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

Disability

Person

Task

Context
Social Perspective on Disability

- Disability
- Context
- Task
- Person
Access Technology for Reading Disabilities

Katherine Deibel
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

**Phonological Processing Deficit**

**Rapid Naming Deficit**
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: $b \leftrightarrow d$
  - Vertical mirroring: $b \leftrightarrow p$

- Occur among all readers
  - Slightly more frequent with reading disabilities

- Likely only if result is a real word:
  - Possible: bad $\rightarrow$ dad
  - Unlikely: different $\rightarrow$ 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%

- **Reading Difficulty**: 90% experience difficulty with reading

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>
<thead>
<tr>
<th>Table 1: Frequency of Special Characters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-English or Math</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Ø</td>
</tr>
<tr>
<td>π</td>
</tr>
<tr>
<td>§</td>
</tr>
<tr>
<td>¥</td>
</tr>
</tbody>
</table>

– Table and image locations

– Paragraphs

– Line and word positions

– Line breaks

– Fonts

– Italics

– Boldface

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
Access Technology
Acceptance and Adoption

Katherine Deibel
University of Washington
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, \( \approx 1 \) 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 and girls”
    — 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
Outline

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

- Phillips and Zhao (1993)
- Elkind et al. (1996)
- Jeanes et al. (1997)
- Martin and McCormack (1999)
- Riemer-Reiss and Wacker (2000)
- 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

Types of Disabilities

Study includes people with reading disabilities

Study does NOT include people with reading disabilities

ONE

MANY

Types of Assistive Technologies

ONE

MANY
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

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

- Developed by Bruce Baker
- Readapted by Thomas King
Baker’s Basic Ergonomic Equation

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

- **Desire or need to complete a task**
- **Time to Complete Usage**
Baker’s Basic Ergonomic Equation

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

Physical + Cognitive

Baker’s breakdown of Effort
Baker’s Basic Ergonomic Equation

Likelihood of Usage = \frac{Motivation}{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
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

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

<table>
<thead>
<tr>
<th>Disagree</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>🟦</td>
<td>☑</td>
</tr>
</tbody>
</table>

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. Tools you might find helpful are:

- **Text Reader**: Given your strong auditory skills, hearing the text read aloud...

- **Phonetic Speller**: 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

Explaination: 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