

How to choose effective alternative access solutions: an evidence-based approach

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Session ATPAP-30

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Speaker Disclosures

Heidi Koester has Financial or Non-Financial Relationships to disclose:

- KPR created some of the software tools described in this presentation. Compass software is a commercially-sold product; all others are free of charge.
- I write the KPR blog at kpronline.com/blog, but neither KPR nor myself receives any revenue, donations, donated items, or other compensation related to this blog.
- KPR research and development has been supported by: US National Institutes of Health (NIH), US National Institute on Disability and Rehabilitation Research (now NIDILRR), and Paralyzed Veterans of America (PVA).
- As a Strand Advisor to ATiA, I receive complimentary registration.

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Learning Objectives

- Identify 5+ products and techniques that support alternative access for people with motor impairments
- Describe 3 key research findings on alternative text entry and their relevance to service delivery
- Compare 2 or more alternative access solutions for an individual by conducting trials and collecting data

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Introduction – Heidi Koester, Ph.D.

- President of Koester Performance Research (KPR)
- Previously: Rehabilitation Engineer at 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 computing interfaces for people with physical impairments
- Foundational belief is that **clear evidence leads to better solutions**


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Today's Topic

- Use evidence to choose effective alternative access solutions
- Particular focus on input devices for text entry and pointing for people with motor impairments

- Available access solutions
- Feature-matching to choose candidates
- What does the research say?
- Tools to conduct trials and collect data
- Combine all the evidence to make an informed decision



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Introduction – What we mean by “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 – What we mean by “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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Introduction – Types of evidence

- Observation
- User Feedback
- **Measurement**

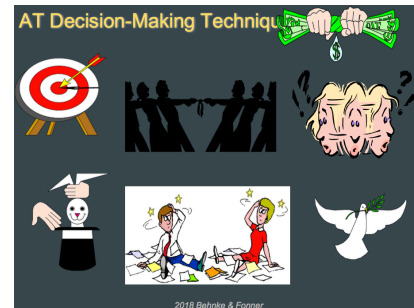


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Introduction – Decision-making without evidence:



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Introduction – Why bother with evidence:



ONE ACCURATE
MEASUREMENT IS
WORTH A THOUSAND
EXPERT OPINIONS

GRACE HOPPER

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What's available – many types of access solutions

- Built-in accessibility settings
- Alternative keyboards
- One-hand typing solutions
- Mouthstick or stylus
- Trackball, trackpad
- Hands-free mice
- Cursor on-screen keyboard
- Speech recognition
- Eye gaze
- Switch access (one- or two-switch scanning, Morse code)
- Brain-computer interface
- Positioning and physical supports



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What's available – a sampling of hands-free mice

Lip/chin joysticks



Target trackers



Speech recognition



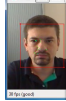
Wearable sensors



Eye trackers



Face trackers



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What's available – resources to learn more

- Built-in accessibility settings – Win, Mac, iOS, Android, ChromeOS
 - Google: e.g., “Windows accessibility settings”
 - kpronline.com/blog/better-mouse-control-with-pointing-wizard/
 - Keyboard Wizard tool: kpronline.com/kbwiz
 - Pointing Wizard tool: kpronline.com/ptwiz

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What's available – resources to learn more (cont.)

- One-hand typing solutions
 - kpronline.com/blog/your-guide-to-10-one-hand-typing-options/
- Hands-free mice (including speech and eyegaze for mouse)
 - kpronline.com/blog/your-guide-to-25-hands-free-mice/
- Switch access (one- or two-switch scanning, Morse code)
 - kpronline.com/blog/morse-code-typing-for-the-ipad/
- Positioning
 - kpronline.com/blog/better-typing-with-keyboard-assistive-technology/
- Other AT blogs, info sites

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What's available – resources to learn more (cont.)

- Vendor catalogs and websites:
 - AbleNet, EnableMart, Inclusive, Westminster Technologies, etc.
- Matthew White's 1000+ pins: pinterest.com/couragekennyAT/boards
- QIAT listserv: qiat.org
- RESNA listserv: resna.org

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Questions at this point?



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A process for choosing an effective solution

- Systematic, evidence-based
- Identify and document individual's specific needs*
- Feature-matching: review available options for candidates that provide the needed features
- Gather external evidence, if available
- Conduct trials with the candidates to collect specific evidence about each one
- Combine all the evidence to make an informed decision with the entire team

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Meet “Adam”

- High school student with quadriplegia (C4-5 SCI)
- Head/neck movements are fairly strong
- Hand/arm movements very limited – can activate a light touch switch with back of right hand
- Speech, vision, cognition are all unaffected
- Grade-appropriate schoolwork, plans on college

Adam’s main needs and current setup

- Mouse control and text entry for Windows
 - Also has Android phone and tablet
- Use all types of software for schoolwork, socializing, etc.
- **Home:** uses Dragon for dictating text and some mouse commands. HeadMouse tracker (when set up) for remaining mouse control
- **School:** Dragon not ideal in most classroom situations. Trying HeadMouse + dwell for mouse control and for text entry with on-screen keyboard. HeadMouse working OK but is there something better?

Primary questions to address

- What is Adam’s best option for mouse/pointing tasks in the school environment?
- Is Dragon OK as the main pointing solution at home, or should he have another mouse solution readily available?
- For text entry, what is Adam’s best option in the school environment? (where speech is less suitable)
- It helps to be explicit about these, in writing

Feature-matching: Adam’s feature list (pointing)

- Build this based on:
 - HAAT or SETT models for overall considerations of abilities/needs, context/setting, activities/tasks
 - Checklists at wati.org
 - Forms at educationtechpoints.org
 - Specific considerations at kpronline.com/blog/13-considerations-for-choosing-a-hands-free-mouse/

Chapter 1 - Assistive Technology Assessment

WATI Student Information Guide

SECTION 3

Computer Access

1. Current Computer Access

How does the student currently access the computer?

<input type="checkbox"/> Doesn't access the computer	<input type="checkbox"/> Adapted keyboard/mouse
<input type="checkbox"/> Touch type with two hands	<input type="checkbox"/> Specialized Software
<input type="checkbox"/> Headtrack with one hand	<input type="checkbox"/> Head
<input type="checkbox"/> Touch type with one hand	<input type="checkbox"/> Speech recognition
<input type="checkbox"/> Headtrack with one hand	<input type="checkbox"/> Switch scanning
<input type="checkbox"/> Touchscreen	<input type="checkbox"/> Other

List current AT _____

What difficulty is the student having with current method? _____

Adam’s feature list

- **Cursor control:** direct. Head control probably best but all options possible (lip/chin, face, speech, eye)
- **Mouse buttons:** built-in switches, but dwell ok if needed
- **Components/connections:** The fewer, the better. Will be set up at start of each class. Prefer not to be tethered.
- **Wearable-free:** Would rather don a headset for class than wear a dot on forehead
- **Away from face:** preferred
- **Mounting:** prefer to have none
- **Compatibility:** Needs to be available for Windows & Android, with options for additional platforms.

Adam’s feature list

- **Tasks:** typing with on-screen keyboard. Regular mouse control + precise control for drawing, presentations
- **100% independent use:** not strictly needed in school but good as a goal
- **Portability/transferability:** has own laptop, so needs to be portable but not necessarily transferable. (Secondary consideration is having a solution for school computers when laptop not convenient or available)
- **Robustness:** Easy to setup & position. Works in all lighting conditions. Speech not usually best option in classrooms. Needs to be pretty tough, transportable
- **Cognitive load:** prefer typical mouse paradigm but cognition not a concern






Feature-match at the family level

- Can we eliminate any families at this point?
- Lip/chin joysticks: for school, not a good fit due to mounting, components, and setup. (Might be a great option for home, however.)
- Eye trackers: less direct and precise cursor control
- Speech: not a good fit for school
- Consider **wearable sensors**, **target trackers**, and **face trackers**

Feature-match at the device level

- Narrow down to devices in each family
- Feature-matching table to identify any unsuitable devices
- Use checklist or spreadsheet to compare Adam's feature list to the features available in each hands-free mouse option

Feature-match at the device level

Feature Match: Wearable Sensor Systems		C	D	E	F	G
Adam's feature list vs. available systems		GlassOuse 1.2	Quha Zono	EnPathia	eeZee Switch	EO Air Mouse
						
		\$499	\$999	\$295	\$827	\$150
		Info page	Info page	Info page	Info page	Info page
		Manual	Manual	Manual	Manual	Manual
1	Consideration	✓	✓	✓	✓	✓
2	Cursor Control	Direct	✓	✓	✓	✓
3		Head control probably best	✓	✓	✓	✓
4					X Tilt not rotation	
5	Mouse Buttons	1	2	2	2	2
6		Built-in switches	✓	✓	✓	✓
7		Button software included	✓	✓	✓	✓
8		Built-in dwell support	✓	✓	✓	✓
9	Components	1	2	3	2	1
10		The fewer, the better	✓	✓	✓	✓
11	Connections	Prefer not to be tethered (Wireless)	✓	✓	✓	✓
12	Mounting	Prefer none	✓	✓	✓	✓
13	Wearable form	Prefer headset to forehead dot	✓	✓	✓	✓
14	Away from face	Preferred	✓	✓	✓	✓
15	Compatibility	Windows & Android	✓ Bluetooth	✓ USB	✓ USB	✓ USB
16	Tasks	Need precise control	✓	✓	✓	✓
17	Independent Use	Not strictly needed but preferred	✓	✓	✓	✓
18	Portability	Needs to be portable	✓	✓	✓	✓
19		Not necessarily transferable	✓	✓	✓	✓
20	Robustness	Easy setup	✓	✓	✓	✓
21		Reasonable toughness	✓	✓	✓	✓
22		Good in all lighting and acoustic conditions	✓	✓	✓	✓
23		Battery life (hrs)	15	30	no battery	unknown

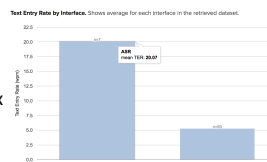
[Example spreadsheet](#)

Feature-matching: Adam's candidate devices

- After feature-matching each family:
- **Wearable sensors**: GlassOuse, Quha Zono
- **Target trackers**: HeadMouse Nano, Tracker Pro
- **Face trackers**: several Windows options
- To address the Home question about speech vs other options for pointing tasks, may also be good to collect data on speech recognition.

Gather external evidence: Adam's candidates

- What does "the research" say?
 - Pointing: there isn't much
 - Text entry: [AT-node database](#)
 - Speech (20wpm) is about 4x faster than cursor OSK
- Can also seek other evidence sources:
 - Reviews, blogs, etc.
 - QIAT listserv
 - Ask me!



Trials with the candidates

- Purpose
 - Measure performance (speed and accuracy)
 - Direct experience of using each candidate
 - Concrete understanding of how each device relates to each consideration, e.g., components, setup, portability, touchiness for positioning and lighting, etc.
- Sketch out a written plan

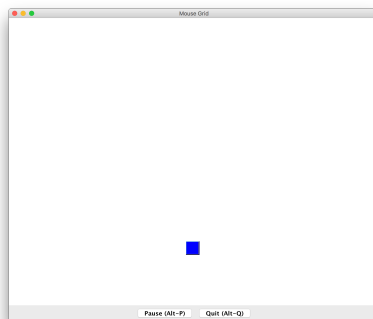
Trials with the candidates

- Data Collection Tools (developed by KPR)
 - Measure performance (speed and accuracy) on basic tasks
 - While allowing direct experience of using each candidate
- Compass software (kpronline.com/compass)
- Web version of Aim test (kpronline.com/aim-online)

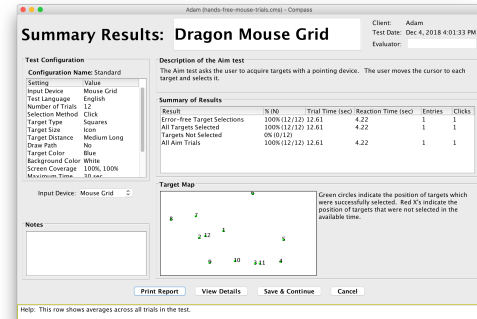
Compass trials with Adam (sample plan)

- Prep
 - Get/install each device, have ready on Adam's laptop
 - Put Compass on the laptop (or run from USB drive)
- Testing (baseline + each candidate device)
 - Warmup for a few minutes – move cursor, click button
 - Aim test (could also do text entry with OSK)
 - Feedback from Adam
- Analysis
 - Compass report
 - Table of Adam's feedback

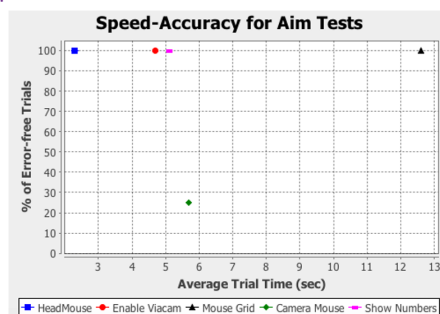
Compass Aim trials with Adam



Compass Aim report for one device



Compass Aim trials: all devices



So which is best?

- Well, pointing with speech (especially MouseGrid) is definitely pretty slow – backing up Adam's hunch that he could benefit from having a readily available mouse alternative at home
- Face trackers are slower (and less precise), so these may have a limited role but aren't ideal
- Comes down to HeadMouse/TrackerPro vs. GlassOuse/Zono
 - Speed & accuracy of those is similar
- Wireless headset is a better form factor for Adam
- So: final decision is between GlassOuse and Quha Zono

Questions at this point?



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First of two more quick examples

- Can we enhance communication rate with single-switch scanning?
 - High school student with CP
 - Very good switch control, highly skilled on his AAC device, good speller
 - Yet, typing at 1.2 wpm
 - Research demonstrates that a systematic approach (using KPR's [Scanning Wizard](#)) can double text entry rate
 - Applying this approach yielded a 136% improvement

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Second of two more quick examples

- Will new mouse settings lead to enhanced mouse control?
 - Woman post brain tumor, some motor control challenges
 - Uses standard mouse, gets the job done but "seems slow"
 - Research suggests that optimizing built-in accessibility settings can make mousing faster and easier
 - Used KPR's Pointing Wizard to identify changes to pointing settings: can select targets 60% faster, with 50% fewer clicks. (Saves 6 seconds per target!)

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What other questions could you address with this approach?

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Software demos (if time remaining)

- Compass software (kpronline.com/compass for free trial)
- Aim online (kpronline.com/aim-online)
- AT-node (kpronline.com/atnode)
 - [Text entry rate for speech vs. OSK for people with high cervical SCI](#)
- Scanning Wizard (scanningwizard.com)
- Keyboard Wizard (kpronline.com/kbwiz)
- Pointing Wizard (kpronline.com/ptwiz)

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- **Handouts**
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Heidi Koester, Ph.D. has been researching effectiveness of access systems for people with physical impairments for about 20 years, including projects on switch scanning, word prediction, and effective assessment practices. While she is primarily a researcher and developer, she has extensive practitioner experience in AT service provision as well.



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