

KPR Koester Performance Research

A Method for Enhancing Text Entry Rate with Single-switch Scanning

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Overview

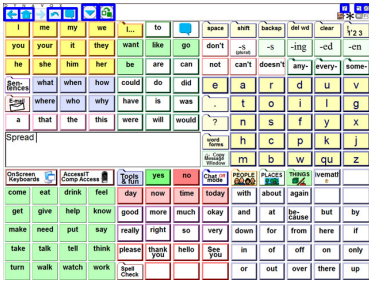
- Brief introduction
- Description of the method
 - Analyze user's current scanning system
 - Tweak their current system to (hopefully) decrease errors and increase efficiency
- Evaluation of the method
 - For 9 users of single-switch scanning, rate improved by an average of 120%
- Application of the method
 - Measure, analyze, revise

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Single-switch Scanning

- Allows people to independently use a computer or AAC device with just a single switch



“Spread your envelopes out...”
 Subject 004

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Single Switch Scanning Example

- Baseline for Subject 004:
 - Excellent switch control
 - Excellent command of layout
 - High satisfaction
 - But text entry rate (TER) surprisingly slow

TER (wpm)	1.23
Selection Errors (%)	3.61%
Timing Errors (%)	13.21%

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Single Switch Scanning Challenge

- Remains an important option for some users
- Speed is slow
- Reports in literature:
 - *Very* fast user, with no impairments, may achieve 7 or 8 wpm
 - 1 wpm or less is not uncommon

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Factors that Influence TER

- Switch characteristics: e.g., type, location
- Timing parameters: e.g., scan delay, 1st-item delay
- Item layout & organization: based on frequency of use
- Scan pattern: e.g., manual v. auto initiation, loop count
- Language features: e.g., word prediction, fixed words, abbreviations, semantic compaction
- Dead time: time between last selection and resumption of scanning for next selection
- Etc.

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Study Goals

- Develop a method for enhancing TER with single-switch scanning
 - Adjust the configuration settings and/or switch characteristics as needed, in a systematic way
- Evaluate the method with actual users

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Method for Adjusting Settings

- Analyze switch activation
 - response time & errors
- Analyze scanning selections
 - measure TER
 - count & classify scanning errors
- Adjust settings to reduce scanning errors (to < 25%)
- Adjust settings to enhance efficiency

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How to Adjust?

- Systematically look at:
 - each error type
 - each possibility to increase efficiency.

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Participants

- 9 people who use single-switch scanning on an AAC device to communicate

ID	Sex	Age	Dx	System	Letter Layout	Prediction	Scan Rate (s)	Satisfaction
001	F	53	CP	Dynavox DV4	Freq-based	2-char 4-word	1.5	3
002	F	41	CP	PRC Vantage WordPower	QWERTY	6-word	0.9	5
003	M	21	CP	Dynavox Vmax	Alphabetic	6-word	2.6	5
004	M	17	CP	Dynavox Maestro Scanning WordPower	Freq-based	6-char 4-word	1.5	4
006	F	19	CP	Dynavox Vmax Picture WordPower	QWERTY	16-word	1.0	3
007	F	28	CP	Words+EZkeys	Freq-based	6-word	0.9	5
008	F	37	CVA	Viking Communicator 4 Scanning WordPower	Freq-based	3-word	0.8	4
009	M	50	CP	Words+Say-It-Sam	QWERTY	8-word	1.3	1
010	F	54	ALS	Viking Communicator 4	Freq-based	8-word	1.0	5

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Procedure

- ABA Study Design
 - A = original settings
 - B = revised settings
- Baseline Phase
 - Measure and video-record performance with original settings
 - Perform Switch and Scan Tests
- Identify Revised Settings
 - Then use for 4 weeks, measuring performance each week
- Reversal Phase
 - Revert to original settings and measure performance

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Example of Changes Made

- For Subject 004:
 - Removed 1st-item delay of 0.27 sec
 - Removed the titlebar and message window from scan pattern
 - Moved letters+WP group to the top of scan pattern
 - Moved letters up by 2 rows
 - Remove character prediction cells
 - Keep scanning on letters+WP group, once it has been selected, until word completed

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004's Layout Before:

“Spread your envelopes out...”

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004's revisions

“Fellow workers will also respect...”

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Summary of Changes Made

Settings Category	Subject									
	001	002	003	004	006	007	008	009	010	
Language Features	✓	✓	✓	✓	✓					
Item Positions	✓	✓	✓	✓	✓		✓	✓	✓	
Scan Pattern		✓		✓	✓		✓	✓		
Dead Time	✓	✓		✓	✓		✓			
Timing Parameters		✓	✓	✓	✓	✓	✓	✓	✓	
Switch				✓						

✓+= Faster speed with revised, ✓-= Slower speed for revised.

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Key Dependent Variables

- 2-Sentence Transcription Task
- Text Entry Rate (TER)
 - Number of correct characters divided by total time for the test
- Total Scanning Errors
 - All timing errors during scanning + all incorrect item selections
 - Example of timing error: let scanning go through all the rows for a cycle before selecting the desired row
 - Report as a percentage of correct selections
- Four-question survey at study completion

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Baseline vs. Revised for TER

- TER with revised settings averaged 120% faster than with original settings ($p=.003$)

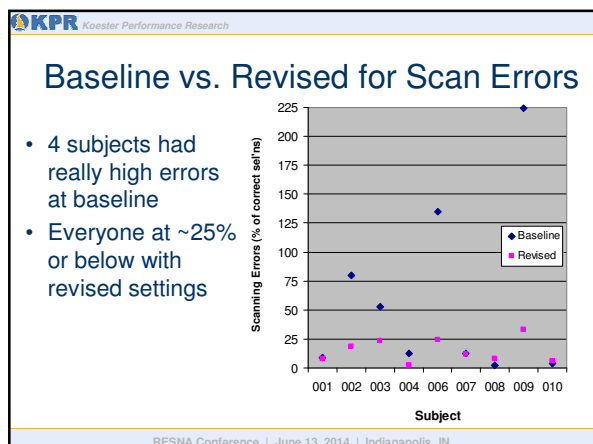
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Baseline vs. Revised for TER

- Symmetric reversal pattern for each subject

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Questionnaire Results

- Everyone kept the revised settings to use after the study was over.

Subject	Question			
	Q1. Now Prefer	Q2. Initial Dislike	Q3. Faster	Q4. Permanent
001	4	3	3	5
002	4	5	3	5
003	5	2	4	5
004	5	3	5	5
006	4	2	5	5
007	3	1	4	4
008	4	1	4	5
009	5	5	5	5
010	4	3	4	5
Mean	4.22	2.78	4.11	4.89

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- Success of the Revised Settings**
- More than doubled participants' TER, on average.
 - Reducing errors was a key for four subjects
 - At baseline, they were averaging more than 1 error for every correct item selection (123%)
 - With revisions, decreased to less than 25%
 - Increased efficiency benefited everyone
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- TER in Context**
- Baseline TER ranged from 0.28 to 2.92 wpm
 - This is pretty low
 - For low-error subjects, especially, it's likely much lower than you would guess by observation alone
 - Research indicates a minimum of 3 wpm for productive communication
 - Revised TER ranged from 1.12 to 6.51 wpm, with four people above 3 wpm.
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- What Now?**
- Working on a way to make this method easier to apply
- Meanwhile, practitioners can:
- Measure performance (speed and accuracy)
 - Analyze sources of error and opportunities for enhanced efficiency
 - Revise system settings accordingly
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- What Now? Key Measurements**
- Switch Hit Time
 - Can user activate switch quickly and reliably?
 - What is the matching scan delay setting?
 - Scanning Errors
 - Can user use switch to make scanning selections?
 - Text Entry Rate
 - Overall productivity with the system
 - Other measures of overall productivity may be appropriate in some situations
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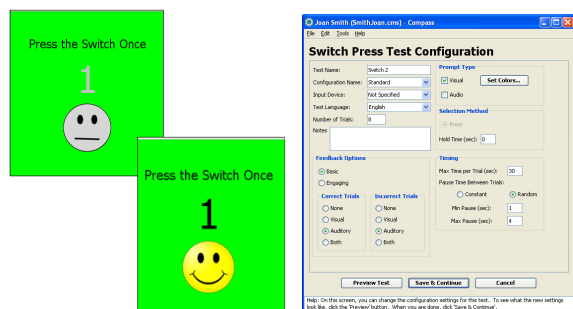
Measure Switch Hit Time

- Compass or SSPT software

Single Switch Performance Test

- Free from www.aacoinstitute.org
- Three Tests
 - Activation
 - Release
 - Repetition
- Limited configuration and reporting

Compass Switch Press Test



Compass Switch Report

Summary of Results

Result	% (0)	Trial Time (sec)	1st Press Time (sec)	Release Time (sec)	Switch Hits
Correct Trials	100% (10/10)	1.49	1.03	0.46	2.1
Incorrect Trials	0% (0/10)				0
No Switch Pressed	0% (0/10)				0
All Switch Trials	100% (10/10)	1.49	1.03	0.46	2.1

Recommendations

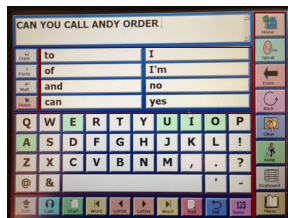
These recommendations are based on your use of the switch during this test. They relate to using the switch to make choices in an automatic scanning system. Feel free to ignore these if you have no plans to use your switch with a scanning system.

Setting	Value	Description
Scan Rate	1.751 sec	The amount of time that items remain highlighted in a scanning system.
Extra Delay		Extra time to highlight the 1st row and column. Blank unless Hits Required > 1 in this test.

- Compare trial times across switches/sites
- Determine appropriate scan rate

Example for 009

- 50 year-old man with cerebral palsy
- 5-group scanning display on his AAC system



Example for 009

- Original scan rate = 1.3 sec; Switch hit time = 1.5 sec
- He can't reliably select items within available time

Condition	Scan Rate (sec)	Errors/correct sel' n	TER (wpm)
Original	1.3	2.3	0.28
Revised	1.9	0.33	1.15

- Slower scan rate, better letter layout, lower loop count combine to yield **300% improvement** in TER

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Measure Scanning Errors

- Any type of suboptimal selection
- Tally marks
- Video review
- Compass Scan Test, in some cases

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Compass Scan Test

DO_YOUR_BEST_IN_ALL_THAT_YOU_DO.

Y

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	-	,	.	?

Enter Text

Quit Test

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Compass Scan Test

- Snippet of report
- All error types counted

Summary of Results

Result	% (N)	Trial Time (sec)	Timing Errors
Correct Item Selected	75% (6/8)	7.71	16.67% (1/6)
Incorrect Item Selected	25% (2/8)	11.59	0% (0/2)
No Item Selected within Max. Time	0% (0/8)		0% (0/0)
All Item Trials	100% (8/8)	8.68	12.5% (1/8)

Additional Results

Error Type	Count	Correct Selections	Proportion
No Switch Press	1	6	0.17
No Switch Press Target Row	0	6	0
Before Target Row	0	6	0
After Target Row	0	6	0
Before Target Column	1	6	0.17
After Target Column	1	6	0.17
Unintentional Row	0	6	0
Unintentional Column	0	6	0
Total Scanning Errors	3	6	0.5

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Scanning Errors

- Looking for 25% or lower
- Helps to know which type of errors as well
- Recall that 4 of our participants were at 50% or above, averaging more than 1 error per correct selection
- Crisis situation

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Measure TER

- See where things stand
- And if things are getting better or worse over time
- Video review
- Use built-in logging with PRC or DynaVox
- Stopwatch
- Be sure to only count correct characters

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What Now? Revise Settings

- Improvements almost always possible
- Revisions are tailored to individual needs, by following flowchart recipe
- But there may be a few changes that tend to benefit everyone

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Some Rules-of-thumb for Settings

- Base timing parameters on switch hit time
- Provide time for user to use prediction effectively (i.e., to select from the list on the first scan)
- Put Letters+prediction group first; stay there once selected until word is done
- Character prediction not useful, typically
- Set loop count to 1
- Use manual initiation only if necessary
- Reduce errors, then increase efficiency

Conclusions

- Proper settings can greatly enhance text entry rate with single-switch scanning
- A few basic measurements and principles can help others achieve similar results

Final Words

- KPR research & development is supported by:
 - National Institutes of Health
 - U.S. Dept of Education (NIDRR)
 - Paralyzed Veterans of America Research Foundation
- Thanks for being here today!
- Heidi Koester, hkh@kpronline.com
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