

Accessibility

Designing for the full range of human capabilities.











People vary in their physical and mental capabilities.

- How are your abilities different from other people?
- How will your abilities change in the future?
- How do your abilities change in different environments?

We have a range of ability dimensions (i.e. personal characteristics and factors that affect our capabilities):

Age	Culture
Gender	Language
Cognitive abilities	Personal history
Physical abilities	Emotional, physical, spiritual needs

The “average person” is just a statistical ideal

- No one person is “average”

Individual performance and capabilities vary significantly

- If you build software for someone else, they will likely differ from you in some way
- Challenging to build software that is equally usable and accessible for everyone

Additionally, each one of us deals with temporary disabilities, or situational impairments.

- Can arise due to nature of our environment or our health
- What forms of “temporary” disabilities are there?

Temporary & situational disabilities

Sick, injured

- Temporarily impaired cognitive capabilities
- Temporary loss of motor capabilities

Driving a car

- Limited attentional bandwidth

Making dinner at home while attending to children

- Limited attentional bandwidth

Underwater diving

- Impaired sight, hearing, mobility

Using an ATM late at night in an unfamiliar surrounding

Padded lampposts for distracted texters being tested in London

BY JOSHUA TOPOLSKY

MARCH 6TH 2008, AT 5:39:00 AM ET

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According to a recent report, human beings are becoming so incredibly stupid that they require cushioned lamppost bases so that when they run into them they don't mess up their

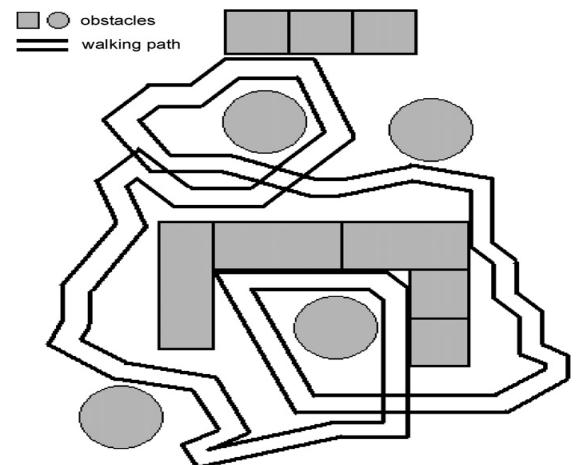
Task: tap with stylus on targets of varying sizes at varying distances from the start button

Conditions:

- Sitting
- Treadmill: slow
- Treadmill: fast
- Obstacle course (self-paced)

Measure:

- Pointing speed
- Errors



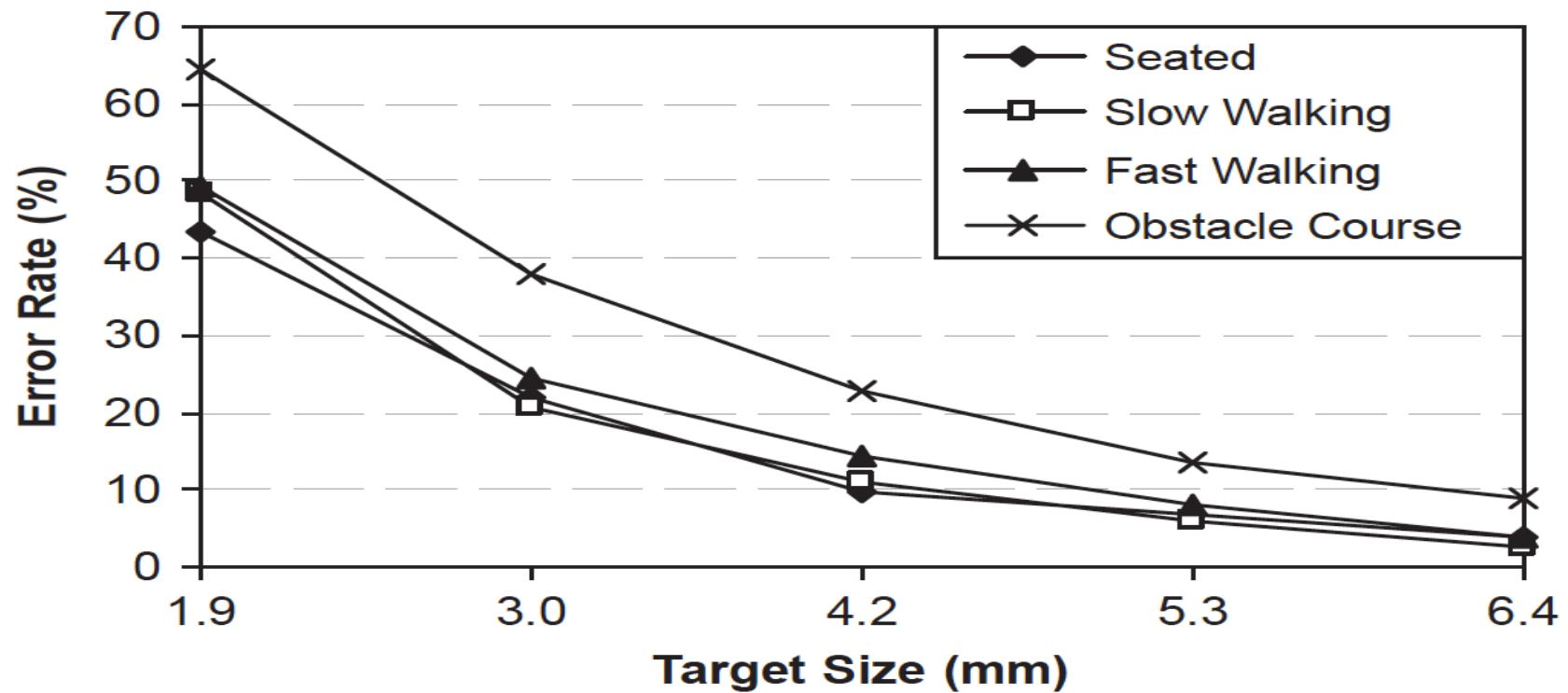
Lin et al. How do people tap when walking? An empirical investigation of nomadic data entry. International Journal of Human-Computer Studies (2007) vol. 65 (9) pp. 759-769

Overall task completion time with standard deviations in parentheses

	Mobility condition			
	Seated	Slow walking	Fast walking	Obstacle course
Task completion time (s)	457.2 (74.2)	448.1 (94.8)	468.3 (82.1)	526.9 (73.7)

Lin et al. How do people tap when walking? An empirical investigation of nomadic data entry. International Journal of Human-Computer Studies (2007) vol. 65 (9) pp. 759-769

Walking + Pointing Performance



Lin et al. How do people tap when walking? An empirical investigation of nomadic data entry. International Journal of Human-Computer Studies (2007) vol. 65 (9) pp. 759-769

Walking + Visual Search and Cognitive Performance

Reading Comprehension

Ratatouille is a dish that has grown in popularity worldwide over the last few years. It features eggplant, zucchini, tomato, peppers, and garlic, chopped, mixed together, sautéed briefly, and finally, cooked slowly over low heat. As the vegetables cook slowly, they make their own broth, which may be extended with a little

The name ratatouille:

Question (2/2)

Ratatouille can best be described as

- French pastry
- sauce to put over vegetables
- pasta dish extended with tomato paste
- vegetable stew

Word Search

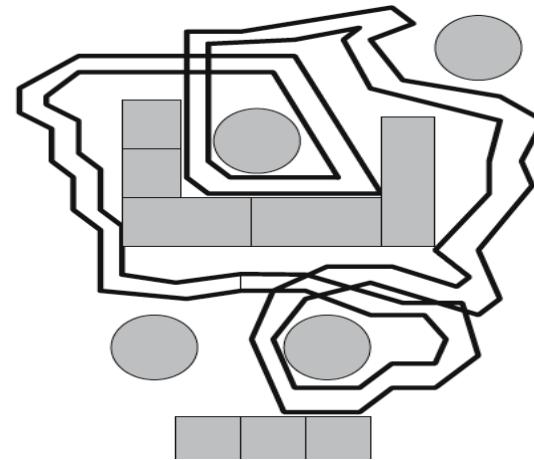
PLANS

The speeding up of plans to deploy an Iraqi army that might relieve some of the pressure on American forces comes against a backdrop of mounting difficulties in Iraq for the Bush administration. Attempts to raise billions of dollars for reconstruction

Barnard et al. Capturing the effects of context on human performance in mobile computing systems. Personal and Ubiquitous Computing (2007) vol. 11 (2) pp. 81-96

Walking + Visual Search and Cognitive Performance

- Conditions:
 - Sitting
 - Obstacle course (self-paced)



Barnard et al. Capturing the effects of context on human performance in mobile computing systems. Personal and Ubiquitous Computing (2007) vol. 11 (2) pp. 81-96

Reading time:

- people were slower when walking compared to sitting

Response time:

- no difference in how quickly people responded to the reading comprehension questions between the two conditions

Correctness of Responses:

- significantly worse in the walking condition

Reading Comprehension

Ratatouille is a dish that has grown in popularity worldwide over the last few years. It features eggplant, zucchini, tomato, peppers, and garlic, chopped, mixed together, sautéed briefly, and finally, cooked slowly over low heat. As the vegetables cook slowly, they make their own broth, which may be extended with a little tomato paste. The name ratatouille comes from

Done

Question (2/2)

Ratatouille can best be described as a

- French pastry
- sauce to put over vegetables
- pasta dish extended with tomato paste
- vegetable stew

Submit

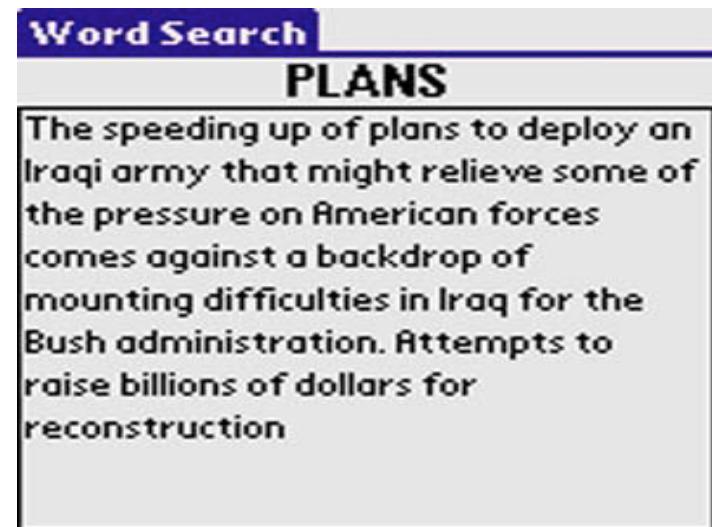
Walking + Visual Search and Cognitive Performance

Time:

- people took longer to tap on the line containing the highlighted word in the walking condition

Error:

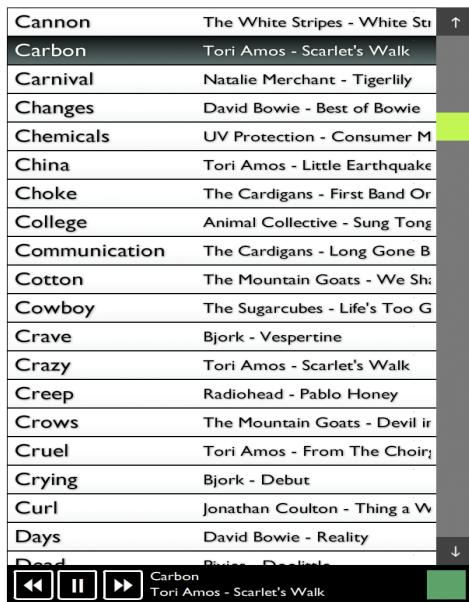
- people made twice as many errors in the walking condition



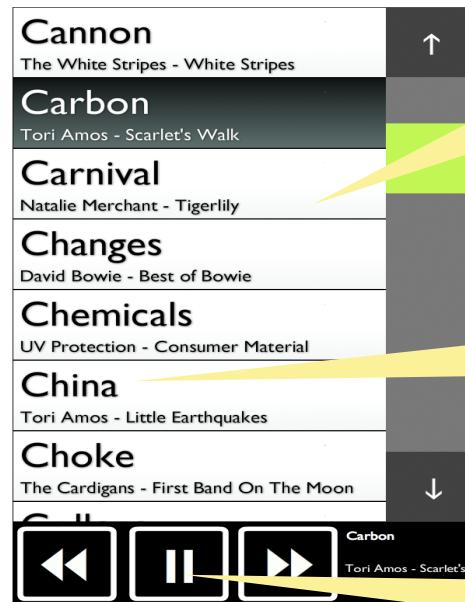
Walking Impairments

- Reduced reading speed
- Reduced reading comprehension
- Higher cognitive load
- Fragmented attention
- Impaired dexterity/coordination

Adapting to Walking



sitting UI



walking UI

Varied saliency of visual elements helps address limited attention

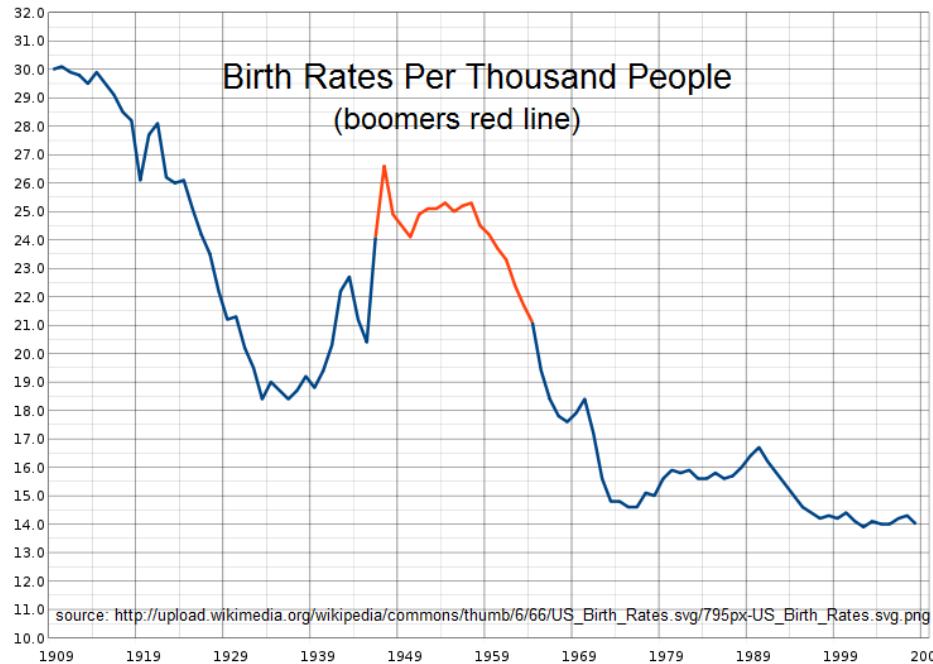
Larger visual cues address reduced reading ability

Larger interactors address impaired dexterity

Kane et al. Getting off the treadmill: evaluating walking user interfaces for mobile devices in public spaces. MobileHCI '08: Proceedings of the 10th international conference on Human computer interaction with mobile devices and services (2008)

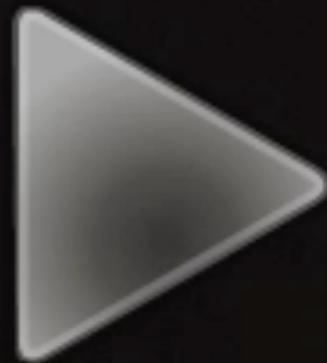
By 2030, nearly 25% of the US population will be over 65

- Compared to 10% of the population in 1991



Affects of aging

- Reduced motor coordination (fine/gross motor skills)
- Visual impairments
- Hearing impairments
- Loss of memory



Resume

The AgeLab at M.I.T.

<http://www.nytimes.com/2011/02/06/business/06aging.html>

Chronic & long-term disabilities

10-20% of population estimated to have a long-term disability

- 3-6 million Canadians
- 30-60 million Americans

Visual

- 1 in 100 have a significant visual disability
- 1 in 475 are legally blind
- 1 in 2000 are totally blind

Hearing

- 1 in 10 have a significant hearing impairment
- 1 in 125 are deaf

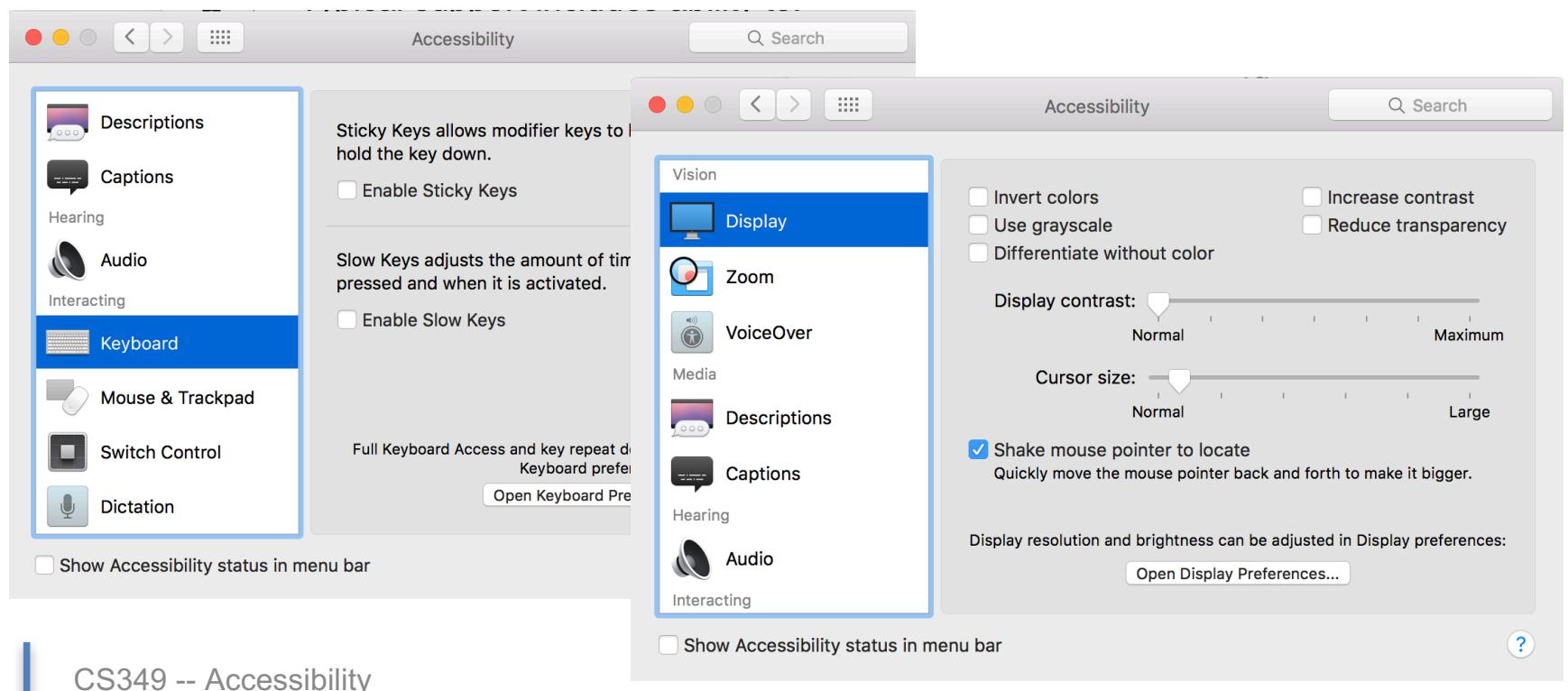
Motor

- 1 in 250 are wheelchair users

Cognitive

Source: Handbook of Human-Computer Interaction,
chapter by Newell & Greg, 1997

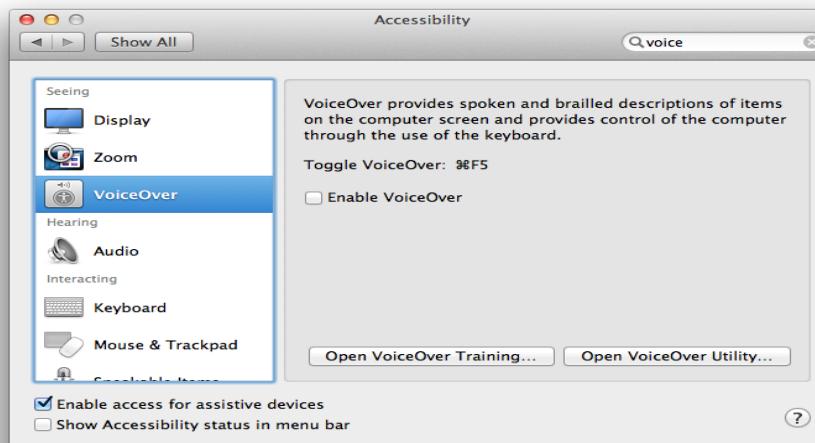
- Full support for a range of accessibility issues. e.g.
 - Control cursor from keyboard (motor)
 - Adjust acceleration, tracking, precision (motor)
 - Speech dictation (visual/motor)
 - Magnify portions of the screen, adjust element sizes or font-size, provide full voice dictation (visual)
 - Captions / subtitles (audial)



screen magnifier

Ctrl +
Ctrl +
Ctrl +
Ctrl +
Ctrl +

braille display



screen reader

[http://www.youtube.com/
watch?v=UzffnbBex6c](http://www.youtube.com/watch?v=UzffnbBex6c)

Visual Impairments

- “How Does a Blind Person Use a Computer?”



<https://www.youtube.com/watch?v=UzffnbBex6c>

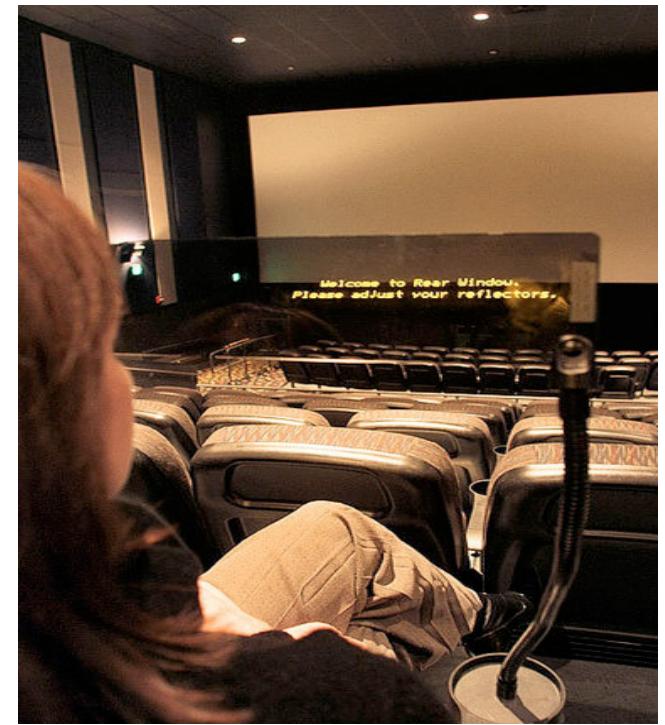
Microsoft's Seeing AI Project



<http://www.pivothead.com/seeingai/>

For Hearing Impairment

<http://www.youtube.com/watch?v=Ik9TILoYaN4#t=46>



More recent version (wireless, works with 3D glasses)

<https://www.cineplex.com/Theatres/ClosedCaption>

Image credit:

<http://videotechnology.blogspot.com/2010/12/rear-window-captioning.html>



Add/Update Shipping Information

We found an error while verifying your shipping address.
We've marked the problem in red for you.

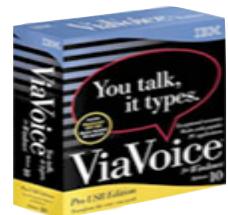
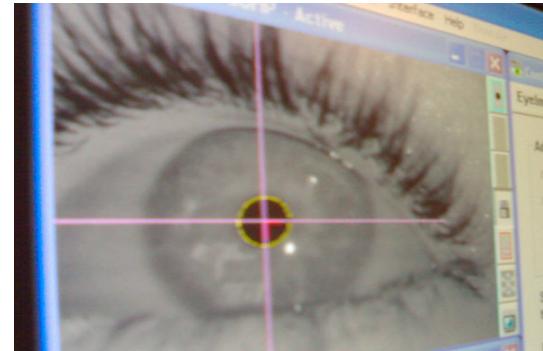
Update the address book of
Required information is marked in GREEN CAPS.
[HELP](#) for questions about shipping.

NICKNAME:	<input type="text" value="MYSELF"/>	
Please assign a "nickname" for the person you're shipping to. You may change or delete this information at any time.		
FIRST NAME:	<input type="text" value="DOUGLAS"/>	MIDDLE INITIAL: <input type="checkbox"/>
LAST NAME:	<input type="text"/>	
ADDRESS:	<input type="text" value="245 SAN JOSE RD"/> <input type="text"/> <input type="text"/>	
(International use only)		
CITY:	<input type="text" value="LOS GATOS"/>	
STATE/PROVINCE:	<input type="text" value="California"/>	
Includes APO and FPO. Use "Other" if country is not USA or Canada.		
ZIP/POSTAL CODE:	<input type="text" value="95333"/>	
COUNTRY:	<input type="text" value="Select a country"/>	
SHIPPING METHOD:	<input checked="" type="radio"/> Standard UPS (2 business days plus)	<input type="radio"/> International: HELP <input checked="" type="radio"/> Canada Canada Post (4-10 business days)

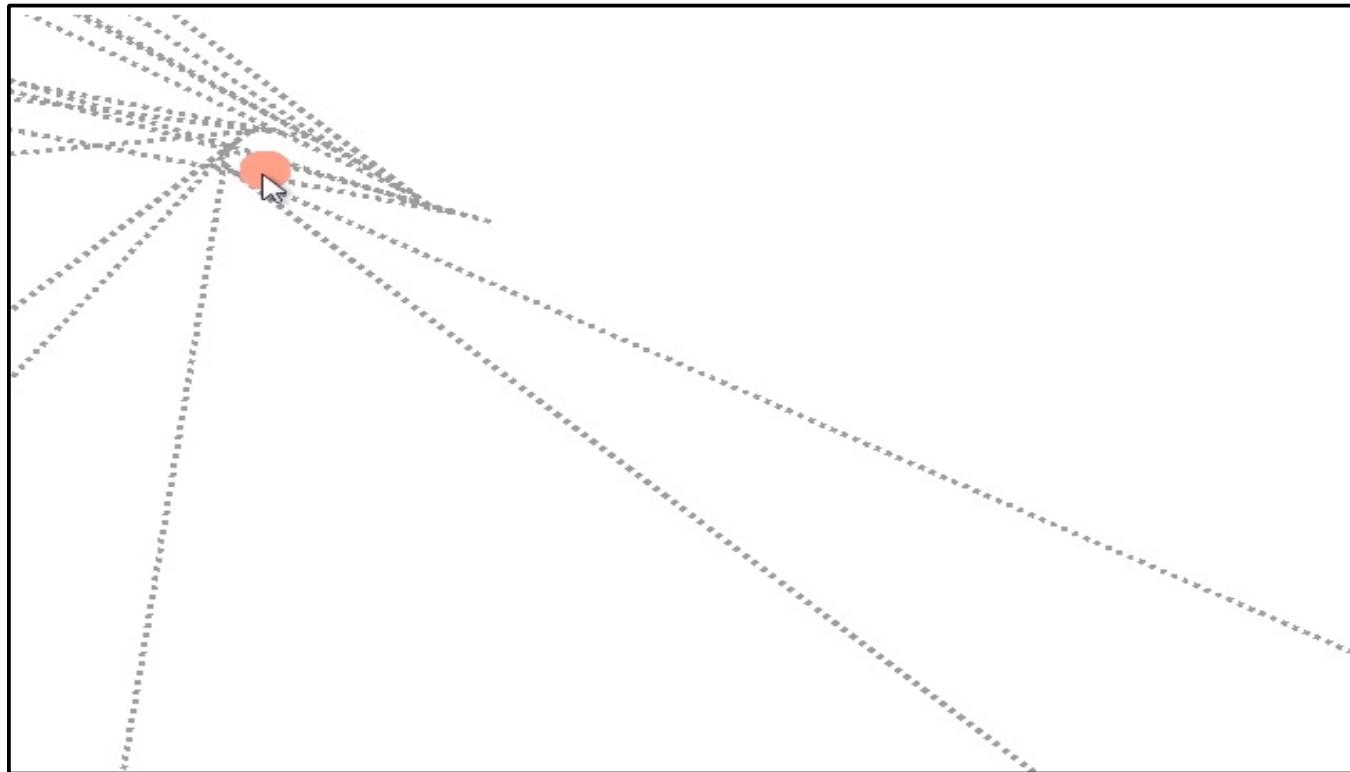
Just... don't do this.

For Motor Impairment

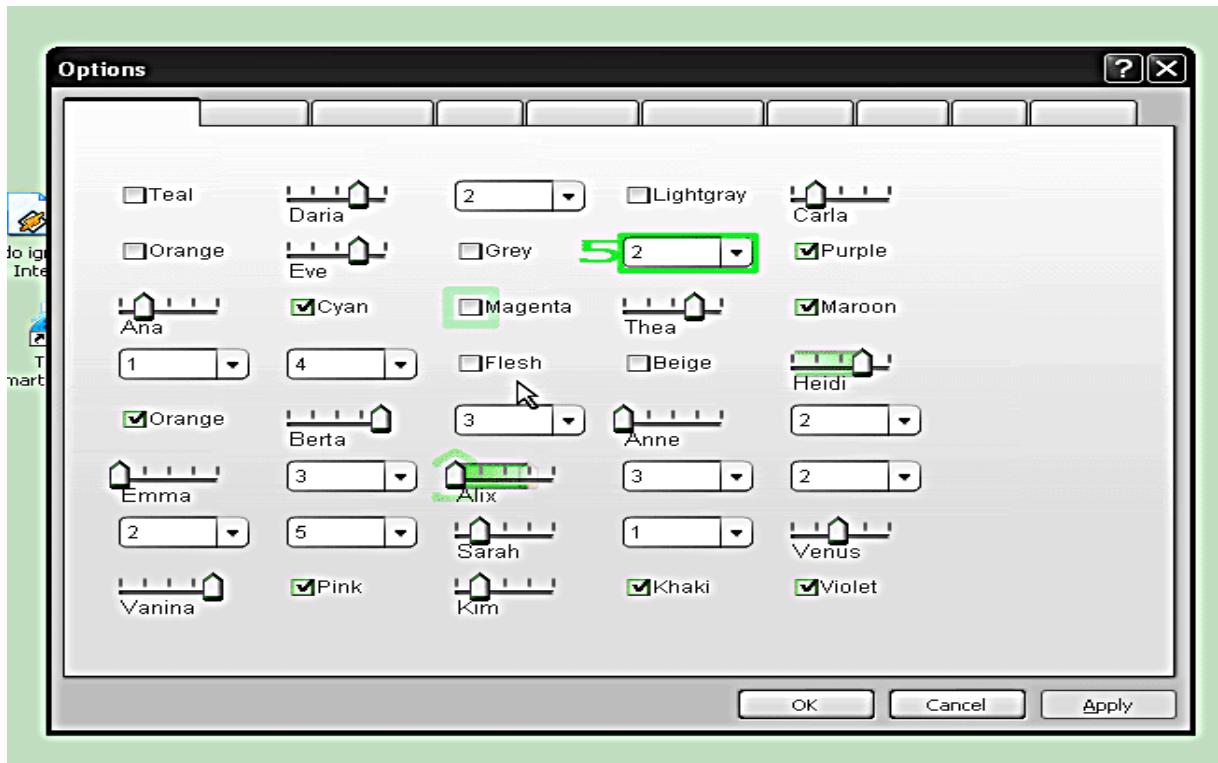
Sticky keys...
Filter keys...
Repeat rate...



- Wobbrock et al. Angle Mouse (2009)
- <http://depts.washington.edu/aimgroup/proj/angle/anglemouse.mov>



The afterglow effects show the most recently performed actions in the UI potentially reducing the load on the working memory (or compensating of its deficiencies).



Baudisch et al. Phosphor: explaining transitions in the user interface using afterglow effects. UIST '06: Proceedings of the 19th annual ACM symposium on User interface software and technology (2006)

We should design technologies to be “inclusive”. Often, these technologies end up benefiting everyone!

The “Curb Cut” Phenomenon



Cassette tapes were developed for a limited-market, and then *widely* adopted because of their portability

- Developed as an alternative to reel-to-reel tape so visually impaired individuals could use books on tape more easily
- Engineers didn't think average user would buy it because of inferior audio quality



Caption decoders for the deaf benefited tens-of-millions more consumers than originally intended:

- Businesses routinely "word-search" and "data mine" video content stored in data warehouses;
- People "listen" to programs, in silence, while someone is sleeping or in noisy environments like sports bars;
- Children learn to read more effectively by displaying words as they are being spoken;
- Adults learn a second language more effectively by displaying words as they are being spoken; and,
- Theatre-goers understand foreign language movies through the use of native language captions;

Source: <http://www.icdri.org/technology/ecceff.htm>

Screen reader and text to speech synthesis originally developed for vision impaired users

- TSI Speech+ (1976) portable calculator for the blind
- Voice assistive technologies like Siri



Web accessibility is essential for equal opportunity.

“The dream behind the Web is of a common information space in which we communicate by sharing information.”

- Tim Berners-Lee

United States' Disabilities and Rehabilitation Acts

- All government facilities, services, and communications must be accessible to individuals with disabilities
- 1998 amendment to Rehabilitation Act, Section 508, explicitly includes access to electronic and information technology
- If you plan on selling software or electronic services to a US government body, it must be accessible to those with disabilities

Canada

- Currently, no federal accessibility legislation pertaining to electronic and information technologies
- Web Standards for the Government of Canada often used
 - <http://www.tbs-sct.gc.ca/ws-nw/index-eng.asp>

Ontario:

- Designated public sector organizations and large organizations shall make their internet websites and web content conform with the World Wide Web Consortium Web Content Accessibility Guidelines (WCAG) 2.0, initially at Level A by January 2014 and increasing to Level AA by January 2021.

Lawsuit over web site accessibility for the blind becomes class action

By [Nate Anderson](#) | Last updated October 3, 2007 1:34 PM

A lawsuit brought in 2006 by a blind student at the University of California-Berkeley has now morphed into a class action case against US retailer Target. A federal judge has just certified a nationwide class in the case, which alleges that Target's web site is not fully accessible to the blind. It's a case that could help establish the ways in which the Americans With Disabilities Act applies to the Internet, and it has already generated a ruling that, in California at least, commercial web sites must be accessible.

The case focuses on the alleged lack of descriptive "alt" tags in Target's HTML, making the site difficult to navigate with screen reading software. The use of image maps is also claimed to make the site inaccessible.

Public locations in the real world have long been required to abide by the ADA, but the law was written in the days before the Web, and it remains unclear how it should be applied to web sites. One of the lawyers from Disability Rights Advocates, which is handling the case, sees inaccessibility as a simple issue of discrimination, online or off.

"Target Corporation has led a battle against blind consumers in a key area of modern life: the Internet economy," said Larry Paradis in a statement after the ruling. "The court's decision today makes clear that people with disabilities no longer can be treated as second-class citizens in any sphere of mainstream life."

In addition to certifying the case as a national class action under the ADA, Judge Marilyn Hall Patel ruled that two California statutes also apply: the California Unruh Civil Rights Act and the California Disabled Persons Act. Whatever happens on a national level, a separate class of Californians has also been



The image shows a composite of several elements related to the Olympic and Paralympic games. At the top left is the classic five-ring Olympic logo. To its right is a wide-angle shot of a stadium at night, with a large digital screen on the left displaying the French slogan "La nature Nature la réinvente". To the right of the stadium is the Rio 2016 Paralympic Games logo, which features two stylized, colorful human figures. Below these images is a screenshot of the official Rio 2016 website. The website has a white header with the Olympic rings and the Rio 2016 Paralympic Games logos. It includes links for "TAKE PART", "THE GAMES", "RIO DE JANEIRO", "TICKETS", "MASCOTS", "NEWS", and "MORE". The main content area is titled "Accessibility" in large blue text. Below this title is a section titled "What is accessibility?" with a detailed explanation of web accessibility standards. Further down is a section titled "Accessibility features of the Rio 2016™" with a list of specific features implemented on the site. At the bottom of the website screenshot, there are social media sharing icons for Facebook, Google+, and Twitter.

La nature Nature la réinvente

Rio 2016 Paralympic Games

Accessibility

What is accessibility?

Accessibility features of the Rio 2016™

The Rio 2016™ Olympic and Paralympic Games Site was developed with features designed to facilitate access for people with special needs.

- Modals (images or texts that appear overlaid on site content) and Flash contents are not used, due to certain characteristics that make it impossible for the visually impaired to access part of their content.
- Keyboard navigation via shortcut keys, so that users do not need to search for navigational buttons on the screen, and may focus only on the information.
- The invisible menu is the first navigation item for people with disabilities, enabling them to scroll through the pages in a more objective manner, directing them to the top areas, menu, and footer.
- All images are followed by a description, ensuring full understanding of what is portrayed.
- The font increase feature on internal content pages helps the portal adapting to the needs of every visitor.

Accessibility Testing Tools

The screenshot shows the WAVE web accessibility evaluation tool interface. On the left, the 'Summary' panel indicates 0 Errors, 9 Alerts, 41 Features, 33 Structural Elements, 2 HTML5 and ARIA, and 11 Contrast Errors. The main content area displays the University of Waterloo homepage with an ARIA-LABEL="UNIVERSITY NAVIGATION" banner. The page features a large image of a woman's profile and text about a campus vigil. A green navigation bar at the bottom includes icons for 'alt', '?', and 'alt' again.

WAVE web accessibility evaluation tool

uwaterloo.ca

Styles No Styles Contrast

Summary

WAVE has detected the following:

- 0 Errors
- 9 Alerts
- 41 Features
- 33 Structural Elements
- 2 HTML5 and ARIA
- 11 Contrast Errors

Panel Options

- DETAILS: A listing of all the WAVE icons in your page.
- DOCUMENTATION: Explanation of the WAVE icons and how you can make your page more accessible.
- OUTLINE: The heading structure of the web page.

UNIVERSITY OF
WATERLOO

*ARIA-LABEL="UNIVERSITY NAVIGATION"

ABOUT WATERLOO | FACULTIES & ACADEMICS | OFFICES & S

Campus vigil marks 26th anniversary of Montreal Massacre

National Day of Remembrance and Action on Violence Against Women invites Canadians to reflect on ways to end violence against all women and girls

h2 LEARN AD

innovations

<http://wave.webaim.org/report#/uwaterloo.ca>

It is important to design user interfaces to be not only usable, but accessible, such that the technology can reach more people, and have an impact across more situations.