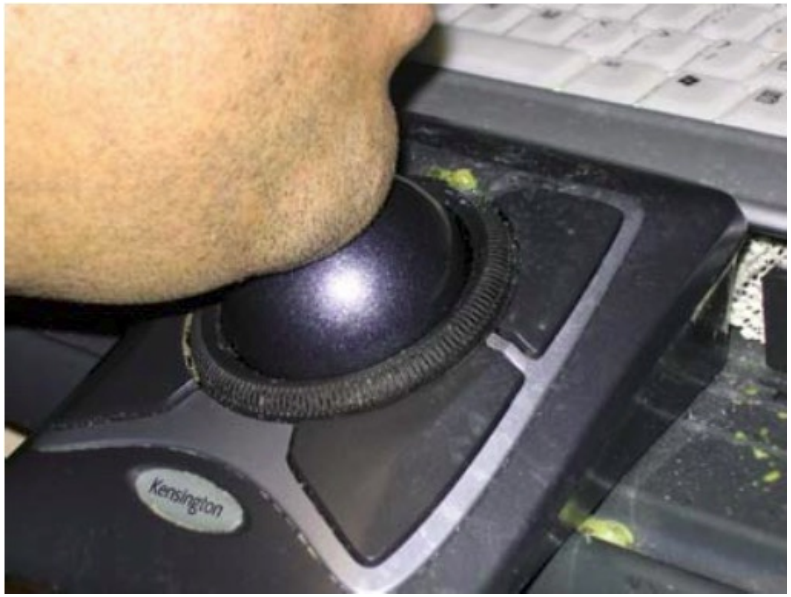
Ability-based design

An overview

Jacob O. Wobbrock, Ph.D.
wobbrock@uw.edu
@wobbrockjo



Ability assumptions

All human-operated technologies contain embedded "ability assumptions," whether explicit or implicit.

Consider a touch screen.

What are the assumed abilities?

(There may be more than you think…)

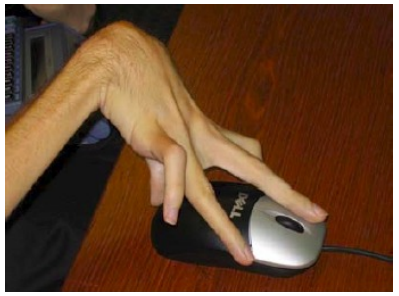
	NGL	▼1.31	6.35	2,106
BRISTOW GROUP IN	BRS	▼2.01	12.74	1,269

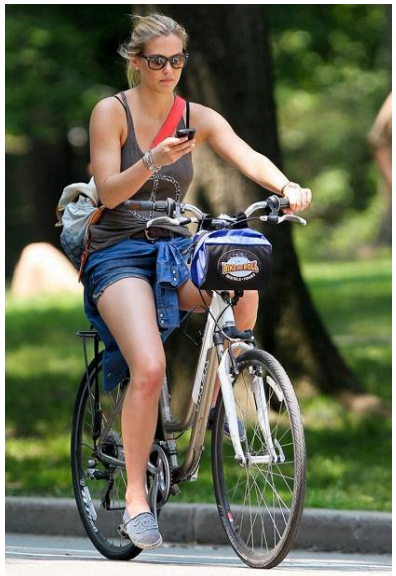
Oblivious systems

Not everyone has the assumed abilities to operate a given interactive system.

Even when people do, not all situations allow them to exercise their abilities. We call these "situational impairments."

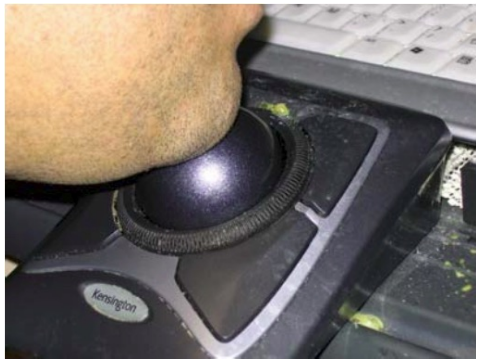
Most interactive systems have no idea about people's abilities or the situations people are in.





The burden of adaptation

Today, the burden is on the user to adapt him- or herself to the ability-demands of interactive systems.



Interactive systems usually have no idea the user is having to do this.

How can we move the burden of adaptation from the user to the system to take advantage of whatever abilities a user *does* have?

http://www.standard.co.uk/

Ability-based design (Wobbrock et al. 2011, 2014)

A design approach in which the human abilities required to operate an interactive system are questioned, and systems are made operable by and adaptable to alternative abilities.

Principles (Wobbrock 2014)

	Principle	Description
Stance (required)	1. Ability	Designers will focus on users' abilities, not *dis*-abilities, striving to leverage all that users *can* do in a given situation, context, or environment.
	2. Accountability	Designers will respond to poor performance by changing systems, not users, leaving users as they are.
Interface (optional)	3. Adaptation	Interfaces may be adaptive or adaptable to provide the best possible match to users' abilities.
	4. Transparency	Interfaces may give users awareness of adaptive behaviors and what governs them, and the means to inspect, override, discard, revert, store, retrieve, preview, alter, or test those behaviors.
System (optional)	5. Performance	Systems may monitor, measure, model, display, predict, or otherwise utilize users' performance to provide the best possible match between systems and users' abilities.
	6. Context	Systems may sense, measure, model, portray, or otherwise utilize context, situation, or environment to anticipate and accommodate effects on users' abilities.
	7. Commodity	Systems may comprise low-cost, inexpensive, readily available commodity software, hardware, or other materials that users have the ability to procure.

Comparison

Ability-based design

- Focus on abilities of a user
- Focus on what one person can do
- $\lim_{n\to\infty}$ Design for one
- Runtime adaptation
- Sense, model, adapt
- Usually dynamic

Universal design

- Focus on accessibility of environment
- Focus on what most people can do
- $\lim_{n\to\infty}$ Design for all
- Design-time accommodation
- Understand, design, test, deploy
- Usually fixed

Some projects

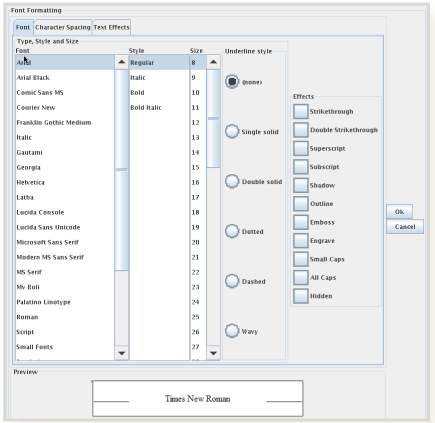
Supple (UIST '07, CHI '08)

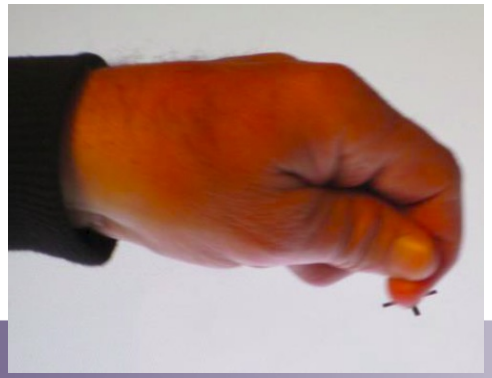
Angle Mouse (CHI '09)

Walking UIs (MobileHCI '08)

Slide Rule (ASSETS '08)

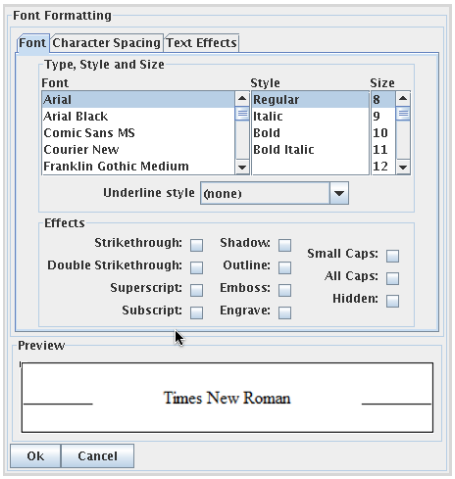
Smart Touch (CHI '16)



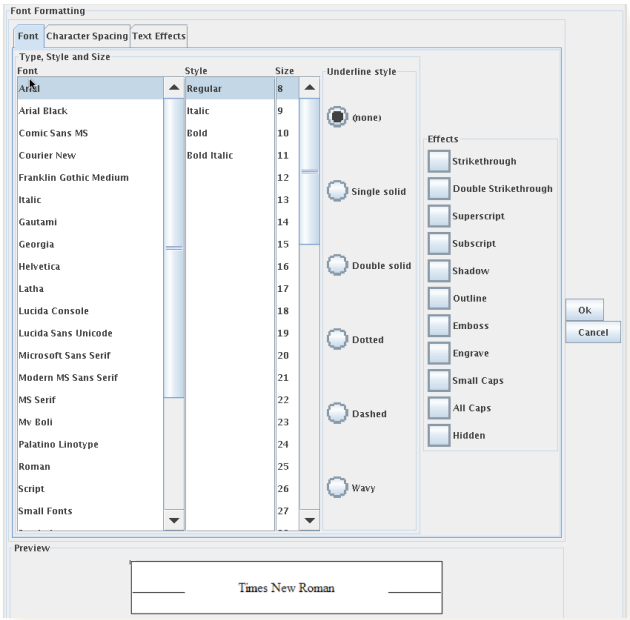


Supple (Gajos, Wobbrock & Weld 2007, 2008)

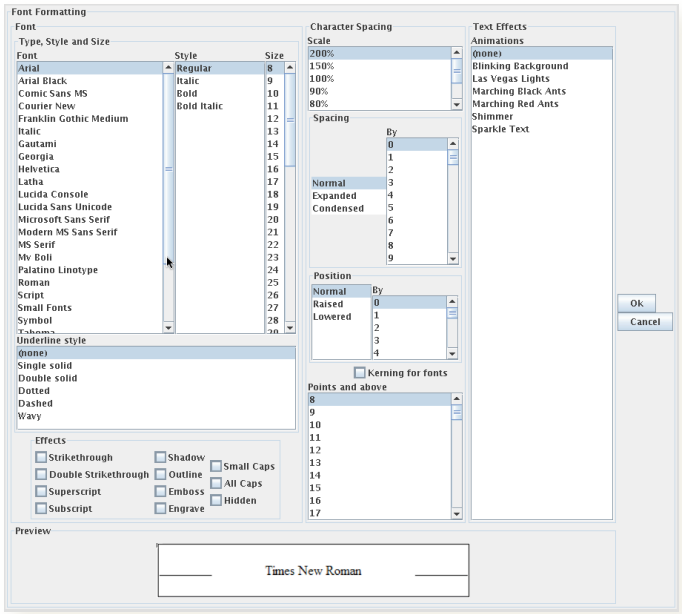
Automatically adapt user interface designs to a user's mouse pointing abilities.



Microsoft Word font dialog



For someone with Cerebral Palsy

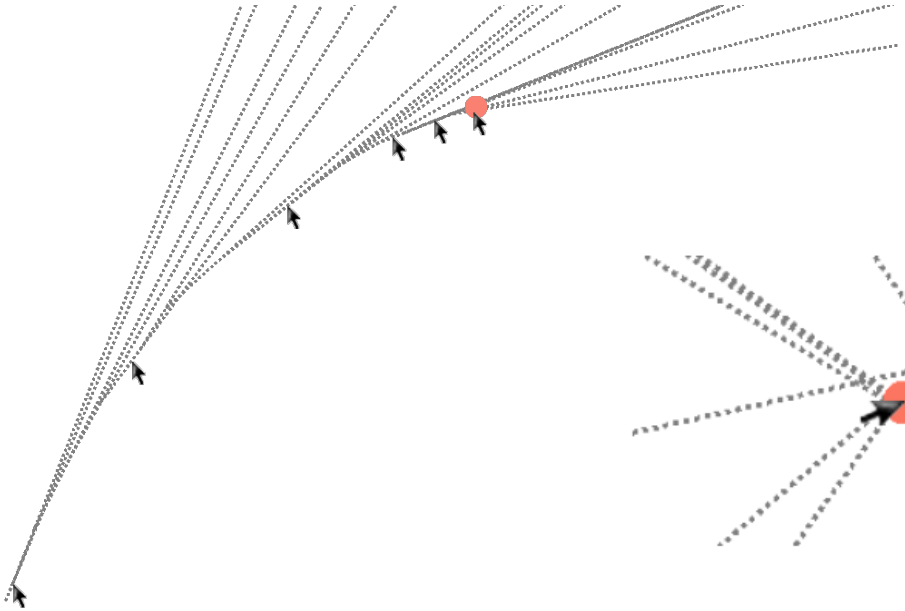


For someone with Muscular Dystrophy

https://www.youtube.com/watch?v=B63whNtp4qc

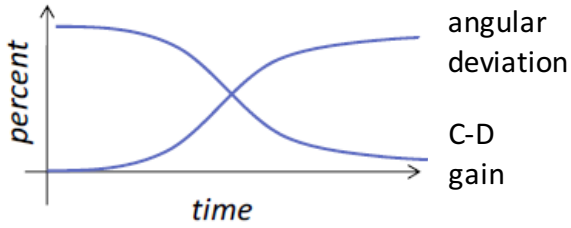
Angle Mouse (Wobbrock, Fogarty, Liu, Kimuro, Harada 2009)

Automatically adapt the mouse control-display gain to make targets bigger in motor-space, making them easier to click on for people with poor motor control.



Continuously observe the spread of angles during movement

Angles diverge with difficulty acquiring targets



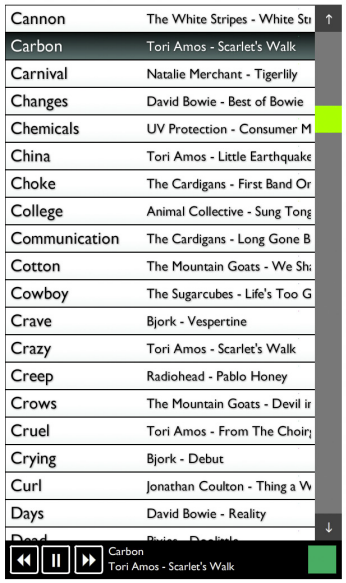
Adapt mouse C-D gain in response

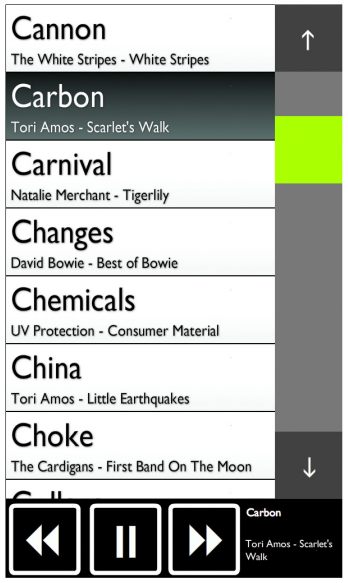
https://www.youtube.com/watch?v=O4ahGmHenps

Walking UIs (Kane, Wobbrock & Smith 2008)

Automatically adapt the amount of detail shown on a mobile device screen based on whether the user is walking or standing still.

Use sensors to detect standing versus walking





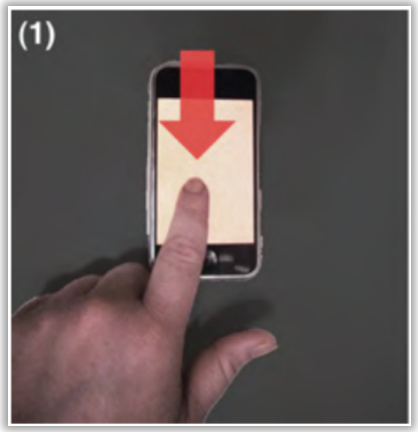
Adapt level of detail (fonts, target sizes, etc.) to improve usability

Slide Rule (Kane, Bigham & Wobbrock 2008)

Enable touch-based screen reading with a fingertip and target selection with a second-finger tap for blind people. Apple incorporated into VoiceOver for iOS.

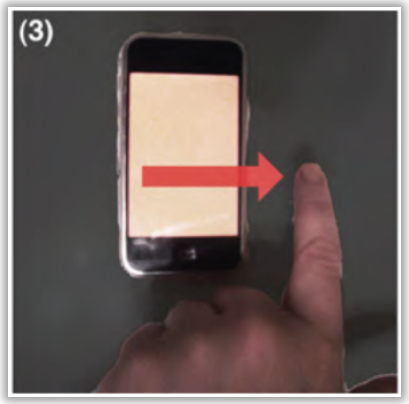
- *Split-tap:* As an alternative to selecting an item and double-tapping to activate it, touch and hold an item with one finger, then tap the screen with another.

— "Learn VoiceOver gestures" by Apple
http://help.apple.com/ipod-touch/9/#/iph3e2e2281



Index finger "reads the screen"

Middle finger taps anywhere to trigger reading-finger target



Flick gestures for targetless navigation

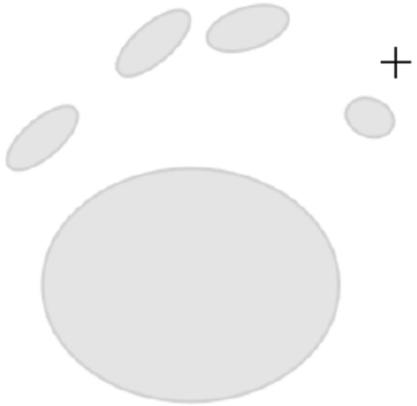
L-gesture to navigate hierarchies

https://www.youtube.com/watch?v=496IAx6_xys

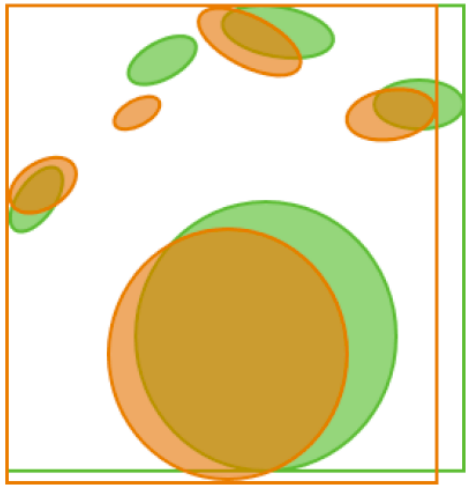
Smart Touch (Mott, Vatavu, Kane & Wobbrock 2016)

Model however people with motor impairments touch interactive tabletops, and then disambiguate that touch at runtime to resolve intended targets.

Collect samples of touch however the user wants



Create and store a model of that touch



Resolve ambiguity at runtime via pattern matching

Next steps?

- Examples of ability-based design for sensory impairments? cognitive impairments? learning abilities?
- Ways of inferring ability "in the wild"?
- "Sensors" for situational impairments?
- Generalized and reusable "ability profiles"?
- Architectural / OS-level possibilities?
- Other ideas?

Thank you

Jacob O. Wobbrock
The Information School
University of Washington

wobbrock@uw.edu
@wobbrockjo

(updated 2/17/2016)