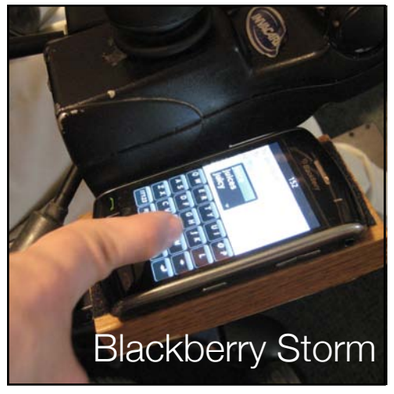
Touchscreens & customers with disabilities:

a comparative field study of three smartphones



wireless RERC

2009

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Wireless RERC

Rehabilitation Engineering Research Center for Wireless Technologies

promoting equitable access to & use of wireless technologies by people with disabilities and encouraging adoption of universal design in future generations of wireless devices & applications

wireless RERC

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About us

The Wireless RERC was established in 2001 by the US Department of Education as one of 22 funded Centers.

Collectively, the Centers address the

- **Communication**,
- **Transportation**,
- **Prosthetics** &
- **Wireless**

needs of individuals with

- **Cognitive**,
- **Manual** &
- **Sensory** limitations.

The Wireless RERC is headquartered at the **Shepherd Center** in Atlanta, Georgia, in partnership with the **Georgia Institute of Technology**.

SHEPHERD CENTER
A Catastrophic Care Hospital

Georgia Institute of Technology

Our work

The Wireless RERC conducts:

Research projects focusing on:

- User needs
- Usability testing
- Public policy
- Advanced auditory interfaces

Development projects focusing on:

- Location-based information services
- Emergency communications & assistance

Training projects focusing on:

- Industry professionals
- Consumers
- Future researchers
- State of technology conference

Wireless RERC established & maintains a

Consumer Advisory Network (CAN)

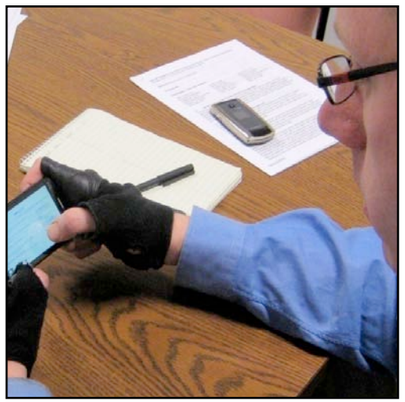
The CAN represents the diversity in age & abilities among current & potential users of mobile wireless products & services.

Who are our CAN members?

- Over **925 Americans** ages 18+
- Individuals with **diverse cognitive**, **manual**, and/or **Sensory limitations**
- **84% currently use wireless technologies**

Meet the Testers

5 male & 8 female CAN members
26-83 years of age with diverse abilities.

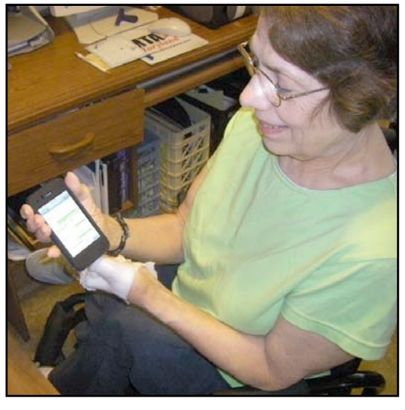


Matt, 31

- Manual limitations
- Works full-time
- Verizon customer
- Uses Samsung Gleam

Chris, 40

- Manual limitations
- Works full-time
- Verizon customer
- Uses Motorola Silver L7c



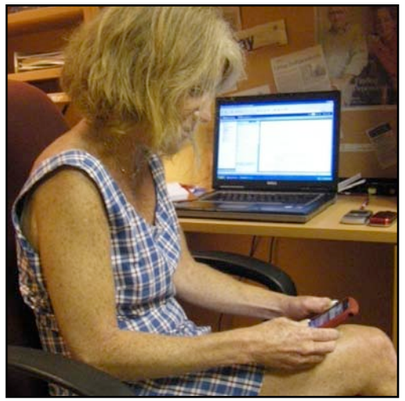
Connie, 68

- Manual limitations
- Visual limitations
- Retired
- AT&T customer
- Uses Nokia 2610

Rachel, 28

- Legally blind
- Works full-time
- Verizon customer
- Uses Blackberry Curve

Meet the Testers



Elise, 44

- Cognitive limitations
- Works full-time
- T-Mobile customer
- Uses Motorola RAZR

Diane, 49

- Visual limitations
- Part-time volunteer worker
- Not currently wireless user

Nick, 26

- Legally blind
- Works full-time
- Verizon customer
- Uses LG Dare

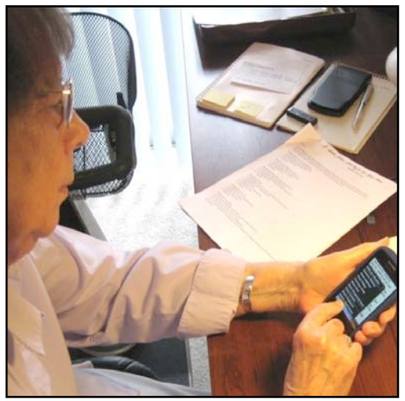
Mike, 51

- Manual limitations
- Works full-time
- Verizon customer
- Uses LG VX 5300

Roxanne, 51

- Visual limitations
- Works full-time
- AT&T customer
- Uses Nokia 6201

Meet the Testers



Marjorie, 83

- Cognitive limitations
- Manual limitations
- Visual limitations
- Retired
- Uses Jitterbug

Janine, 37

- Cognitive limitations
- Visual limitations
- Graduate student
- Sprint customer
- Uses Motorola RAZR

John, 62

- Manual limitations
- Works full-time
- Verizon customer
- Uses Samsung Instinct

Deb, 41

- Cognitive limitations
- Manual limitations
- Visual limitations
- Verizon customer
- Uses Motorola flip phone

Meet the

Devices

Three current smartphones with **touchscreen interfaces** recommended by industry partners

"Courtesy of Apple "

Apple iPhone 3G

- Capacitive touchscreen
- Manufacturer: Apple, Inc.
- Network: AT&T

"Courtesy of RIM Blackberry "

Blackberry Storm 9530

- Capacitive “ClickThrough” touchscreen
- Manufacturer: RIM
- Network: Verizon

"Courtesy of HTC "

HTC Touch HD

- Resistive touchscreen with stylus
- Manufacturer: HTC Corporation
- Network: AT&T

Methodology

- **Random sequencing** of devices
- **Orientation session** involving a “sit-by” demo & initial assessment
- **Field testing** per tester’s schedule
- **Debriefing session** involving a re-assessment & interview

Operations & applications evaluated

- **Power on/off & home screen**
- **Settings**
- **Directory/phone book**
- **Calendar**
- **Voice communication**
- **Text entry**
- **Internet browsing**

Data gathered

What was assessed?

Cognitive interactions

- Understanding & intelligibility

Manual interactions

- Target activation
- Scrolling & flicking
- Sliding & dragging
- Sizing

Visual interactions

- Target identification
- Seeing & reading
- Legibility & eyestrain

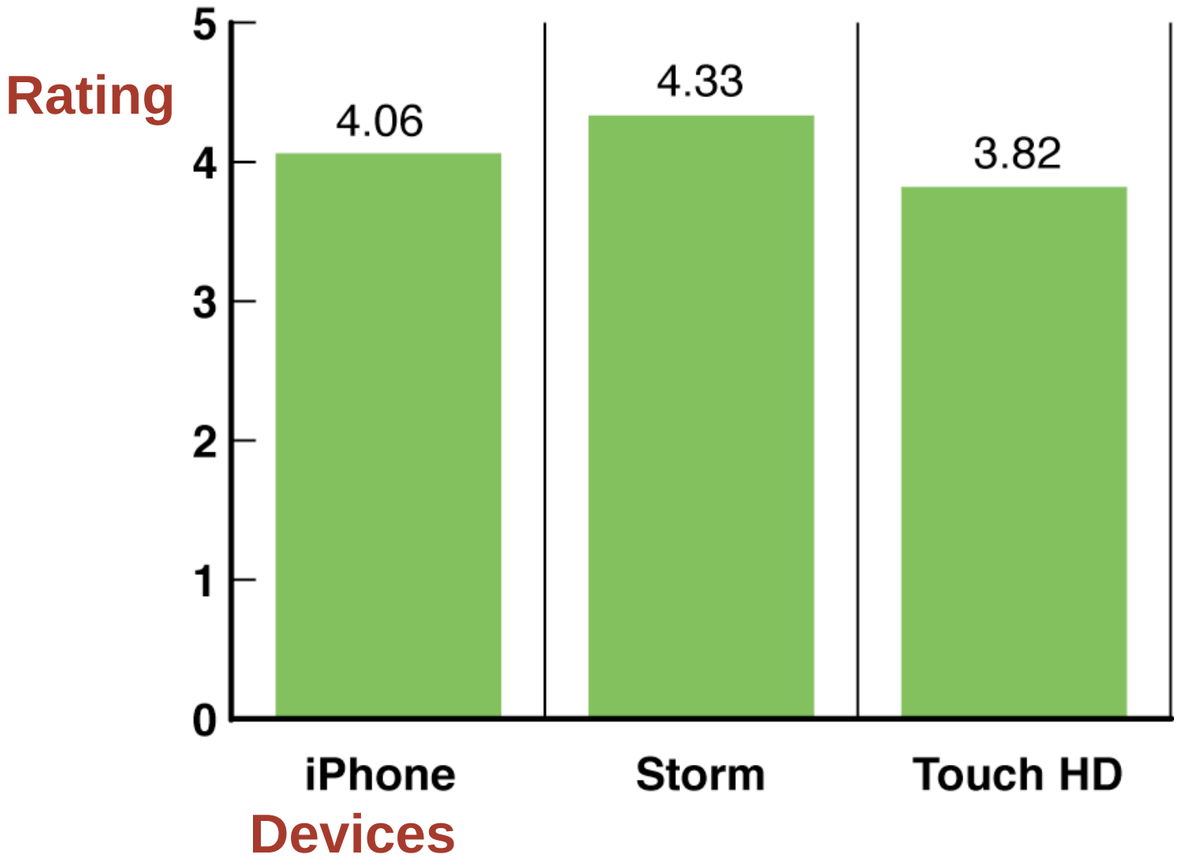
For each operation & application, testers were asked to give **usability ratings** from 1 - 5 (1 = very difficult, 5 = very easy) for **cognitive**, **manual** and/or **visual interactions**.Testers were also invited to **add comments** describing their **experience**.

Strengths & **weaknesses** of each device were discovered along with **preferences** per functional limitation

Findings

Cognitive interface

Usability ratings



Findings

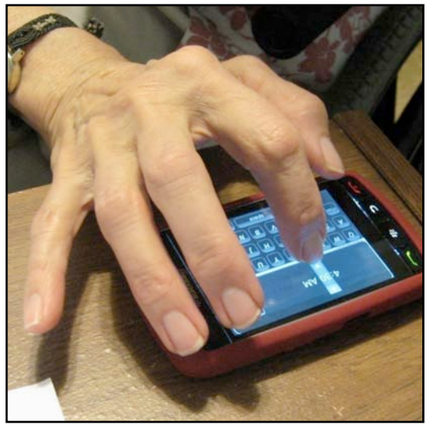
Cognitive interface

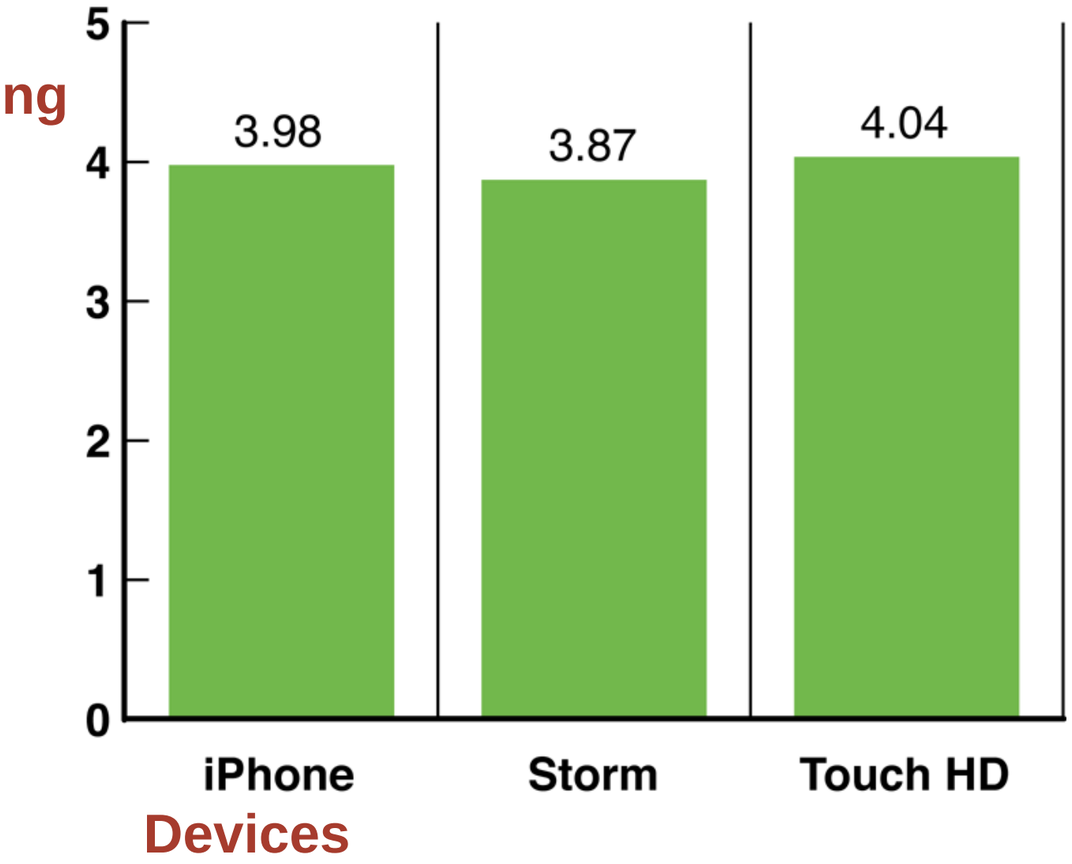
	Apple **iPhone 3G**	Blackberry **Storm 9530**	HTC **Touch HD**
+	• Graphics clear & well-differentiated • Intuitive processes (e.g., “slot machine” calendar) • One-button return to home screen	• Blue highlight confirms choice before input • Tactile & auditory feedback to most inputs • SureType has powerful word predictor • Familiar icons & use of color	• Visual (flashing) feedback with key selection
–	• Confusing terms (e.g., Safari, SMS)	• Spontaneous re-orientation from landscape to portrait	• Limited use of color for communication • Spontaneous re-orientation from landscape to portrait • Task sequences non-intuitive (e.g., answering call, changing settings) • Repeated screen blackouts

Findings

Manual interface

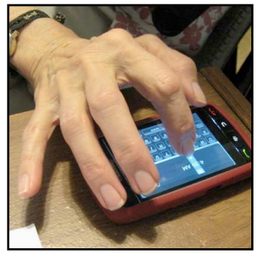
Usability ratings





Findings

Manual interface

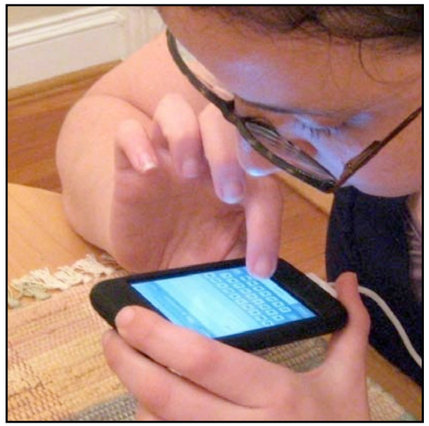


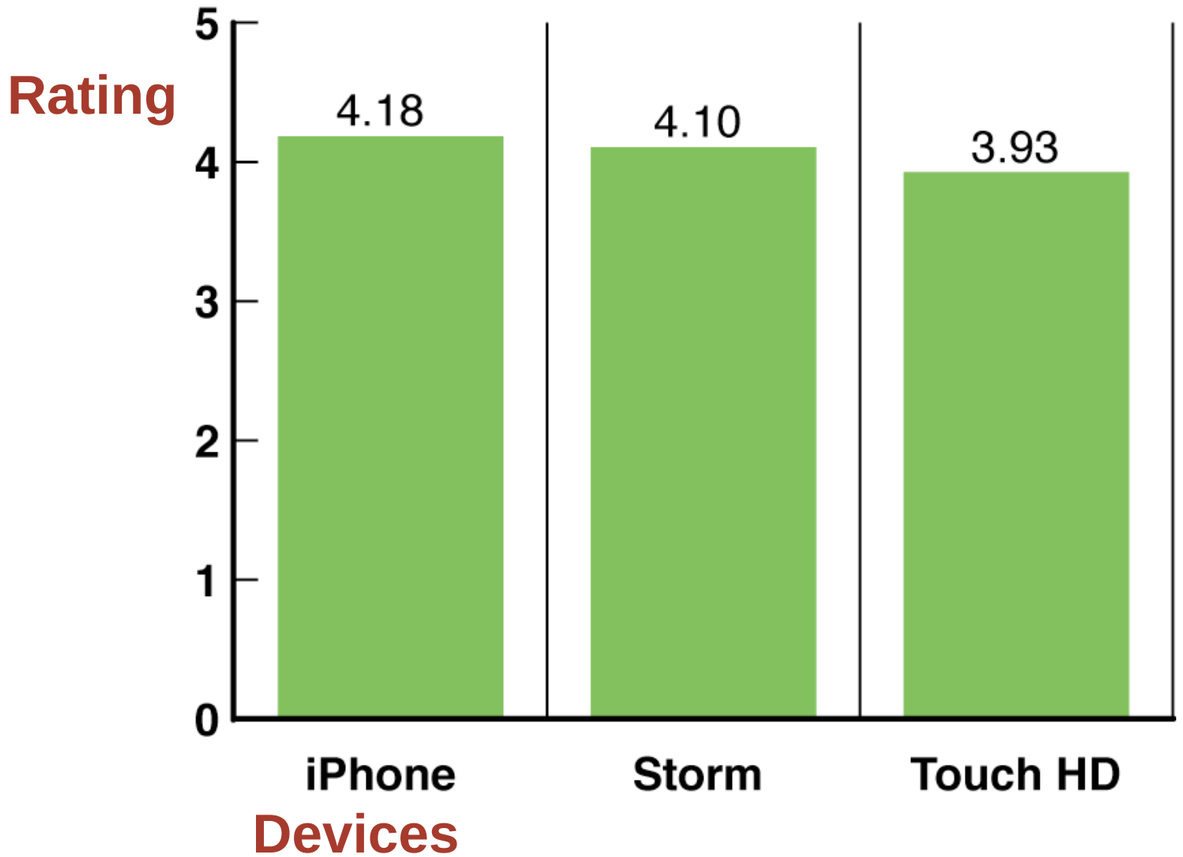
	Apple **iPhone 3G**	Blackberry **Storm 9530**	HTC **Touch HD**
+	• Positive initial experience (“slide to unlock”) • Superior, intelligent response to touch (e.g., “slot machine” calendar) • One button return to home screen	• Blue highlight confirms selection before activation • Resistance of touchscreen prevents multiple inputs	• Responsiveness to stylus, fingernail & knuckle • “Slider” controls require only tap vs. press + slide
–	• Glitchy slider controls for brightness & volume • Touch response seemed to vary among applications	• Substantial effort required for input, causing slips & errors • Text errors easy to make & difficult to correct	• Difficulty using stylus for swiping & dragging • Inefficient use of screen space makes choices small

Findings

Visual interface

Usability ratings





Findings

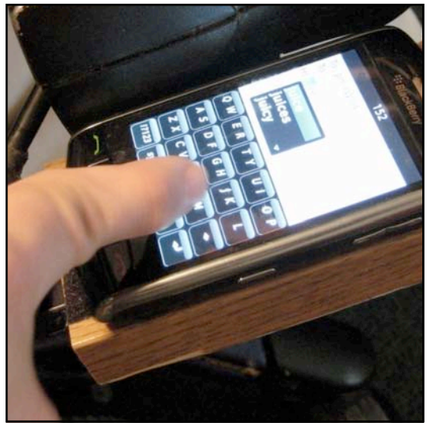
Visual interface

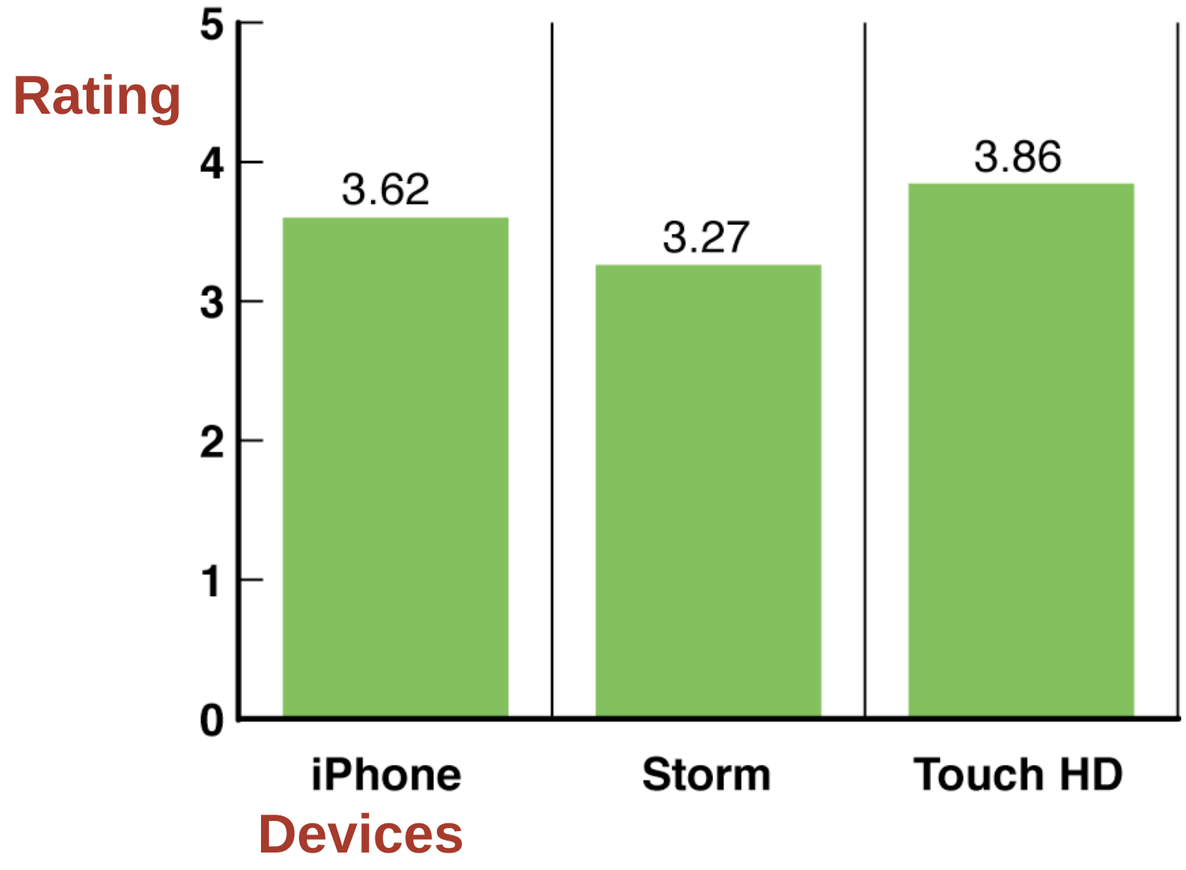
	Apple **iPhone 3G**	Blackberry **Storm 9530**	HTC **Touch HD**
+	• Strong graphics & colors aid comprehension • Browser allows extreme zoom for web page magnification	• Blue highlight emphasizes choice • Choice of enlarged font works across most applications	• Visual (flashing) feedback with key selection • Use of stylus maximizes view of screen
–	• Fingers obstruct view of screen • Some icons & labels very small (e.g., battery charge)	• Reversing screen contrast only partially useful • Fingers obstruct view of screen • Lock button very difficult to locate	• Limited use of color • “Backspace” & “Return” icons easily confused • Linear display of applications prevents seeing all on one screen

Findings

Specific to text entry

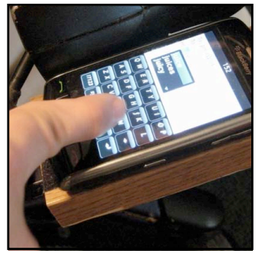
Usability ratings





Findings

Specific to text entry



	Apple **iPhone 3G**	Blackberry **Storm 9530**	HTC **Touch HD**
+	• QWERTY keys “pop up”, enlarge & click when pressed	• SureType keyboard has largest keys • QWERTY keyboard in landscape mode easiest to see	• Keyboard usable with stylus, fingernail & knuckle • Stylus allows unobstructed view of keyboard
–	• Keyboard available in portrait format only during testing, recent software update resolved this issue	• Difficult text correction offsets effective word prediction • Excessive pressure required for key input causes fatigue • Correcting text errors easiest by backspacing to error, eliminating correct text as well	• Selection of enlarged font doesn’t apply to text display • Second-tier keyboard very hard to see

Findings

Specific to Internet browsing

For most testers, internet browsing proved the most challenging task. Some were unable or too frustrated to complete it. Although this yielded insufficient usability ratings data, useful observations were gained across the three devices.

Observations

- Experience with internet browsing via desktop computer exacerbated confusion & frustration (e.g., unfamiliar navigation techniques & unfamiliar appearance of familiar web pages).
- Lags in response to user input causes frustration & confusion; prominent “hourglass” or other familiar icon, plus audio feedback would assure that device is responding.
- Double-tap method of web page enlargement sometimes results in unintended selection (compounded by lag time, resulting in multiple inputs).
- Because mobile browsing is so functionally challenging, service interruptions are especially frustrating to customers with disabilities.

Opportunities for success

- **Successful initial experiences** encourage novice users (e.g., iPhone's “swipe to unlock” following power-on).
- Since usability suffers without successful **initial setup** (e.g., choosing fonts), **ease of completing this operation is critical**.
- **Handset skins** have considerable potential in enhancing usability (e.g., securing grip & adding stability on surfaces, tactile locators for exterior controls).
- The apparent advantages of **resistive touchscreens** (e.g., HTC Touch HD) for users with significant manual limitations should be considered as touchscreen development continues.

Next steps

- Share findings with consumers and industry through **MyWirelessReview.com**.
- **Promote** application of **findings** through **industry** site visits.
- **Share** findings **with designers & developers** through Industrial Designers Society of America.
- **Collaborate with industry partners** on user testing of future wireless products and services.