Access Technology for Reading Disabilities

and

Access Technology Acceptance and Adoption

Katherine Deibel
University of Washington
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Who I am

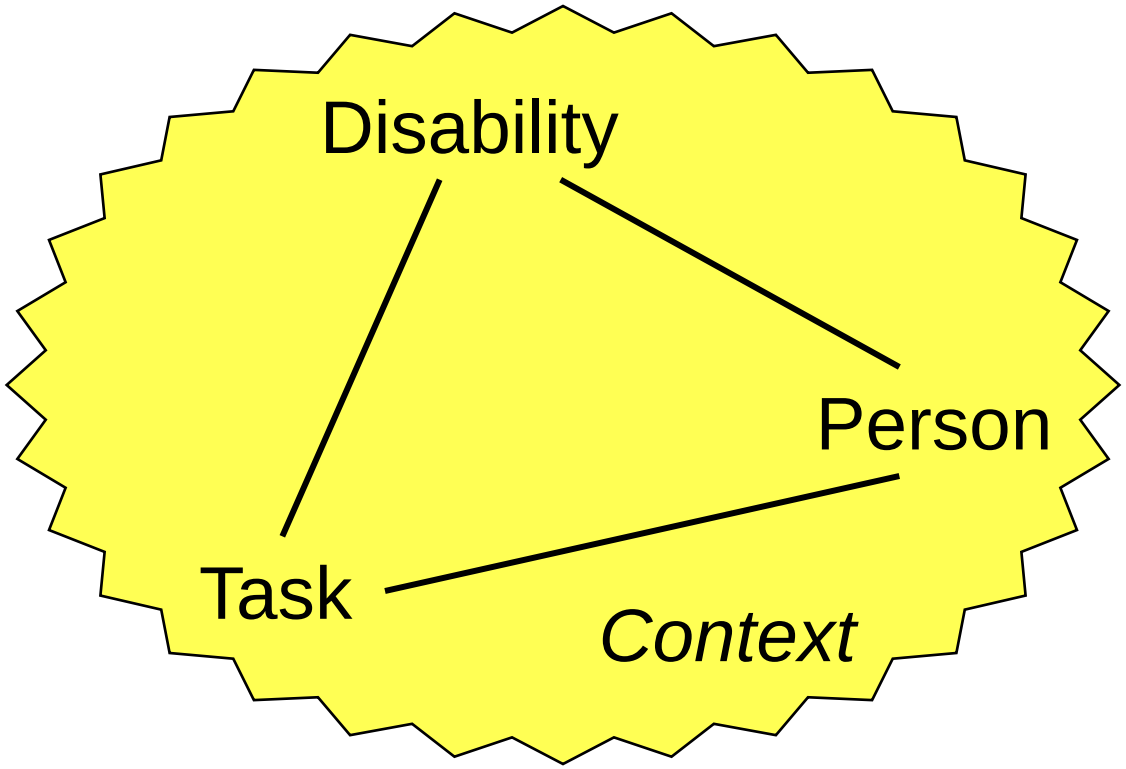
- 7th Year Graduate Student in CSE at UW
- Dissertation:

  "Understanding and Supporting the Adoption of Assistive Technologies for Adults with Reading Disabilities"
- Advisors:
  - Alan Borning (CSE)
  - John Bransford (Educational Psychology)

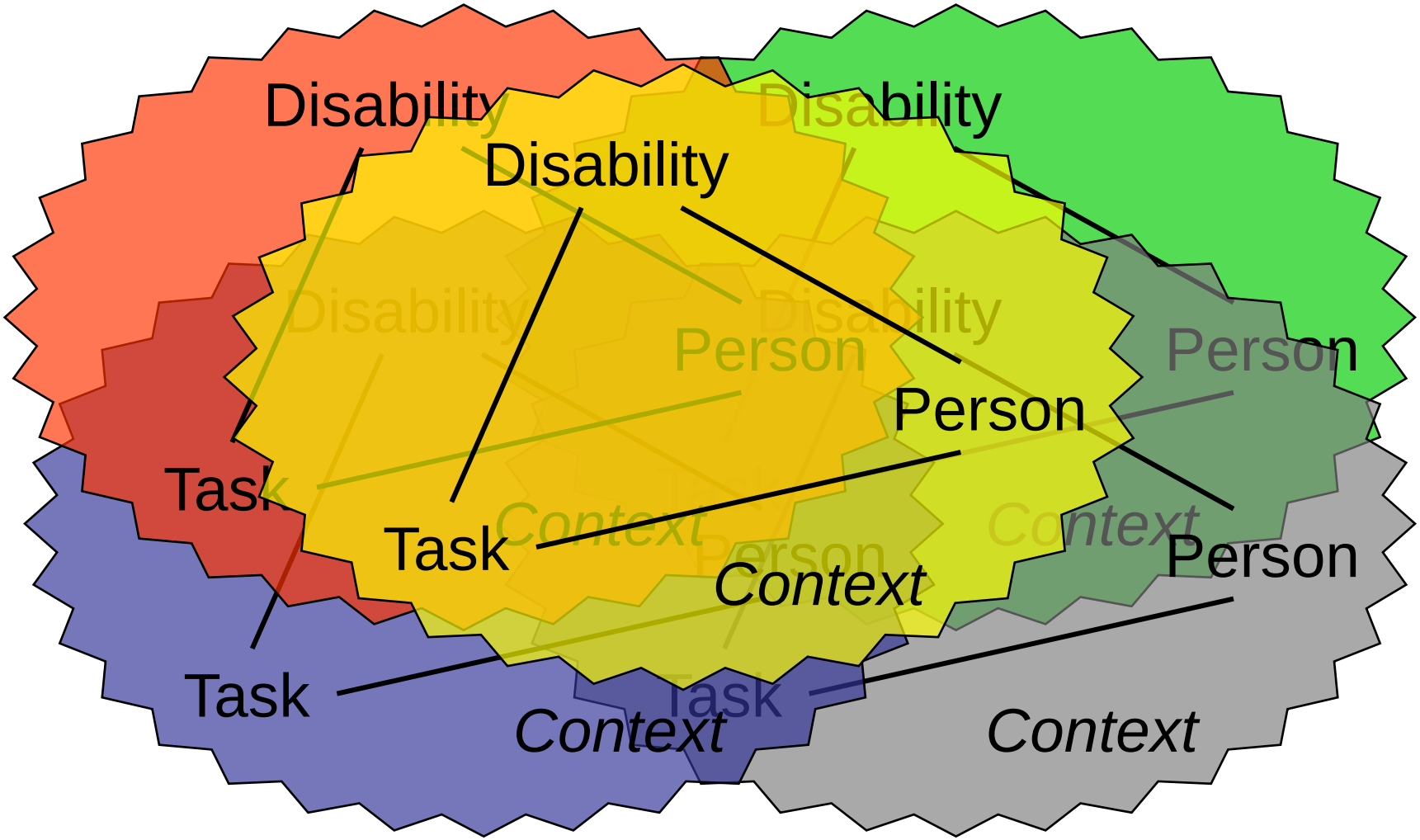
Outline of Tonight

- Introduction
- Access Technology for Reading Disabilities
- Break
- Access Technology Acceptance and Adoption
- Supporting Access Technology Adoption among Adults with Reading Disabilities

Social Perspective on Disability



Social Perspective on Disability



Access Technology for Reading Disabilities

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University of Washington

Outline

- Background
  - Defining Reading Disabilities
  - Prevalence
  - Symptoms
- Access Technologies for Reading Disabilities
  - Research Products
  - Commercial Products
- Why the lack of research & development?

Cognitive Disabilities

Disabilities affecting thinking, memory, and learning:

- Amnesia
- Dementia
- Aphasia
- Mental retardation
- ADD/HD
- Learning Disabilities
- Down Syndrome
- Autism
- Alzheimer's Disease
- Senility

Learning Disabilities

Disabilities affecting the learning and maintenance of new skills despite adequate intelligence and education:

Generalized:

- Information Processing
  - Input
  - Integration
  - Storage
  - Output
- *ADD/HD*
- *Autism*

Specific:

- Reading Disabilities (Dyslexia)
- Dyscalculia
- Dysgraphia
- Dyspraxia
- Dysnomia
- Nonverbal LD

Specific Learning Disabilities

Disabilities affecting the learning and maintenance of specific skills despite adequate intelligence and education:

Specific:

- Reading Disabilities (Dyslexia)
- Dyscalculia
- Dysgraphia
- Dyspraxia
- Dysnomia
- Nonverbal LD

90% have difficulties with reading

More on Disability Classes

- Psychological disabilities are not necessarily cognitive
- Neurological disabilities are not necessarily cognitive
- Print disabilities include
  - Reading disabilities
  - Vision disabilities

Reading Disabilities

A neurological condition defined as a profound difficulty with reading and learning how to read that cannot be explained because of:

- Low intelligence
- Limited sensory ability
- Lack of education
- Lack of socioeconomic opportunity

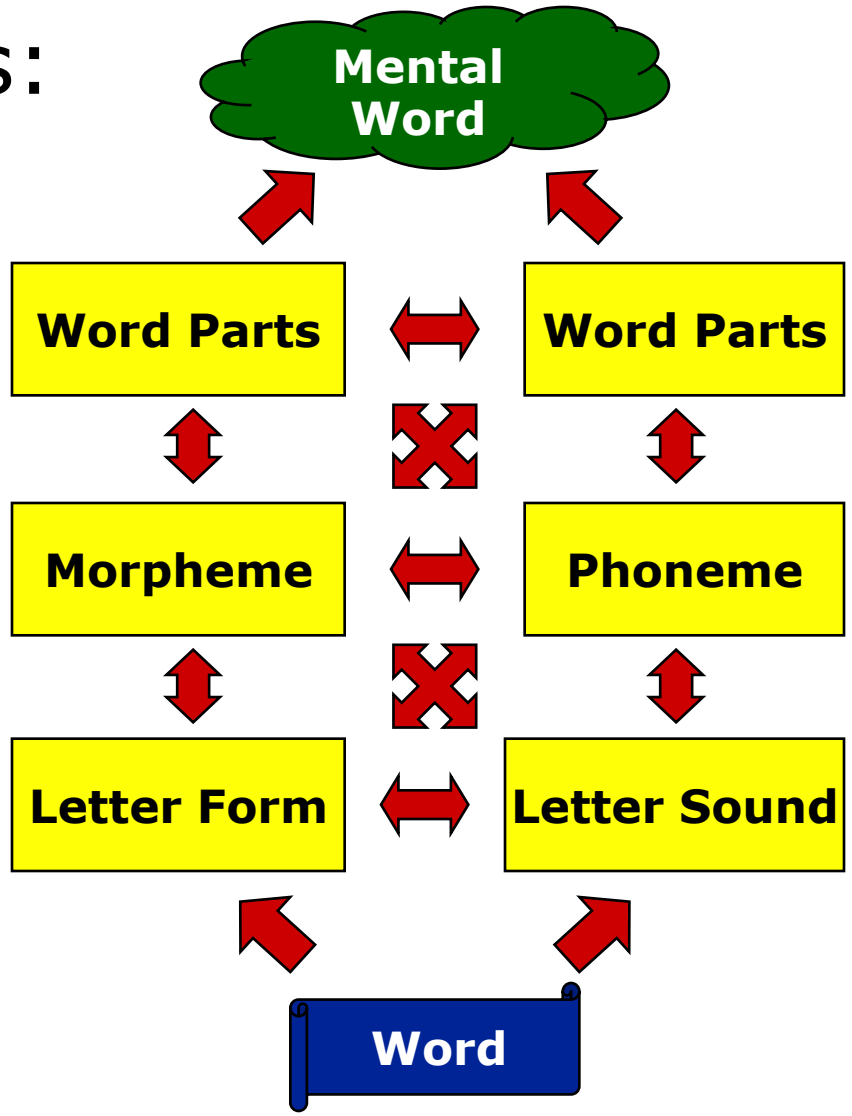
What's in a name?

- Dyslexia
  - Dysphonia (auditory)
  - Dyseidesia (visual)
- Word blindness
- Phonological Processing Deficit
- Strephosymbolia (twisted letters)
- Visual Stress / Meares-Irlen Syndrome

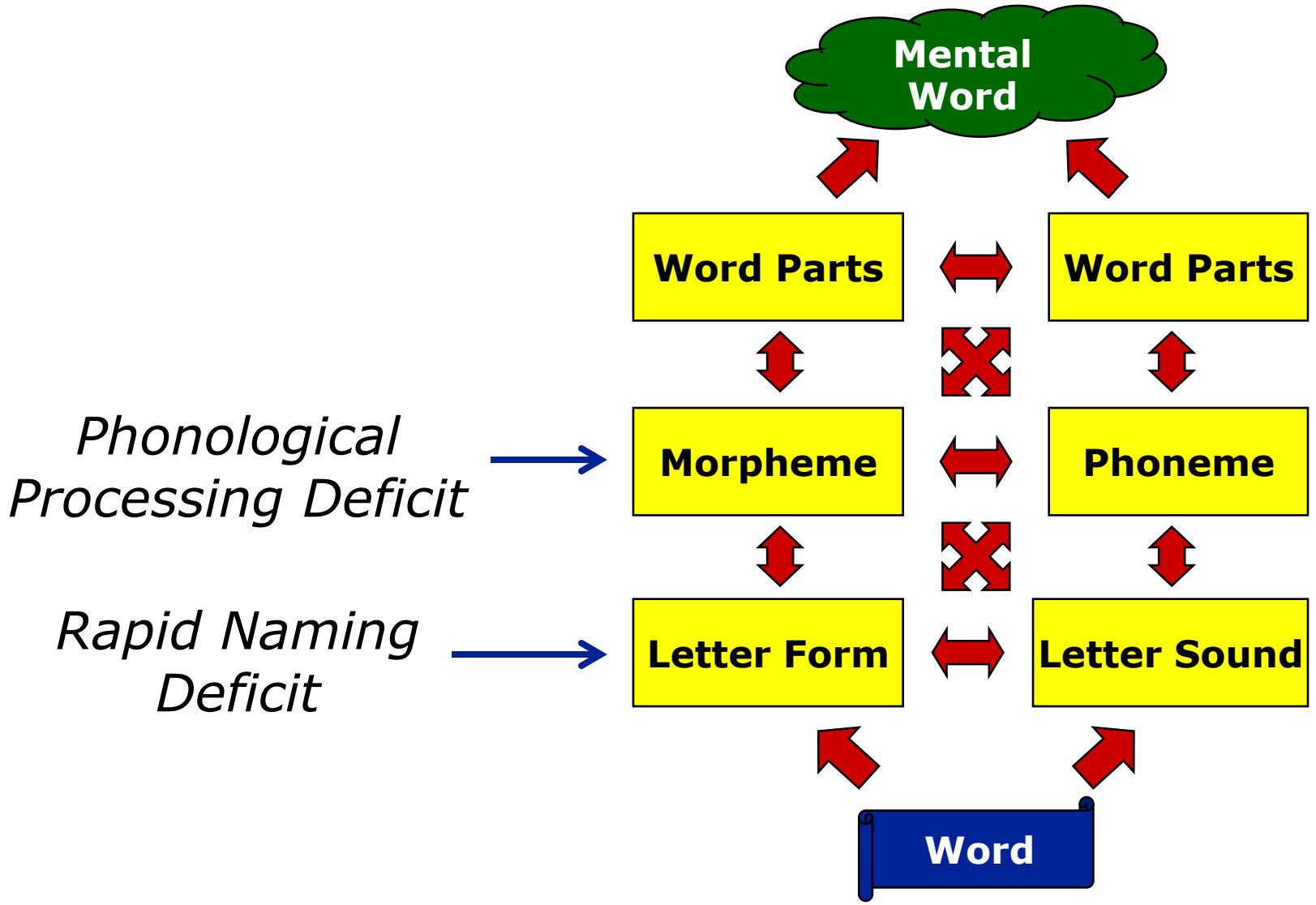
Reading Disability

How We Recognize Words

- Dual route process:
  - "Aural"
  - Visual



Deficits in Reading Disabilities



Symptoms of Reading Disabilities

- Rapid naming and phonological processing deficits
  - Difficulty translating words into sound
  - Word misidentification
  - Dropping or substitution of letters
  - Impacts reading comprehension

Difficulties

- Rapid naming and phonological processing deficits
- Memory
  - Short-term memory
  - Visual memory

Difficulties

- Rapid naming and phonological processing deficits
- Memory
- Visual stress
  - Letters and words move and blur together
  - Eye strain and headaches
  - Difficulty sustaining reading
  - Affects 20-30% of the general population

Difficulties

- Rapid naming and phonological processing deficits
- Memory
- Visual stress

Severity of difficulties varies greatly across individuals

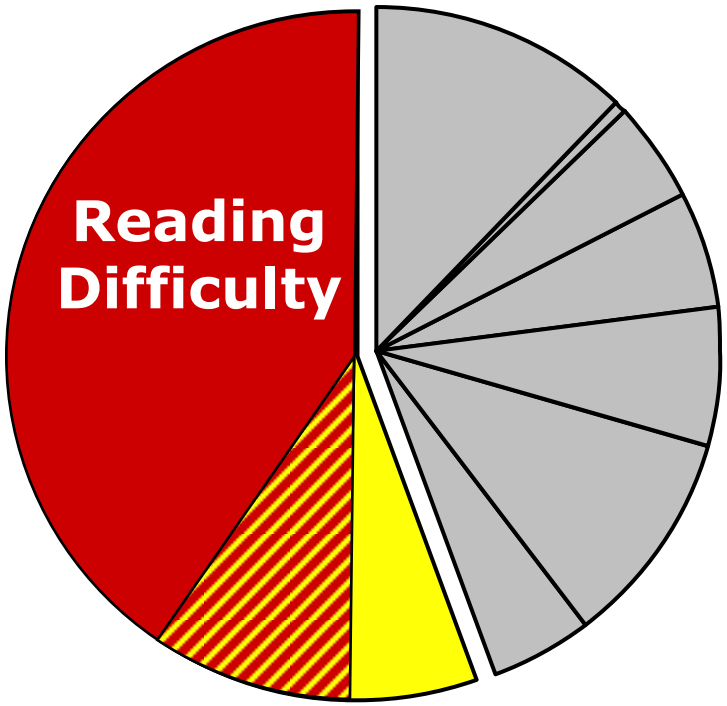
Regarding Reversals

- Letter Reversals:
  - Horizontal mirroring: b ↔ d
  - Vertical mirroring: b ↔ p
- Occur among all readers
  - Slightly more frequent with reading disabilities
- Likely only if result is a real word:
  - Possible: bad → dad
  - Unlikely: different → bifferent

Prevalence of Reading Disabilities

- 7-15% of the population have some difficulty with reading
- Occur in all languages
- Most common form of disability at 4-year universities in the U.S.
  - 55% of students registered as having a learning disability

Disabilities and University Students



Learning Disability	**55%**
Mobility / Orthopedic	12%
Speech / Language	1%
Blind / Visual	5%
Hearing	6%
Mental / Emotional	10%
Health	6%
Other	5%

- **90%** experience difficulty with reading
- Data includes ADD/HD

Students Registered with Disability Services (NCES Report 1999-046)

Outline

- Background
- Access Technologies for Reading Disabilities
  - **Research Efforts**
  - Commercial Products
- Why the lack of research & development?

Text-To-Speech

- Text read aloud by a computer
- First implemented with Bookwise
- Researched with many variations
- Benefits:
  - Bypasses deficits
  - Improves reading rate and word identification
- Drawbacks:
  - Users need strong auditory skills
  - Requires digitization of texts

Fixed Word Displays and Highlighting

- Cardboard windows limiting view of text
- Computerized fixed word displays:
  - One word at a time
  - One word in the center of the screen
- Row and word highlighting
  - Timed movement
  - Can be used with text-to-speech

Color Overlays

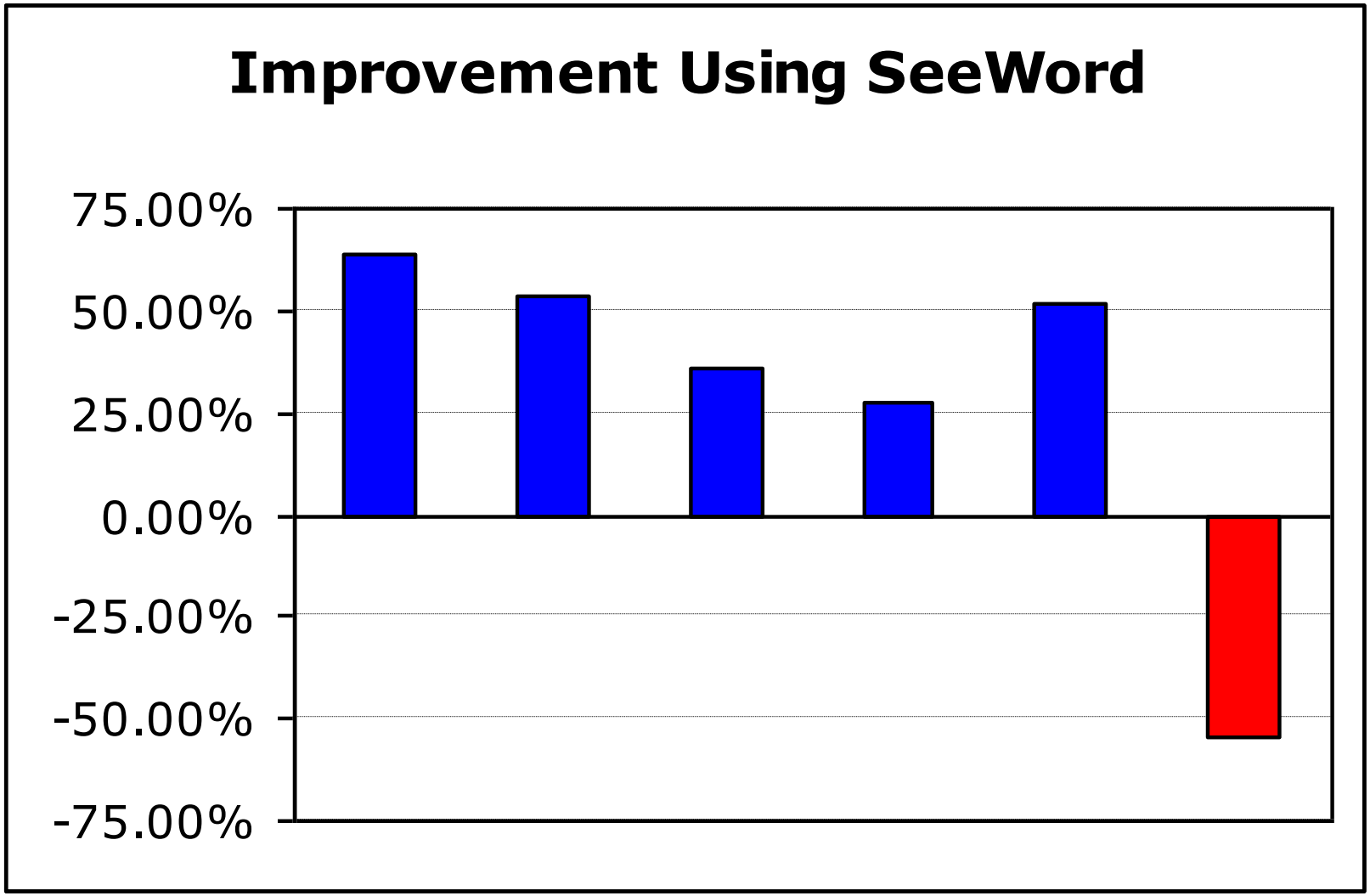
- Colored transparencies placed over text to reduce visual stress
- Optimal color differs by individuals

- Optometric screening used to select optimal color
- Some efforts to computerize screening and overlays

SeeWord

- Front-end for Microsoft Word that breaks WYSIWYG
- Direct manipulation of typography
  - Foreground, background, and letter colors
  - Font type and size
  - Line height
- Small study comparing user-chosen typography with a default
  - 5 participants halved their reading errors
  - 1 participated nearly doubled his errors
  - Suggests guidance is needed for picking helpful typographies

SeeWord


Improvement Using SeeWord
75.00%
50.00%
25.00%
0.00%
-25.00%
-50.00%
-75.00%

Other Research Efforts

- fMRI brain imaging
- Tools for programming
  - Specialized tools for IDEs or editors
- Writing tools
  - Smarter spellchecker
  - Sounds-like word finger

Outline

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Color Overlays and Tinted Lenses

- Plastic overlays and eyeglass lenses
- Color determined by ophthalmological visit
- Has led to criticisms of legitimacy of visual stress as a diagnosis
  - First overlays lacked scientific protocol
  - More rigorous studies conducted later

Read Regular Font

- Font designed to make letters visually distinct
- Children (with and without RD) appear to prefer it
- Default font for children's book at Chrysalis publishing company

Text-To-Speech

- Multiple systems available
- Sometimes built-in to software
  - Adobe Acrobat Reader
  - Mac OS X
- Applications differ greatly
  - Price
  - Functions

Text-To-Speech: Basic Applications

- ReadPlease, Natural Reader
  - Freeware
  - Copy-Paste or text entry for insertion of text
  - Limited configuration options (speed, highlighting, etc.)
  - Conversion to MP3, WAV, etc.
- Deluxe versions
  - License fee
  - High-quality voices
  - Pronunciation editor

Kurzweil 3000

- Commercial program ($1095 - $1495 for individual license)
- High-quality voices available
- Multiple configuration options
  - Speed
  - Pronunciation
  - Highlighting
  - Dictionaries
- Multiple text input
  - Typing
  - OCR
  - File conversion / Import

Outline

- Background
- Access Technologies for Reading Disabilities
  - Research Efforts
  - **Commercial Products**
- Why the lack of research & development?

Gaps in Research and Development

- Singular focus on text-to-speech
  - Considers only one [major] aspect of reading disabilities
  - Bookwise came out in 1993
  - Most TTS are one-offs from Bookwise
  - Kurzweil development focuses on text input
- Limited knowledge of TTS usage
  - Systems often installed in K-12 labs
  - Few studies of technology adoption involving reading disabilities
  - High unawareness and abandonment rates
  - Configuration of systems assumed in studies

Sociocultural factors

- Social and cultural factors affect research and development of access technologies for reading disabilities
- Factors include:
  - Nature of reading disabilities
  - Social views on disabilities
  - Educational policies and philosophies
  - Available technologies
  - Technology practices

History of Scam Treatments

- Snake oil treatments
  - Eye exercises
  - Special diets
  - Unsubstantiated color overlays
- Research community hesitancy
  - Difficulty in publishing new research findings
  - Findings published in other journals
- Insight:

  Outside of the box thinking will need rigorous foundations and proof to reach the research community

History of Display Technologies

- Text-to-speech developed in 1990s
  - Most work conducted on desktop machines with CRT displays
  - Displays known to be non-conducive to vision-only reading
  - Developers made best use of technologies available at the time
- Insight:

  Explore potentials of portable computers (PDAs, tablets, etc.) that are better designed to support reading

Similarities to Vision Disabilities

- Reading disabilities and vision disabilities are print access disabilities
- Ergo, similar solutions suffice for both
  - Well-structured document tags
  - Text-to-speech
- But…
  - People with RD still see and read the text
- Insight:
  - Reconsider what visual information in the text is useful to keep
  - Consider more than aural interventions

Example: Digitization of Texts

- Digitization has focused more on visual impairments
- DAISY Digital Talking Book Standard
  - 6 categories ranging from full audio and title text only…
  - …to no audio and full text
- NIMAS Accessible Text Standard
  - Requires full text and its markup
  - Not meant to be delivered to end readers

Example: Digitization of Texts

- Recent research efforts worth commending
  - Improving OCR and file importing
    - Open source?
  - Headings, tables, pictures identification
  - Reading flow detection
  - Efforts at creating a community of scanned documents

Example: Digitization of Texts

- Thinking beyond just vision disabilities
  - Table and image locations
  - Paragraphs
  - Line and word positions
  - Line breaks
  - Fonts
  - Italics
  - Boldface

Table 1: Frequency of Special Characters

Non-English or Math	Frequency	Comments
Ø	1 in 1,000	For Swedish names
π	1 in 5	Common in math
\$	4 in 5	Used in business
Ψ_1^2	1 in 40,000	Unexplained usage

Figure 1: A sample black and white graphic (.eps format).

a single-column table, this wide table will "float" to a location deemed more desirable. Immediately following this sentence is the point at which Table 2 is included in the input file; again, it is instructive to compare the placement of the table here with the table in the printed dvi output of this document.

2.5 Figures

Like tables, figures cannot be split across pages; the best placement for them is typically the top or the bottom of the page nearest their initial cite. To ensure this proper "floating" placement of figures, use the environment **figure** to enclose the figure and its caption.

This sample document contains examples of **.eps** and **.ps** files to be displayable with LaTeX. More details on each of these is found in the *Author's Guide*.

As was the case with tables, you may want a figure that spans two columns. To do this, and still to ensure proper "floating" placement of tables, use the environment **figure*** to enclose the figure and its caption. and don't forget to end the environment with figure*, not figure!

Maintain and replicate the original structure

Text-To-Speech is Good Enough

- Studies show it benefits ≈85% of users
  - Diminishing returns for better readers
- Suggestions of low adoption rate
  - Elkind study had 50% abandonment rate
  - Little evidence for long-time usage among UW students with disabilities
- Comments that it is not good enough
  - Artificial voices lack nuances of human voices
  - Experiences of "Alan" from Deibel (2007, 2008)
- Insight:
  - Consider how to support the minority of those not helped by text-to-speech

Assistive Technologies and Medicine

- Early AT adoption studies conducted by rehabilitation doctors
  - Focused on disabilities they treated
- Reading disabilities are not "treated" medically but through education
- Insight:

  Consider the different policies, laws, funding, philosophies, etc. between medical and educational treatment of disabilities

Education and the Medical Model

Medical model of disability:

A disability is a flaw or defect that needs fixing or bypassing

Typical Education Research Approach:

- Phonological processing deficit
- Text read aloud bypasses deficit
- Text-to-speech technology
- Use text-to-speech for remediation

Educational Model of Disability

- Person has education disability about X
- Sub-skill Y is identified as lacking
- If we remediate or bypass Y, X will improve
  - Efforts that ignore Y are not pursued
- Insight:

  Consider interventions not involving phonological processing deficit

Repercussions of Educational Model

- Focus on early reading
  - Emphasis on early interventions, K-5
  - Ignores transition from "learning to read" to "reading to learn"
- Insight:

  Lack of support for more advanced reading skills and tasks

Repercussions of Educational Model

- Focus on reading at school
  - Reading takes place outside of schools
  - AT often deployed only in the school labs
- Insight:

  Current assistive devices not designed for use in multiple locales

Invisible Nature of Reading Disabilities

- Disability not visually apparent to others
- Allows individual to hide as "normal"
  - Avoid disability stigma
  - Limit knowledge to trusted others
  - Delay asking for help (including registering for disability services and accommodations)

Social Aspects of Reading Disabilities

- Poor reading is socially associated with poor intelligence
- Individuals with reading disabilities experience:
  - Self-doubt, low confidence, and depression
  - Feelings of isolation
  - Teasing from peers
  - Expectations from others to fail
  - Viewed as lazy or attempting to fraud the system

Invisibility and Technology Usage

Would text-to-speech be used in a….

- …lecture hall?
- …library?
- …study group?
- …in a dorm room with a roommate?
- …in a dorm room alone?

- Insight:

  Need awareness of different contexts and how they affect usage and adoption

Summary

- Reading disabilities affect a large number
  - Wide diversity within the population
- Research literature on access technologies for reading disabilities is limited in scope
- Various social and cultural factors have influenced previous and current research
- Understanding these factors allows for better future research

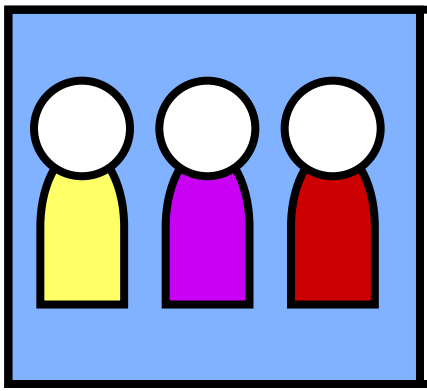
Time for a break

Coming up next…

Access Technology Acceptance and Adoption

Same Kate Time

Same Kate Channel



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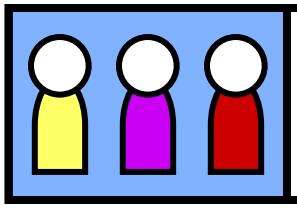


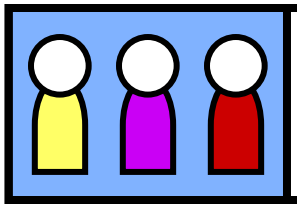
Defining Adoption & Acceptance

- Technology Adoption / Rejection:

  The process by which an individual or group decides to use / not use a technology on a regular basis

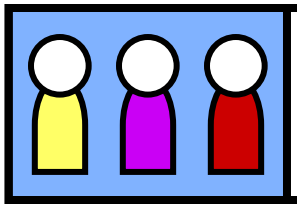
- Technology Acceptance:

  The process by which an individual or group grows to accept a technology as a common or correct way of doing a task



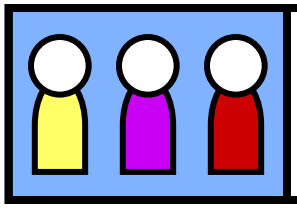
A Question

What has been the most successful access technology of all time?



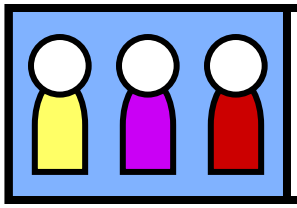
History of Eyeglasses

- China, ≈1 C.E.: As eye protection
- Italy, 1260s: For farsightedness
- Europe, 1500s: For nearsightedness
- Britain, 1725: Modern frame invented
- USA, 1780s: Bifocals invented
- Britain, 1825: For astigmatisms



Social Acceptance of Eyeglasses

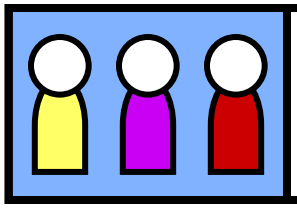
- Generally viewed as not to be worn in public
  - Use only when necessary
  - "Glasses are very disfiguring to women andgirls" — From a 1901 optician journal
  - Led to quick use optics like the stylish monocle or lady's lorgnette
- Exceptions
  - The Spanish
  - Scholars, academics, and clergy
- Result
  - Association of glasses with intellectual pursuits



Point of this Historical Sidetrack

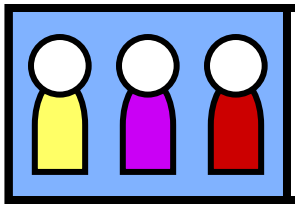
- Culture and society shapes how, when, and if a technology is used
- Technologies shape people's perceptions of their users

It's All About The Context



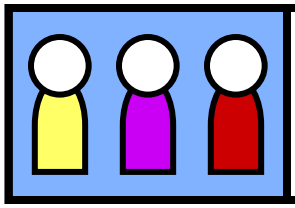
Outline

- **Why care about adoption and acceptance?**
- Theory of Adoption and Acceptance
- Studies of AT Adoption and Acceptance
- Considering Adoption when Designing



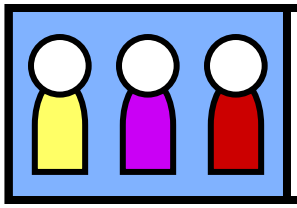
Facts about Abandonment

- Technology adoption is good for business
- 8 to 75% of AT are abandoned after purchase
  - Average rate is 35%
- Differs by technologies
  - Wheelchairs have low abandonment rates
  - Hearing aids have high abandonment rates



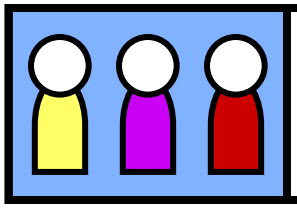
Why Adoption Matters for AT

- A tool is only helpful when it is used
- Abandonment is a waste of resources, time, and funds for users and disability services
- Leads to learned helplessness and pessimism
- Usage patterns influence adoption of technologies by others



Why Acceptance Matters for AT

- Social acceptance of AT being used visibly
  - Lower stigma of being disabled
  - Encourages usage by others
- Reduces challenges of using technology
  - In schools
  - At work
- Non-acceptance can lead to disagreements and in-fighting
  - Cochlear implant and the Deaf community
  - Oscar Pistorius and the Summer Olympics 2008



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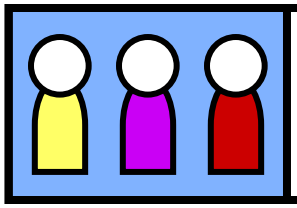
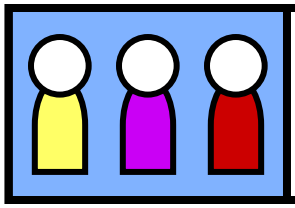


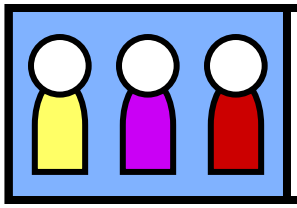
Basic Ideas of Adoption-Acceptance

- Models of information-gathering / processing in regards to new ideas or products
- Studied mainly in Communication Sciences
- Applied to numerous fields and areas:
  - Agriculture
  - Education
  - Health policies
  - Medicines
  - Computer technologies



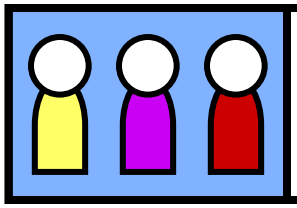
Models of Adoption-Acceptance

- General
  - Rogers's Diffusion of Innovations Model
  - Moore's Crossing the Chasm
  - Davis and Bagozzi's Technology Acceptance Model
- AT-Specific
  - Baker's Basic Ergonomic Equation
  - Kintsch and DePaula's Adoption Framework for Assistive Technologies



Diffusion of Innovations

- Developed by Everett Rogers
- Generalized theory of how ideas and innovations spread and get adopted
- Codified terminology and methodology
- Has needed modifications due to recent innovations in communication technologies

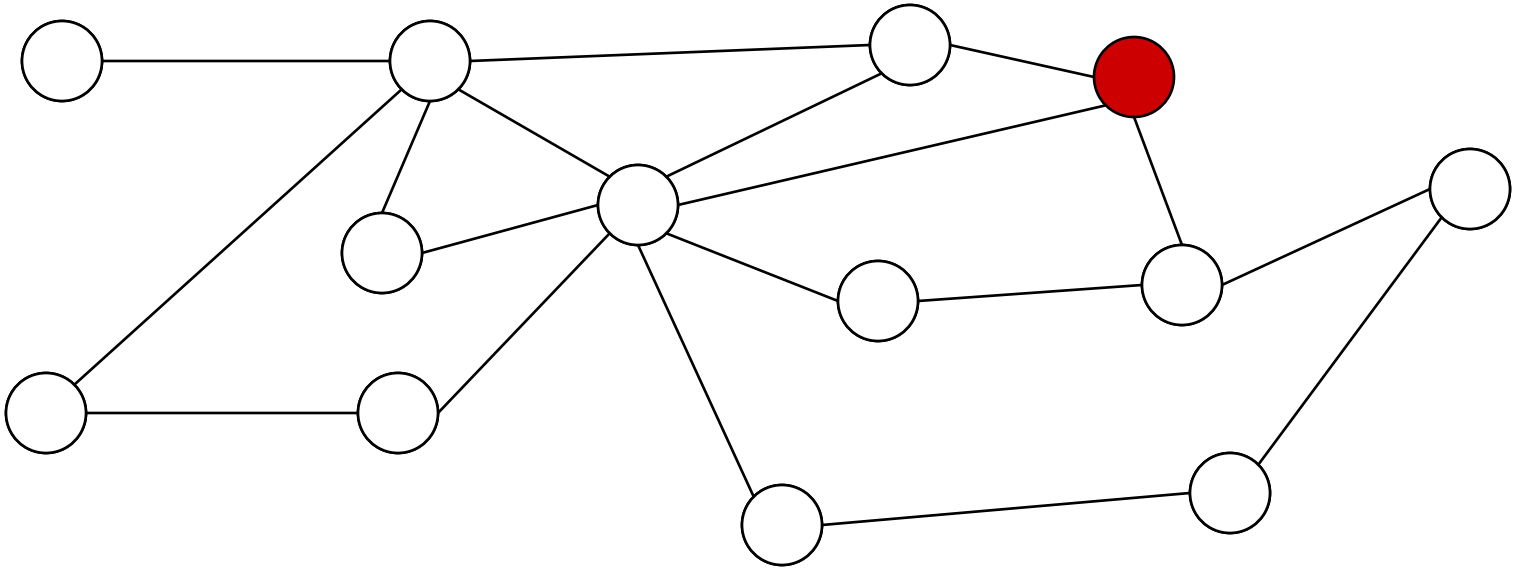


Some Terminology

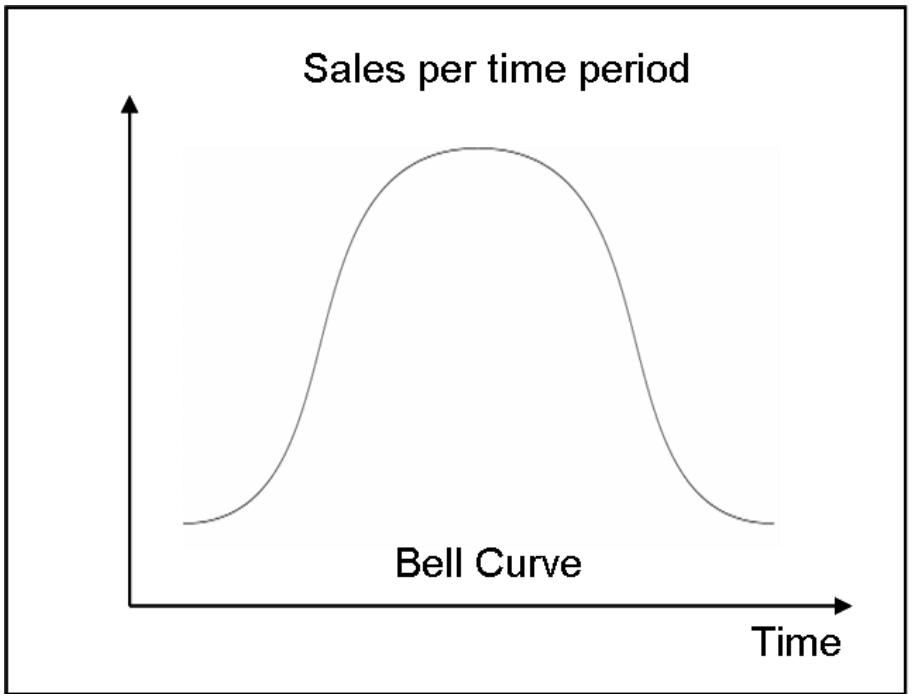
- Adoption
- Rejection
- Abandonment
- Discontinuance
- Reinvention
- Relative Advantage
- Change Agent
- Compatability
- Perceived Ease of Use
- Early Adopter

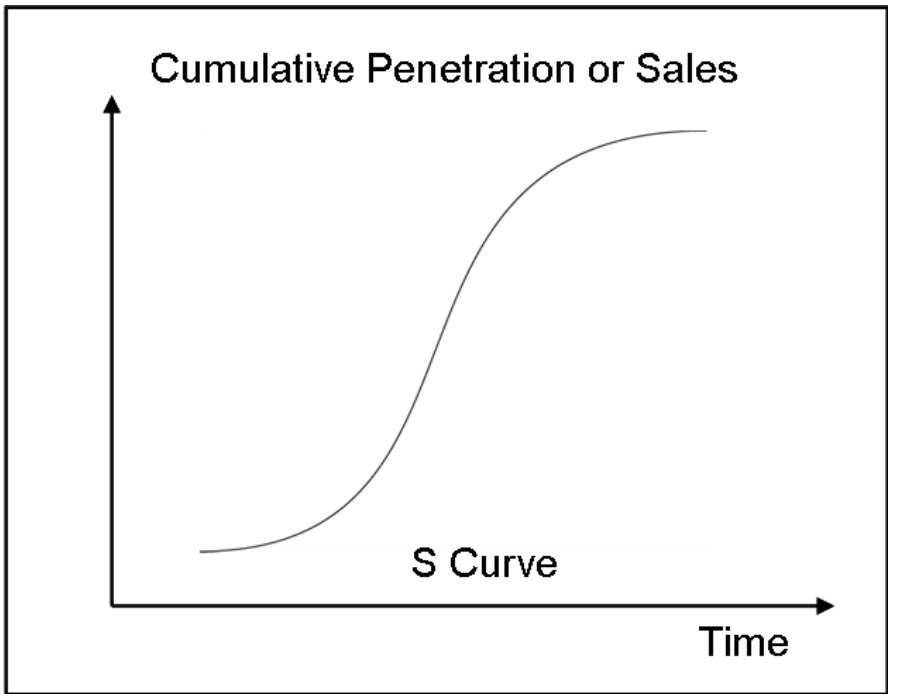
“Visible” Use of Technology

- Knowledge and eventual adoption of technologies are guided by social and communication networks

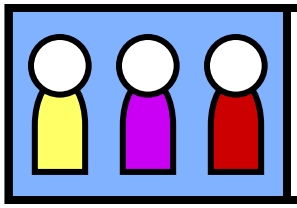


Adoption Rates & Early Adopters



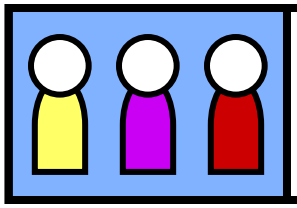


- Innovators: 2.5%
- Early Adopters: 13.5%
- Early Majority: 34%
- Late Majority: 34%
- Laggards: 16%



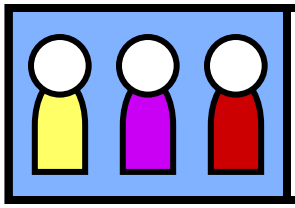
Outline

- Why care about adoption and acceptance?
- Theory of Adoption and Acceptance
- **Studies of AT Adoption and Acceptance**
- Considering Adoption when Designing



Studies of AT Adoption

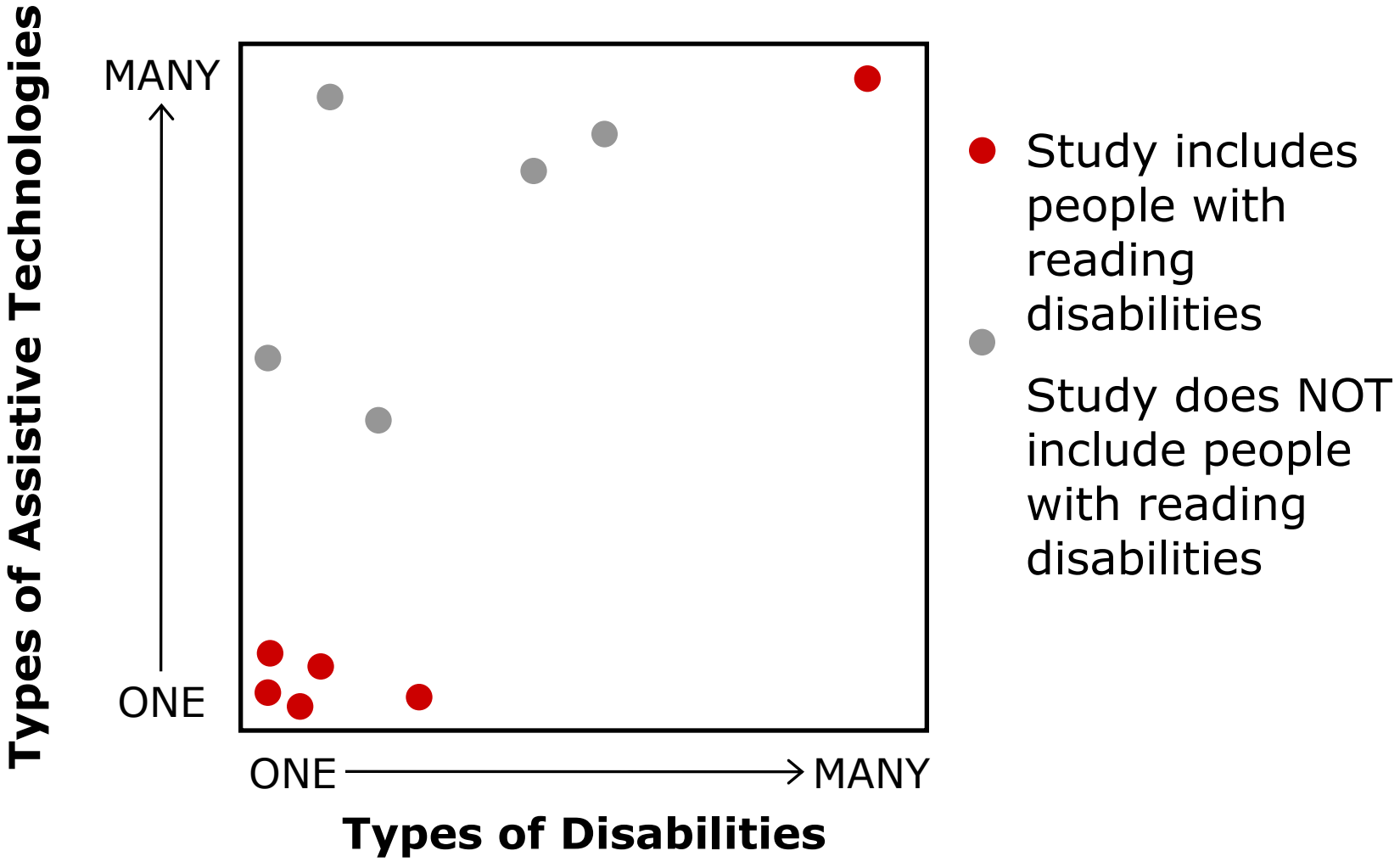
- Phillips and Zhao (1993)
- Elkind et al. (1996)
- Jeanes et al. (1997)
- Wehmeyer (1995, 1998)
- Martin and McCormack (1999)
- Riemer-Reiss and Wacker (2000)
- Koester (2003)
- Dawe (2006)
- Shinohara and Tenenberg (2007)
- Comden (2007)
- Deibel (2007, 2008)

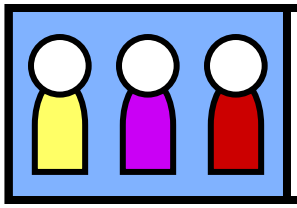


Methodologies and Approaches

- Variety of methodologies:
  - Large-scale quantitative surveys (4)
  - Studies of a single assistive technology (4)
  - Small-scale qualitative case studies (3)
- Different approaches
  - Focus on one or many technologies
  - Focus on one or many disabilities
- Limitations:
  - Difficulty in generalizing smaller studies
  - Larger studies do not separate findings by technology or disability type

Studies of AT Adoption

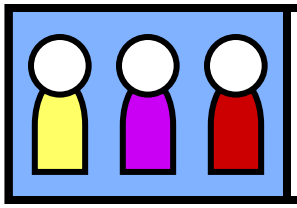




Findings

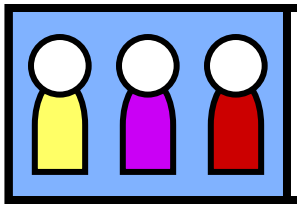
- Predictors of technology adoption
  - Involvement of user in selection process
  - Observable performance benefit
  - Ease of maintenance and configuration
  - Understanding of what the technology does

- Predictors of technology rejection
  - Monetary cost of technology
  - Limited knowledge of available technologies
  - Learning curves for using technologies
  - Technology lifetimes



Outline

- Why care about adoption and acceptance?
- Theory of Adoption and Acceptance
- Studies of AT Adoption and Acceptance
- **Considering Adoption when Designing**
  - Dawe's Studies
  - King's Human Factors
  - Baker's Basic Ergonomic Equation

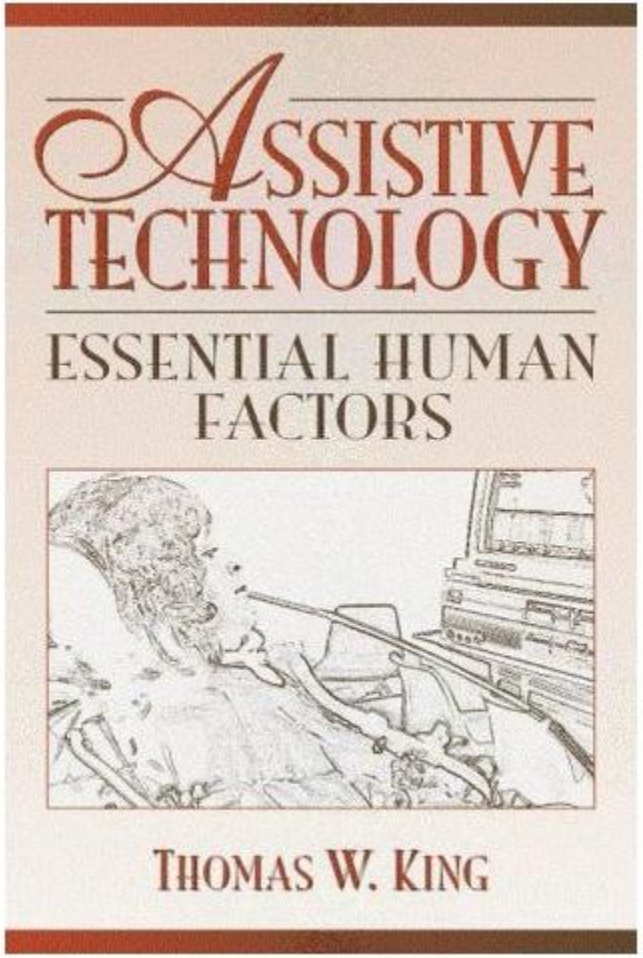


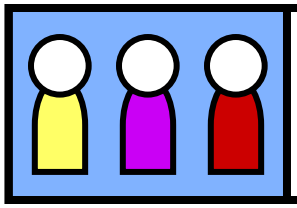
Melissa Dawe's Work

- Dissertation at U. Colorado-Boulder
- Mobile communication system for young adults with severe cognitive disabilities
- Study Approach:
  - In-depth interviews with parents, teachers, and caretakers of young adults with severe CDs
- Motivation:
  - Capture full process of abandonment
  - Capture any re-invention of regular technologies
  - Recognize multiple stakeholders in the purchase and usage of the technology

Thomas King's Human Factors

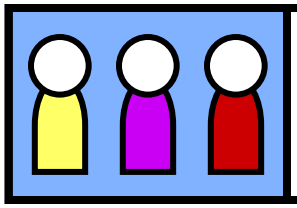
- Special educator and speech-language pathologist
- Focus on augmentative and alternative communication systems
- Years of experience in selection and advising of AT usage
- Many AT failures begin at the design stage





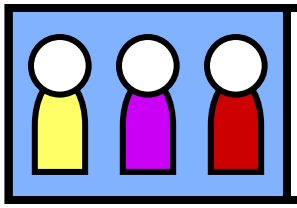
Essential Human Factors

- Device Transparency
- Cosmesis of Devices
- Mappings of commands and actions
- Affordances
- Learned helplessness
- Feedback from controls
- Knowledge in the head versus knowledge in the world
- Constraints on device usage
- Fail-safe mechanisms
- Error prevention



Highlights of Human Factors

- Cosmesis
  - Cosmetic appeal of the appearance of the AT
- Affordances
  - Luxury or comforts provided by design of the machine
- Knowledge in the head or the world
  - Degree of learning needed to use the device
  - Degree to which interface helps guide the operation of the device



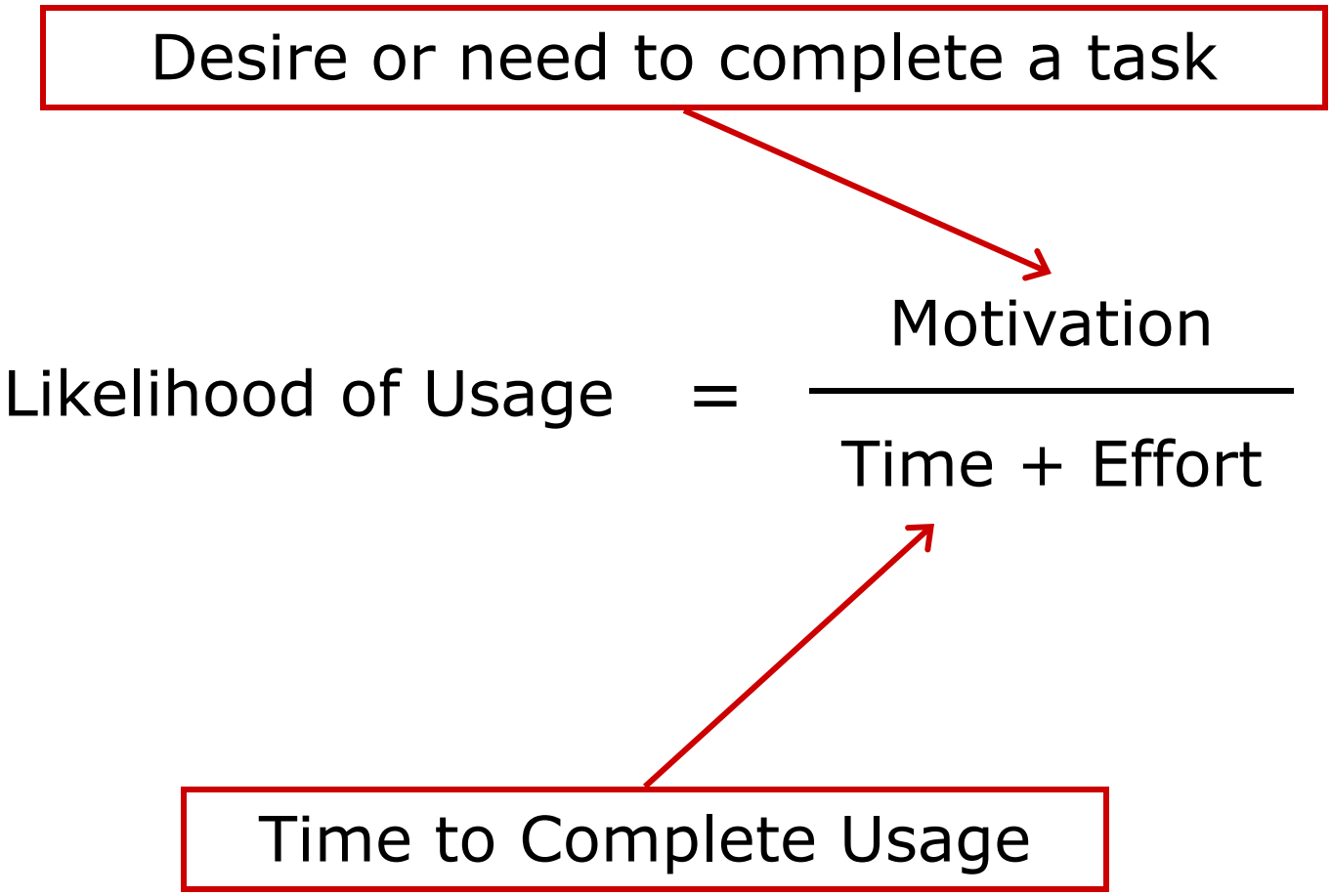
Baker's Basic Ergonomic Equation

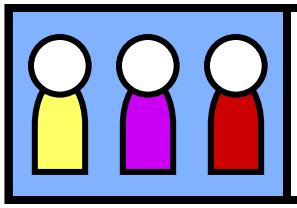
- Heuristic for determining if an AT will be used to conduct a task

$$\text{Likelihood of Usage} = \frac{\text{Motivation}}{\text{Time} + \text{Effort}}$$

- Developed by Bruce Baker
- Readapted by Thomas King

Baker's Basic Ergonomic Equation





Baker's Basic Ergonomic Equation

$$\text{Likelihood of Usage} = \frac{\text{Motivation}}{\text{Time + Effort}}$$

Physical + Cognitive

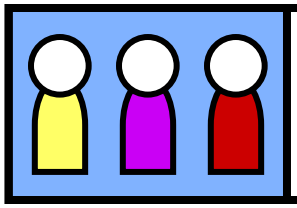
Baker's breakdown of Effort

Baker's Basic Ergonomic Equation

$$\text{Likelihood of Usage} = \frac{\text{Motivation}}{\text{Time + Effort}}$$

Physical + Cognitive + Linguistic

King's breakdown of Effort

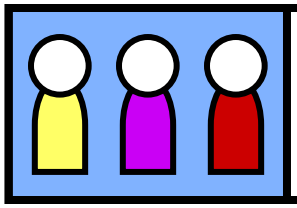


BBEE: A Question

If motivation is high and the device requires minimal time and effort…

$$\text{Likelihood of Usage} = \frac{\text{Motivation}}{\text{Time + Effort}}$$

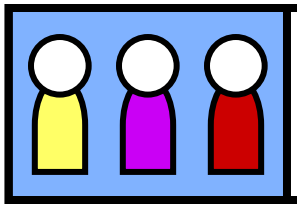
…will a person necessarily use the AT?



BBEE: Answer

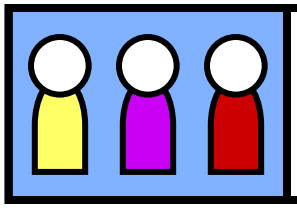
NO…

…BUT WHY?



Invisibility of Reading Disabilities

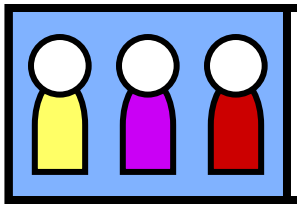
- Disability not visually apparent to others
- Allows individual to hide as "normal"
  - Avoid disability stigma
  - Limit knowledge to trusted others
  - Delay asking for help (including registering for disability services and accommodations)
- Motivation for hiding
  - Poor reading skills associated with low intelligence
  - Teasing from peers
  - Expectations from others to fail
  - Accusations of faking



BBEE: Capturing Stigma

$$\text{Likelihood of Usage} = \frac{\text{Motivation}}{\text{Stigma} + \text{Time} + \text{Effort}}$$

Perceived harm from using the device

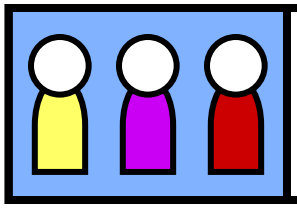


BBEE: Another Question

With even a really high stigma association…

$$\text{Likelihood of Usage} = \frac{\text{Motivation}}{\text{Stigma} + \text{Time} + \text{Effort}}$$

…would some still use the AT?



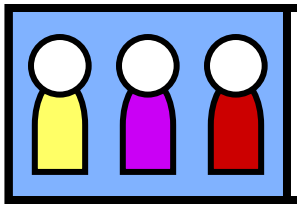
Consider Wheelchairs

- Stigmas associated with using a wheelchair
  - Lowered perceived intelligence

    "What will your friend be having for dinner?
  - Ignored from conversations

    "Is your wife crippled"

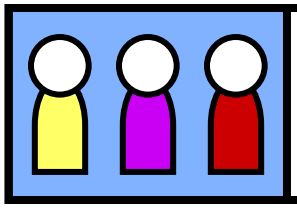
    "No, she's just lazy. You can ask her yourself."
- Alternatives to using a wheelchair?
  - Crutches or walkers (not always an option)?
  - Staying at home forever?
  - Futuristic robotic skeletons?



BBEE: Necessity of Device

Criticality of device for the task

$$\text{Likelihood of Usage} = \frac{\text{Necessity} \times \text{Motivation}}{\text{Stigma} + \text{Time} + \text{Effort}}$$



Summary

- Adoption and usage of a technology is influenced by more than what it does well
- AT adoption and acceptance are critical concerns for AT researchers and developers
- Some design guidelines and tools exist
- Further studies of issues particular to specific disabilities are needed

Promoting Adoption and Diversity in Access Technologies for Adults with Reading Disabilities

Katherine Deibel

University of Washington

Goal

- Understand the technology usage and adoption practices of adults with reading disabilities
- Develop access technologies that help promote adoption by adults with reading disabilities

Research Challenges

- Wide diversity of needs among users with reading disabilities
- Support multiple reading tasks and contexts
- Invisible nature of reading disabilities
  - Tactical efforts at hiding disability
  - Influences when, how, and if an AT will be used
- Population unlikely to seek out help from disability experts or services
  - No guidance in AT selection process
  - No guidance in configuration and maintenance of adopted ATs

Potential Solution

- Provide multiple tools for the user to choose among
- Allow user to control when and where some tools are used
- Provide automated support in the
  - Selection Phase
  - Configuration Phase
  - Maintenance Phase

Observations from Research Literature

- Findings of adoption studies are generally consistent
- General predictors of technology adoption:
  - Involvement of user in selection process
  - Observable performance benefit
  - Ease of maintenance and configuration
  - Understanding what the technology does

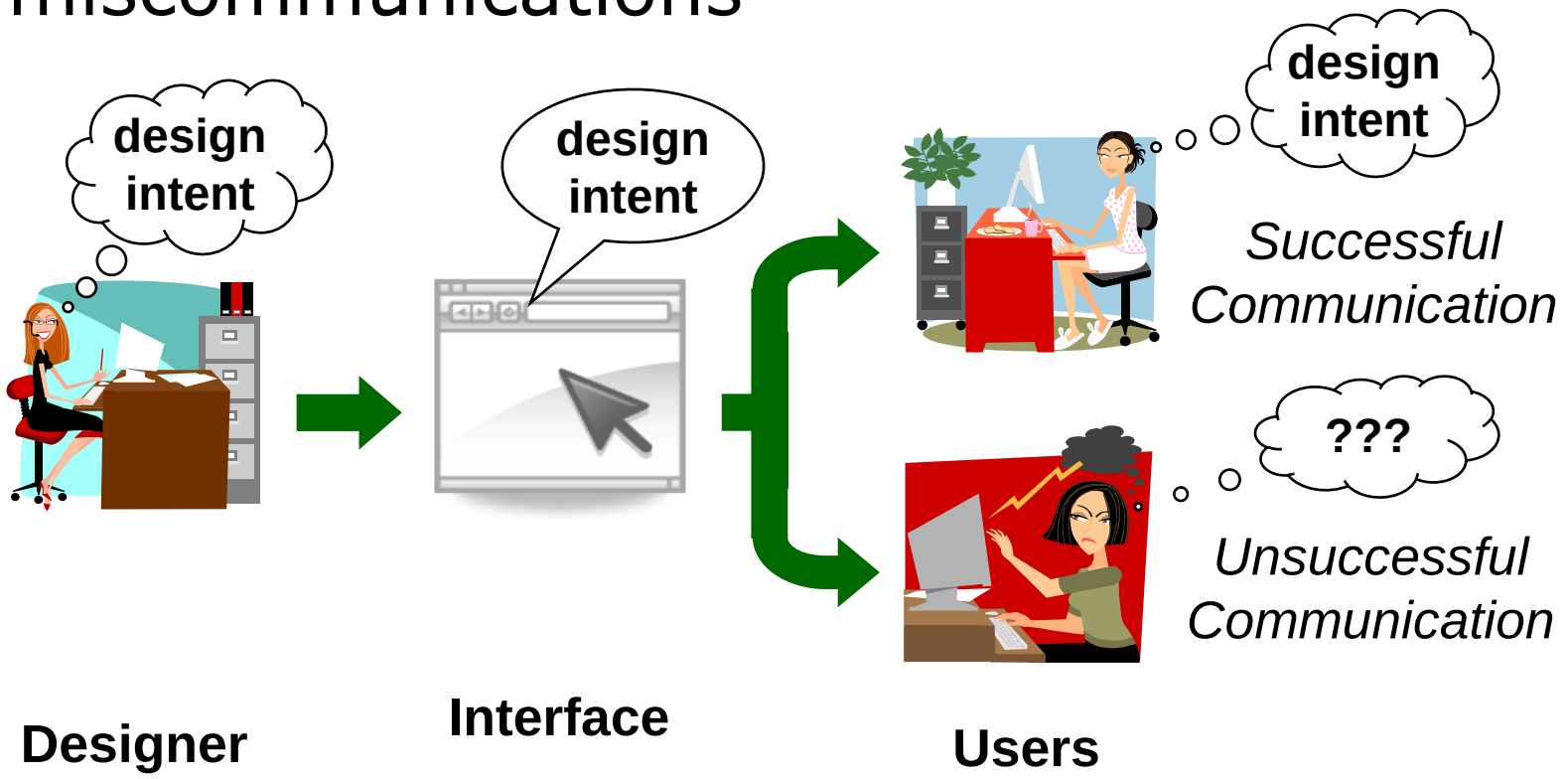
Reframing Findings as Questions

- Successful adoption of access technology relies on the user knowing:
  - What does this device do?
  - Why will this device help people with my disability?
  - Will this device help me with my ability?
  - How do I configure this device?
  - How do I use this device?

Can we develop a system that insures these questions are answered?

Semiotic engineering

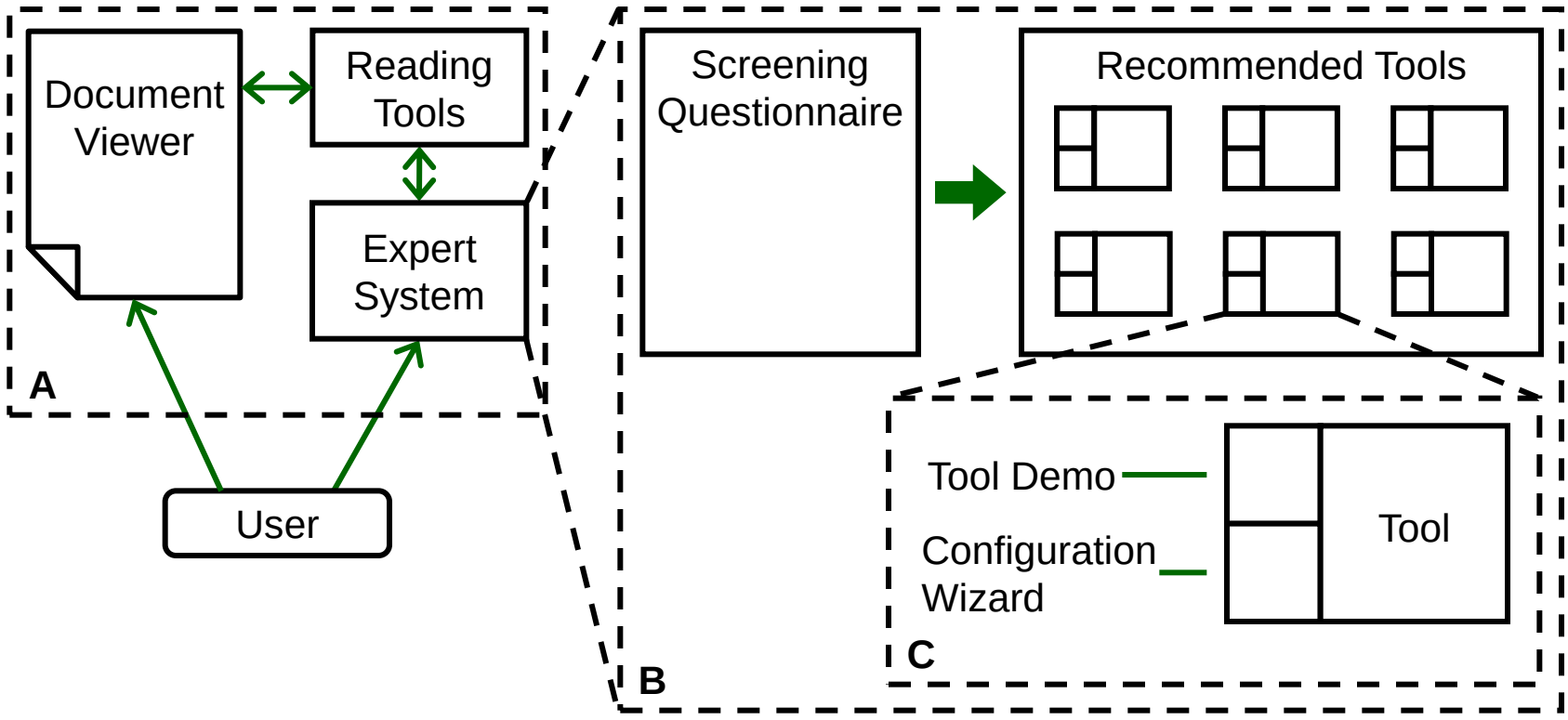
- Interface is viewed as a communication between the designer and user
- Usability breakdowns are viewed as miscommunications



AT and Semiotic Engineering

- Idea:
  - Use semiotic engineering principles and practice to insure the adoption questions are answered
- Has yet to be applied to the design of access technologies (Deibel, 2007)

Schematic of Adoption Support System



A. Overall application. **B.** Detail of expert system.
C. Detail of a reading tool

Screening Questionnaire

Disagree **Agree**

Words on a page begin to move around if I read for longer than 10 minutes. ◎ ◎ ◎ ◎ ●

⋮

Press ▶ to listen to a short conversation. You will be asked a few questions after it has completed.

- User completes questions about typical reading behaviors and automated skill assessments
- System diagnoses the presence and strength of user's reading difficulties

Tool Recommendation

Based on your responses, you experience some difficulty recognizing words when you are reading. *Explain*

Tools you might find helpful are:

- **Text Reader**: *Demo* *Configure*
  Given your strong auditory skills, hearing the text read aloud…
- **Phonetic Speller**: *Demo* *Configure*
  This tool helps with recognizing a word by showing how it is pronounced…

- System presents diagnoses and recommends tools
- User can ask for explanation of diagnoses and demonstrations of the tools

Diagnosis Explanation

Explanation: Word Recognition

Phonological Processing Score: 2 / 10

This score reflects your ability to process letters into sounds, such as in the question…

- System refers to the user's responses to provide transparency of assessment

Tool Demonstration

Demo: Phonetic Speller

Seeing how a word sounds can help you in identifying it. With this tool, you can click on a word to show how it is pronounced:

<foh-toh-graf>

The photograph showed the theft…

- Tool demonstrates what it does and explains why it could be helpful

Tool Configuration

Configure: Color Adjuster

To determine a background color that best reduces visual stress, the system will perform an eye exam. You will need a…

- Configuration wizard works with User to properly tune reading tool

Further Design Expansions

- View document viewer and tools as a general purpose reading tool
  - Develop tools that help people regardless of having a reading disability
  - Lessens stigma of technology as being only for disabled people
- Tools for reading disabilities will be expected to interface with recommender system