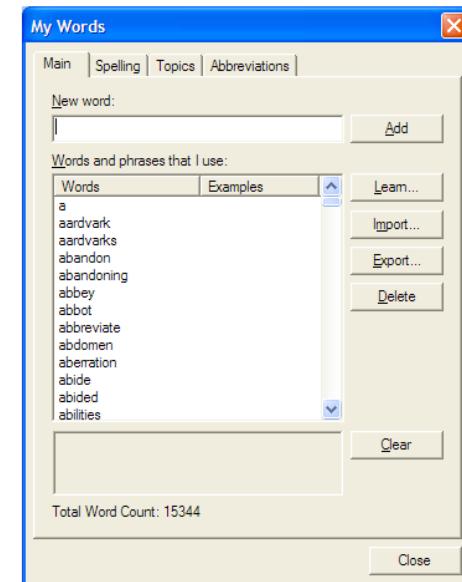
Braille translation

Assistive Technologies

- Alternate input methods
 - Pointing access (with any pointing device)
 - ✓ click selection
 - ✓ dwell selection
 - ✓ sticky keys
 - ✓ expanding quadrant selection
 - e.g: Dasher (<http://www.inference.org.uk/dasher/>)
 - Switch access and switch access scanning
 - ✓ automatic
 - ✓ inverse / step
 - ✓ directed
 - Voice

Assistive Technologies

- Desktop manipulation
- Abbreviation expansion
- Word prediction



Assistive Technologies

- Screen readers
 - Apple Mac OSX – VoiceOver
 - Microsoft Windows – Microsoft Narrator
 - Gnome - Linux Screen Reader

Designing for those from Different Cultures

Cultural Differences

- What they affect
 - Mental models
 - Metaphors
 - Navigation
 - Interaction
 - Appearance
 - Layout and organization
 - Icons, symbols and graphics
 - Typography and formats
 - Language and verbal style

Cultural Differences

■ Globalization

- ‘the entire process of preparing products or services for worldwide production and consumption’

■ Internationalization

- ‘the process of preparing code that separates the localizable data and resources from the primary functionality of the software’
 - ✓ international issues: geographic, political, linguistic, typographic
 - ✓ inter-cultural issues: religious, historical, linguistic, aesthetic, organization of content

■ Localization

- ‘process of customizing the data and resources of code that are headed for a specific market’
 - ✓ language translation, content hierarchies, graphics, colours, icons, symbols

Cultural Differences

- UI design concerns for internationalization
 - Characters and numerals, special characters and diacritics
 - ✓ E.g. è, ü, ç
 - Left-to-right vs. right-to-left, vs. vertical input and reading
 - ✓ North America and Europe: left-to-right
 - ✓ Middle East: right-to-left
 - ✓ Asia: vertical
 - Date and time formats
 - ✓ US: month/day/year, UK: day/month/year
 - ✓ 9am, 9pm vs. 9h, 21h
 - Numeric and currency formats
 - ✓ 100chf, \$100
 - ✓ 1,234.56 (US, UK), 1'234.56 (CH-DE, CH-IT), 1'234,56 (CH-FR)

Cultural Differences

- UI design concerns for internationalization
 - Weights and measures
 - ✓ kg vs. lb, cm vs. inch
 - Telephone numbers and addresses
 - ✓ 026 300 8692 vs 026 300 86 92
 - ✓ 90210, 1700, M2J 1L4
 - Names and titles
 - ✓ Miss, Ms., Mrs. Mme, Mlle
 - Social security, national ID and passport numbers
 - Capitalization and punctuation
 - ✓ Titles: Cultural Differences vs. Differences culturelles
 - Sorting sequences
 - ✓ Ascending vs. descending as default

Cultural Differences

- UI design concerns for internationalization
 - Icons, buttons and colour
 - ✓ English: Undo Dutch: Ongedaan Maken
 - ✓ English: Preferences German: Bildschirmeinstellung
 - Pluralization, grammar, spelling
 - ✓ Color, colour
 - Etiquette, policies, tone, formality, metaphors
 - ✓ English: you, French: tu/vous
- Why should you care?
 - Greater retention of and attention to content
 - Lower customer service costs
 - Visitors remain 2x longer on local-language sites
 - Users are 3x more likely to buy when communication is in own language

Web Content Accessibility

“To make the Web accessible to all by promoting technologies that take into account the vast differences in culture, languages, education, ability, material resources, access devices, and physical limitations of user on all continents.”

- early W3C goal

W3C Web Accessibility Guidelines

- Perceivable

- Provide text alternatives for non-text content
- Provide captions and other alternatives for media
- Create content that can be presented in different ways, including by assistive technologies, without losing meaning
- Make it easier for users to see and hear content

- Operable

- Make all functionality available from the keyboard
- Give users enough time to read and use content
- Do not use content that causes seizures
- Help users navigate and find content

W3C Web Accessibility Guidelines

- Understandable
 - Make text readable and understandable
 - Make content appear and operate in predictable ways
 - Help users avoid and correct mistakes
- Robust
 - Maximize compatibility with current and future user tools

<http://www.w3.org/WAI/WCAG20/glance/>

Important Admin

- Course evaluation
 - Take 10 minutes to do it now
- Exam Registration
 - Between December 3rd 2018 and January 11th 2019
- Exam
 - February 5th, 10h-12h, A230

References

- Children
 - Bruckman, A and Bandlow A. **Human-computer Interaction for Kids.** The Human-Computer Interaction Handbook (1st edition). Jacko, J., and Sears, A. (eds). Lawrence Erlbaum Associates, 2003.
 - Chiasson, S and Gutwin, C. **Design Principles for Children's Technology.** Technical Report HCI-TR-05-02, Computer Science Department, University of Saskatchewan.
 - Schneiderman, B. and Plaisant, C. **Designing the User Interface.** 5th edition. Pearson 2010.
- Older Adults
 - Czaja, S.J and Lee C.C. **Designing Computer Systems for Older Adults.** The Human-Computer Interaction Handbook (1st edition). Jacko, J., and Sears, A. (eds). Lawrence Erlbaum Associates, 2003.
 - Schneiderman, B. and Plaisant, C. **Designing the User Interface.** 5th edition. Pearson 2010.

References

- Accessibility Guidelines
 - Web accessibility
 - ✓ W3C: <http://www.w3.org/WAI/>
 - ✓ usability.gov: www.usability.gov/pdfs/chapter3.pdf
 - General UI accessibility
 - ✓ Apple: http://developer.apple.com/library/ios/#documentation/UserExperience/Conceptual/iPhoneAccessibility/Accessibility_on_iPhone/Accessibility_on_iPhone.html
 - ✓ Microsoft: <http://msdn.microsoft.com/en-us/windows/bb735024>
 - ✓ Gnome: <http://developer.gnome.org/accessibility-devel-guide/3.0/gad-ui-guidelines.html.en>
- Note: most of these sites also have checklists and tools to check if sites/UIs meet the guidelines

References

- Accessibility – Online resources
 - Assistive Technologies: http://en.wikipedia.org/wiki/Assistive_technology
 - Sip and Puff: <http://en.wikipedia.org/wiki/Sip-and-puff>
 - Braille display: http://en.wikipedia.org/wiki/Braille_display
 - Screen reader: http://en.wikipedia.org/wiki/Screen_reader
 - Foot mouse: http://en.wikipedia.org/wiki/Foot_mouse
 - Switch Access Scanning (demo):
http://en.wikipedia.org/wiki/Switch_access_scanning
 - WiViK: <http://www.wivik.com/>
 - <http://www.ilcnsw.asn.au/search>

References

- Accessibility – print
 - Newell, A., Carmichael, A., Gregor, P and Alm, N. **Information Technologies for Cognitive Support.** The Human-Computer Interaction Handbook (1st edition). Jacko, J., and Sears, A. (eds). Lawrence Erlbaum Associates, 2003.
 - Sears, A. and Young, M. **Physical Disabilities and Computing Technologies: An Analysis of Impairments.** The Human-Computer Interaction Handbook (1st edition). Jacko, J., and Sears, A. (eds). Lawrence Erlbaum Associates, 2003.

References

- Cultural Differences
 - Marcus, A. **Global and Intercultural UI Design.** The Human-Computer Interaction Handbook (1st edition). Jacko, J., and Sears, A. (eds). Lawrence Erlbaum Associates, 2003.
 - Jones, M., and Marsden, G. **Mobile Interaction Design.** Mobile Interaction Design. John Wiley and Sons Ltd, 2006.
 - Schneiderman, B. and Plaisant, C. **Designing the User Interface.** 5th edition, Pearson 2010.