

KPR Koester Performance Research

Does Clear Evidence yield Better Solutions?

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Introduction – Heidi Koester, Ph.D.

- President of Koester Performance Research (KPR)
- Previously: Rehabilitation Engineering at University of Michigan Health System
- Sc.B. Biomedical Engineering- Brown University
- M.A. Psychology – University of Michigan
- Ph.D. Bioengineering – University of Michigan

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Introduction – KPR's Mission


- Improve the way we design and deliver assistive technology
- Specifically in the area of computer interfaces for people with physical impairments
- Foundational belief is that **clear evidence leads to better solutions**

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Today's Topic

- Improving physical access to computing and AAC devices through the use of evidence
- Why?
- How?



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Introduction – Define “Access”

- Assistive technology that supports physical access to computing and AAC devices, accommodating a user's physical movement challenges
- Most applicable to individuals who have difficulty using a typical keyboard and mouse
- Address needs for Text Entry and Target Selection

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Introduction – Define “Evidence”

- An indication which shows that something exists or is true
- Your basis for belief or disbelief; knowledge on which to base belief
- Evidence-based Practice: “the conscientious, explicit, and judicious use of current best evidence in making decisions”



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Types of Evidence

- Observation
- User Feedback
- **Measurement**



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Overview of Today’s Talk

- **Why bother**
- **Research evidence:** from the literature
- **Client evidence:** direct measurement
 - Tools
 - Role in the service delivery process
 - Examples

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Why bother



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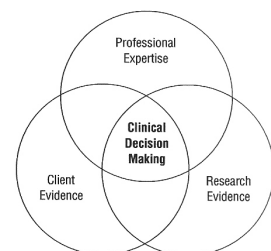
Roles for Measurement in AT Practice

- Setting goals
 - Identifying needs
 - Justifying areas of work
- Getting funding support
- Choosing methods and techniques
- Optimizing configuration
- Tracking progress
- Measuring outcomes

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Evidence Based Practice

- Client Evidence
- Research Evidence
- Professional Expertise
- Integration
- Clinical Decision Making



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Research Evidence for Text Entry

- Review available literature on text entry methods for people with disabilities
 - Understand typing speeds achieved with various interfaces and various impairments
 - Implications for practice and research

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Systematic Review

- Studies with words/minute data for people with physical impairments
- 39 studies, dating back to 1986
- More details in:
 - Koester & Arthanat (2017). Text entry rate of access interfaces used by people with physical disabilities: a systematic review. *Assistive Technology*.
 - Koester & Arthanat (2017). Effect of diagnosis, body site, and experience on text entry rate of individuals with physical disabilities: a systematic review. *Disability & Rehabilitation: Assistive Technology*.

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Results by Interface

Interface	N	Mean	SD	95% CI	Min	Max
Speech recognition	50	15.42	9.99	[12.65, 18.19]	3.5	32.2
Standard keyboard	164	12.47	8.9	[11.11, 13.83]	1.2	48
2-switch Morse	1	12.39	-	-	-	-
1-switch Morse	1	4.88	-	-	-	-
Cursor selection OSK	52	4.24	2.82	[3.47, 5.01]	0.6	11.82
Scanning selection OSK	34	1.67	1.22	[1.26, 2.08]	0.51	6.51
Brain-computer interface	4	0.66	0.08	[0.58, 0.74]	0.56	0.72

Text entry rate in words per minute

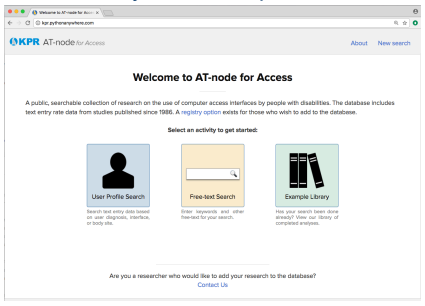
- Notes on Variation
 - Confidence Intervals for the means are actually pretty tight
 - But quite a wide range from min to max

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AT-node Website

- Explore the data yourself at kpronline.com/atnode

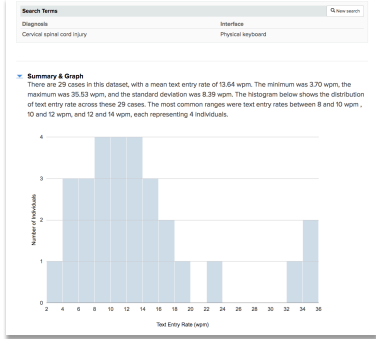


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Quick AT-node Demo

- User Profile Search
- Cervical SCI
- Physical keyboard



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Research Evidence: Summary

- Know this stuff or how to find it
 - AT-node website at kpronline.com/atnode
 - Info at kpronline.com/pubs.php
- Share with your clients
- Provides a context and benchmark
- Yes, your mileage may vary, but we still want to see the EPA/NEDC estimates...

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Client Evidence – Performance Measures

- The Key
 
- “Typical” Keyboard and Mouse Access
 - Tools
 - Understanding the problem
 - Selecting from candidate solutions
 - Configuring an AT interface
- Switch Access

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Understanding the problem - why

- Deep understanding of the status quo
- Are things going as well as they could be?
- What, specifically, needs to change?
- ***How else will you know what problem to work on? And whether it has improved?***

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Understanding the problem - how

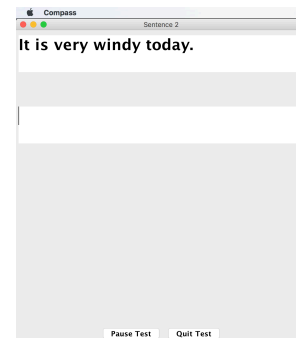
- Compass software for access assessment
 - For Mac and Windows
- Measures
 - Typing speed and accuracy
 - Mouse control
 - Switch control / Scanning
- Easily compare speed and accuracy of devices
- Presents data in shareable format

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Compass Sentence Test

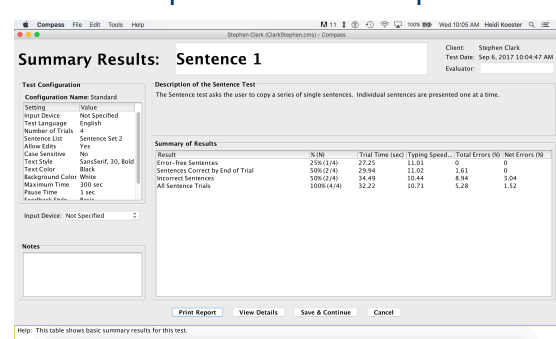
- Compatible with alternative text entry methods
- Adjustable font, size, text difficulty, feedback, etc.
- Accurate and valid measurements



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Compass Sentence Report



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Compass Sentence Report

Result	% (N)	Trial Time (sec)	Typing Speed (wpm)	Total Errors (%)	Net Errors (%)
Error-free Sentences	25% (1/4)	27.25	11.01	0	0
Sentences Correct by End of Trial	50% (2/4)	29.94	11.02	1.61	0
Incorrect Sentences	50% (2/4)	34.49	10.44	8.94	3.04
All Sentence Trials	100% (4/4)	32.22	10.71	5.28	1.52

- Typing Speed, wpm
- Comparing Total and Net Errors shows how well user could identify and fix mistakes.

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Selecting from candidate solutions - Example

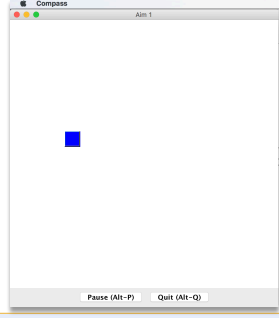
- 53 y/o female following stroke
- Right side weakness
- Pursue career in accounting
- Plans to use mouse with impaired right hand to minimize switching from mouse to keyboard when typing one-handed

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Selecting from candidate solutions - Example

- Use Compass to compare 5 pointing devices
- Aim tests for mouse control
- Measures speed and accuracy of user's target selections
- Reports averages across targets, as well as target-by-target data



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Selecting from candidate solutions - Example

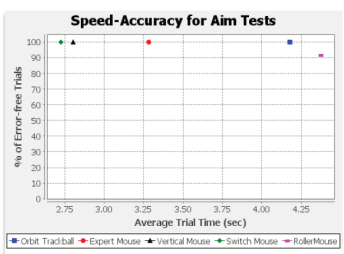
- Discussed comfort of each mouse
- Made qualitative selection
- Viewed comparative reports and discussed results
- Results backed qualitative decision
- **About a 60% difference in speed between fastest and slowest mouse**

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Selecting from candidate solutions - Example

- Discussed results in text of report
- Included graph
- Attached Compass generated report as appendix



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Configuring an AT interface - why

- Leverage the accessibility settings already built-in to most computing devices
 - Keyboard
 - Mouse
 - Display


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Configuring a keyboard – how

- Keyboard Wizard: to establish Sticky Keys and repeat settings

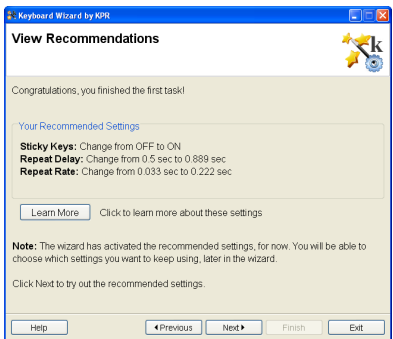
1. Type a sentence



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2. Get recommendations, based on how you typed.



Keyboard Wizard by KPR

View Recommendations

Congratulations, you finished the first task!

Your Recommended Settings

Sticky Keys: Change from OFF to ON
Repeat Delay: Change from 0.5 sec to 0.889 sec
Repeat Rate: Change from 0.033 sec to 0.222 sec

[Learn More](#) Click to learn more about these settings

Note: The wizard has activated the recommended settings, for now. You will be able to choose which settings you want to keep using, later in the wizard.


Click Next to try out the recommended settings.

Help Previous Next Finish Exit

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3. Try out the new settings



Keyboard Wizard by KPR

Practice with the Recommended Settings

Type the phrase below. For more practice, just keep typing.

Remember, the recommended settings have been activated temporarily, for you to try. Later in the wizard, you'll choose the settings you want to keep using.

Try Sticky Keys: To type capital 'N' with Sticky Keys, first press the 'Shift' key, followed by the 'N' key, instead of pressing both at the same time.

The United Nations

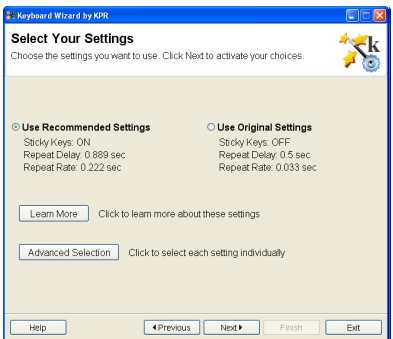
☐ Present a timed sentence as my next step

Help Previous Next Finish Exit

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4. Pick the ones you want



Keyboard Wizard by KPR

Select Your Settings

Choose the settings you want to use. Click Next to activate your choices.

☒ **Use Recommended Settings**
 Sticky Keys: ON
 Repeat Delay: 0.889 sec
 Repeat Rate: 0.222 sec

☐ **Use Original Settings**
 Sticky Keys: OFF
 Repeat Delay: 0.5 sec
 Repeat Rate: 0.033 sec

[Learn More](#) Click to learn more about these settings

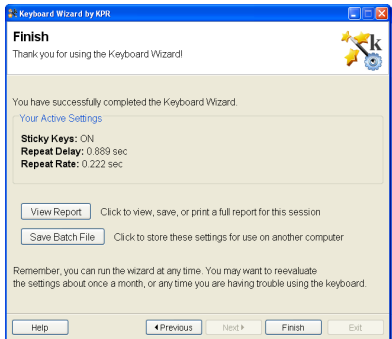
[Advanced Selection](#) Click to select each setting individually

Help Previous Next Finish Exit

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5. Keyboard Wizard activates your choices for you



Keyboard Wizard by KPR

Finish

Thank you for using the Keyboard Wizard!

You have successfully completed the Keyboard Wizard.

Your Active Settings

Sticky Keys: ON
Repeat Delay: 0.889 sec
Repeat Rate: 0.222 sec

[View Report](#) Click to view, save, or print a full report for this session

[Save Batch File](#) Click to store these settings for use on another computer

Remember, you can run the wizard at any time. You may want to reevaluate the settings about once a month, or any time you are having trouble using the keyboard.

Help Previous Next Finish Exit

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Configuring a keyboard - example

- 68 y/o woman with multiple sclerosis
- Runs through Keyboard Wizard
- Adjusting auto-repeat setting:
 - **Improved typing speed 50%**
 - from 2.2 to 3.2 wpm
 - Reduced errors 32 pp
 - from 60% errors to 28%

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Configuring a mouse - example

- Adjusting Windows settings to meet a user's needs
- Pointer speed: gain of the pointing device
- Double-click settings:
 - Double-click time
 - Double-click distance
- Object sizes: menus, caption buttons, scrollbar, taskbar

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Configuring a mouse – Pointing Wizard

- Woman post brain tumor
- Results with new settings:
 - 60% faster**
 - 50% fewer clicks** vs. default settings
- 12 people tested averaged 30% improvement

Speed-Accuracy for Aim Tests

Average Trial Time (sec)	% of Error-free Trials (Aim A1x)	% of Error-free Trials (Aim Bx)	% of Error-free Trials (Aim A2x)
~4.2	~65	-	-
~8.2	-	~20	-
~10.8	-	-	~40

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Client Evidence – Summary so far

- Rationale and recipes for taking direct measurements of client performing basic text entry and pointing tasks
- Tools covered:
 - Compass
 - Keyboard Wizard
 - Pointing Wizard
 - Stopwatch
- 30 to 60% improvements
- Move on to switch access

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Client Evidence – Switch Access

- Switch use for specific constrained tasks
- Switch use for scanning
 - Communication, all-purpose access
- Recall the earlier example of measuring baseline performance (1.2 wpm)
- Briefly introduce Scanning Wizard tool

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Scanning Wizard

- Free website to help configure switch and scanning software (scanningwizard.com)
- Switch Test
 - Measures basic switch skill
 - Speed and accuracy in response to a prompt

Go! (1) → Hit switch → Success! (Green checkmark)

- Scored in green/yellow/red zones

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Scanning Wizard

- Scan Test
 - Can user make accurate and efficient selections from a scanning grid?
 - Can select letters or smiley faces
 - Score in green/yellow/red
- Reports provided for Switch and Scan Tests

I_AM
Enter the Scanner

A	B	C	D	-	.
E	F	G	H	,	?
I	J	K	L	M	N
O	P	Q	R	S	T
U	V	W	X	Y	Z

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Scanning Wizard: Recommendations

- Recommendations for 19 settings

Final Recommendations

In the Switch Test and the Scan Test, we collected data on your switch use and scanning selections. Your scores were:

- Your Switch Test Score is in the Low Difficulty zone
- Your Scan Test Score is in the Medium Difficulty zone

We have analyzed your test results and determined several recommendations, shown below, that could improve how well your scanning setup meets your needs.

- Principles aren't new; help applying them is.

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Client Evidence – Scanning Wizard

- Improve the setup of the scanning system
- Example user improved text entry rate 136% with recommendations from Scanning Wizard
- Major improvements in text entry rate:
 - Averaged 120% improvement in Study 1
 - Averaged 71% improvement in Study 2

M004's Layout Before and After:

Before: 'your envelopes'

After: 'will also respect'

136% improvement in text entry rate.

KPR Software Details

- Resources at KPR website, kpronline.com
 - AT-node at kpronline.com/atnode - Free
 - Compass, Win/Mac, \$179
 - Keyboard Wizard, Win – Free
 - Pointing Wizard, Win – Free
 - Free trial of Compass available
 - Demonstration videos
- Scanning Wizard
 - scanningwizard.com - Free

Summary to this point

- A range of activities and tools to support:
 - Use of research evidence
 - Use of client evidence
 - All with a focus on alternative ICT access
- Move now briefly to general purpose tools for any assistive technology domain

General Purpose Measurement Tools

- Quebec User Evaluation of Satisfaction with assistive Technology (QUEST)
 - <http://www.midss.org/content/quebec-user-evaluation-satisfaction-assistive-technology-quest>
- Psychosocial Impact of Assistive Devices (PIADS)
 - Request from Jeff Jutai (jjutai@uottawa.ca)
- Both are validated instruments

QUEST – Demers (1996)
PIADS – Day (2002)

QUEST

- Measures user satisfaction with any type of assistive technology device and service
- 12 items
 - **Device:** dimensions, weight, ease in adjusting, safe and secure, durability, easy to use, comfortable, effective
 - **Service:** service delivery, repairs and servicing, professional services, follow-up services
- Overall score from 1 to 5

PIADS

- Measures impact of an AT device on the user's life
- 26 items (or 10 in the PIADS short form)
- Overall score from -3 to +3

Uses of Outcome Measures for Individuals

- Pre-intervention
 - Understand how well current AT is/isn't meeting needs
 - Identify features most important to user
- Post-intervention
 - How well new device is meeting needs
 - How well services met needs (QUEST)
 - Specify ideas for improvement

Uses of Outcome Measures for Programs

- Quality Assurance
 - How well are recommended devices meeting clients' needs
 - How well are services meeting needs (QUEST)
 - Specify ideas for improvement
- Impact
 - What's our program's impact, overall?
 - Are there some AT areas where we have more impact than others?

Take-home Points

- Use Research Evidence & AT-node for context
- Take measurements:
 1. With any existing access system
 2. During evaluation
 3. With the new access system

That's how you know it! That's how you show it!

Take-home Points



I have been struck again and again by how important measurement is to improving the human condition.

— Bill Gates —

AZ QUOTES

Next steps:

- Try it yourself
- What practices will you change based on this session?
- Email hhk@kpronline.com for more info or with comments, suggestions, etc.
- Visit kpronline.com for downloads, publications, etc.
- **Thanks for being here today!**