



Effects of Feedback on Eye Typing with a Short Dwell Time

Päivi Majaranta, Anne Aula, and Kari-Jouko Räihä

Tampere Unit for Computer-Human Interaction
University of Tampere, Finland

ETRA2004 @ San Antonio, TX



Contents

- Introduction
- Setup and procedure
- Feedback modes
- Method
- Results
 - Speed
 - Accuracy
 - Gaze behavior
 - Subjective satisfaction
- Conclusions





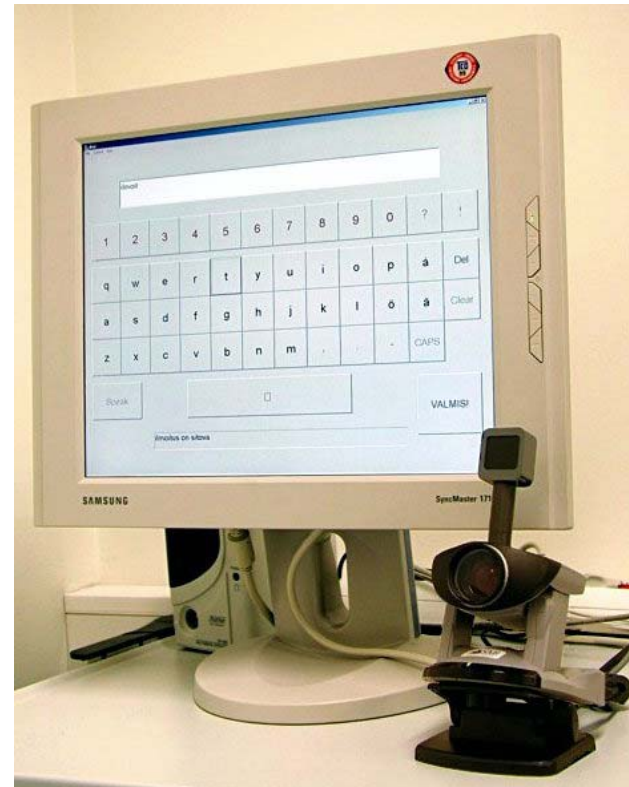
Introduction

- Eye typing is important for people with severe disabilities
- Many existing systems, little research on design issues
 - Previous research on feedback on a general level, not specifically on eye typing
- Follow-up study to a previous study on the effects of feedback on eye typing with a **long** dwell time
 - **900 ms** in the previous study vs. **450 ms** in the current study
 - We assumed that results for long dwell time only partly apply for short dwell time



Setup and Procedure

- SMI iView X eye tracker
 - remote
 - 50 Hz, 1.0 deg.
- Virtual keyboard
- Procedure
 - Read source text
 - Focus on letter
 - Selection by dwell time
 - Letter appears in typed text field



virtual
keyboard

SMI iView X
eye tracking
device




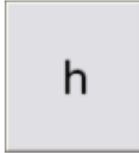

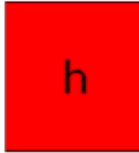
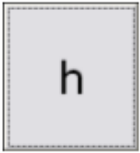
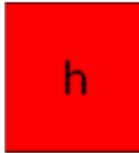
Experimental Software

The screenshot shows the 'iKey' application window with a menu bar (File, Control, Test) and a main interface. At the top is a text field containing 'ilmoitus o'. Below it is a virtual keyboard with four rows of keys. The 'o' key in the second row is highlighted. At the bottom left is a 'Speak' button, a square button, and a 'VALMISI!' button. At the bottom right is another text field containing 'ilmoitus on sitova'. Callout boxes with arrows point to these elements: 'typed text field' points to the top text field, 'virtual keyboard' points to the keyboard grid, '“Ready” key' points to the 'VALMISI!' button, and 'source text field' points to the bottom text field.

1	2	3	4	5	6	7	8	9	0	?	!
q	w	e	r	t	y	u	i	o	p	å	Del
a	s	d	f	g	h	j	k	l	ö	ä	Clear
z	x	c	v	b	n	m	,	.	-	CAPS	



Tested Feedback Modes

Feedback mode	While focused	When selected
Speech	none 	letter spoken 
1-Level Visual	none 	red background 
2-Level Visual	highlight 	red background 

Constant dwell time for all modes: 450 ms
- For 2-Level Visual, 150 ms before highlight



Method

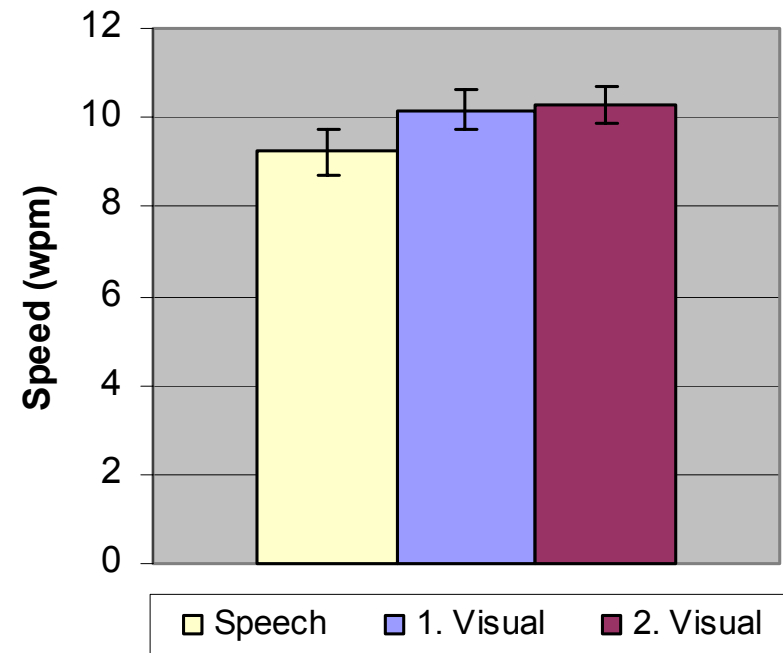
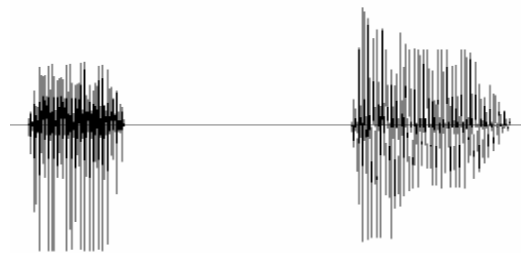
- 15 participants
 - Experienced, all had participated in a previous eye typing experiment
 - 10 male, 5 female
 - Mean age 25
 - Students, with normal or corrected to normal vision
- Repeated measures design
 - 3 feedback methods
 - Order counter-balanced
 - 450 phrases (15*3*10) in Finnish
- Log files & Interview





Typing Speed

- Significant effect on text entry speed
 - Speech: **9.22 wpm**
 - 1-Level: 10.17 wpm
 - 2-Level: 10.27 wpm
- Participants spent time listening to the speech
 - Duration varies
200 ms ('a') - 350 ms ('m')



($F_{2,28} = 6.54, p < .01$)



Accuracy

- Error rate
 - Measure for errors left into the text
 - Compares *transcribed text* to *presented text*
 - Ideally 0%
- Keystrokes per character (KSPC)
 - Average number of keystrokes used to enter each character
 - A measure of overhead incurred in correcting mistakes
 - Ideally, KSPC = 1

E.g. **h e l x [del] l o**

→ Error rate = 0% (“hello”)

→ KSPC = 1.4 (7 keystrokes to enter 5 characters)



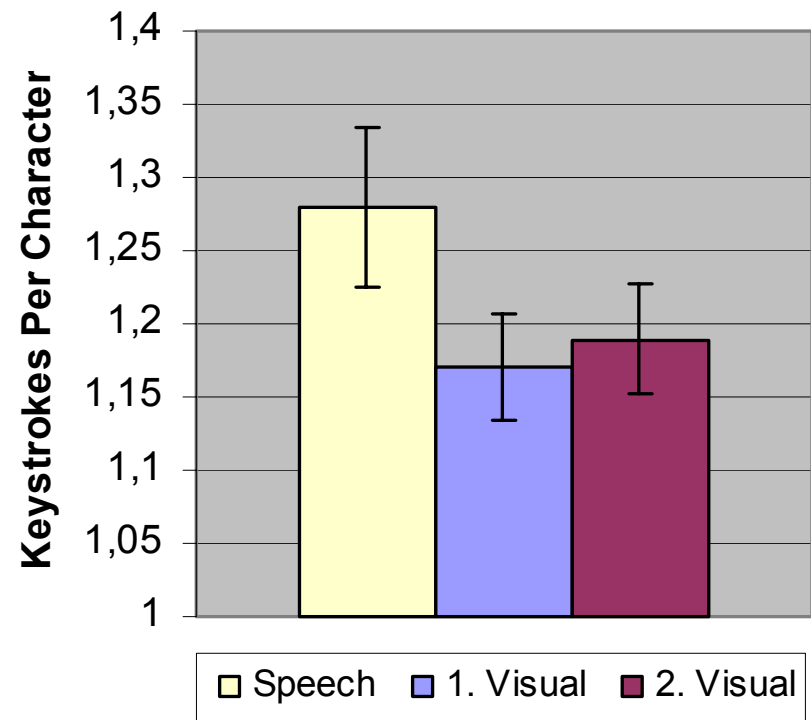
Error Rate

- No statistical differences
 - $F_{2,28} = 2.00$, ns
- Grand mean: 1.20%
 - Speech: 1.69%
 - 1-Level: 0.57%
 - 2-Level: 1.36%



Keystrokes per Character (KSPC)

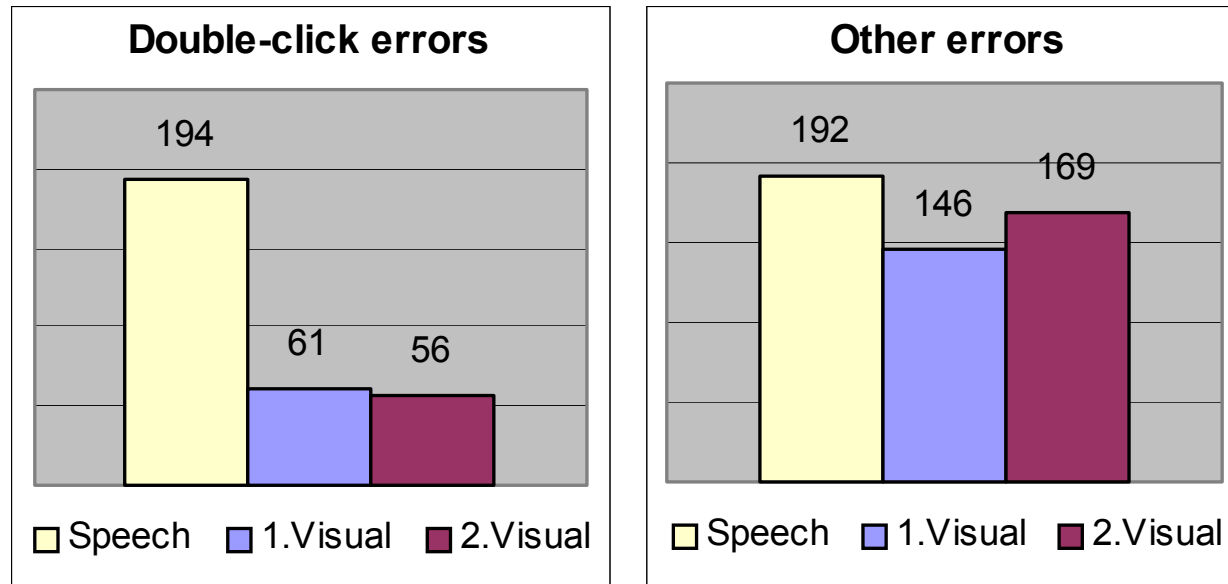
- Significant effect on KSPC
- Grand mean 1.21
 - Speech: **1.28**
 - 1-Level: 1.17
 - 2-Level: 1.19
- Participants spent time listening to spoken feedback
→ unintended “double-click”



($F_{2,28} = 9.83, p < .005$)



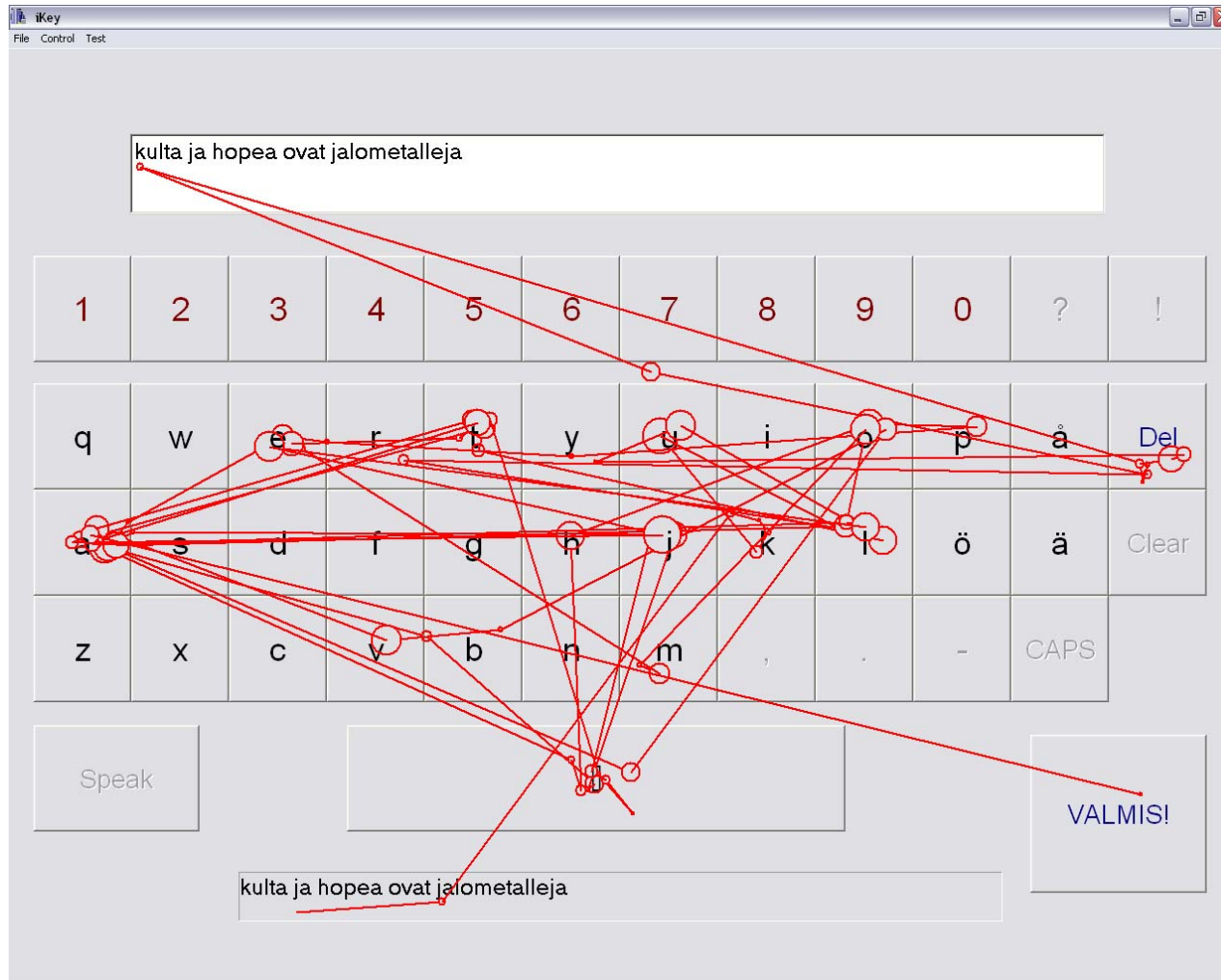
Double Entry Errors



- Significantly more double entry errors with speech
- For “double-click”, 120 ms was added to compensate for the missing search time and to prevent false double entries
- Still, the duration (450+120) was too short for some participants



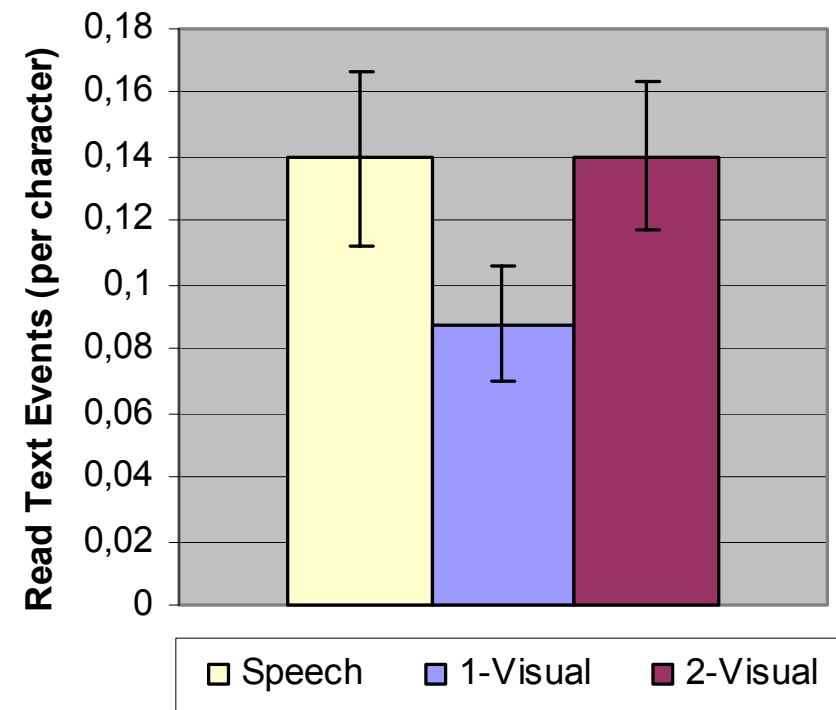
Gaze Behavior





Read Text Events (RTE)

- Significant effect on RTE
 - Measured RTE/character
 - Ideally, RTE = 0
- Speech: 0.139
 - Need to correct more errors
- 1-Level: 0.087
- 2-Level: 0.140
 - Extra confusion caused by 2-level feedback



$(F_{2,28} = 4.50, p < .05)$



Subjective Satisfaction

- Simpler is better
 - Short dwell time requires sharp and clear feedback
- Faster is better
 - Even shorter dwell time long enough for some users
- Some users wanted to hear a “click”
 - Added auditory feedback confirms selection and supports typing rhythm
- Typing rhythm is important with short dwell times
 - Be careful with adaptive dwell times!



Conclusions

- The type of feedback affects
 - Typing speed
 - Accuracy
 - Gaze behavior
 - User experience
- Use brief feedback with short dwell times
 - Feedback takes time
 - Make it sharp and clear!
 - Ensure a distinct point where selection is made
 - May be hard to achieve with speech alone or with separated focus and selection (2-level feedback)



Self-Evident?

- Basic difference between using dwell time vs. using blink or button click
 - Using button click, **you make** the selection
 - Using dwell time, **you initiate** the action, the **system makes** the selection
- Long dwell times
 - Feedback on dwell time progress
- Short dwell times
 - Distinct, brief, clear feedback
 - Selection based on rhythm, not reaction time



Thank you for your attention!

Special thanks to Scott MacKenzie

curly@cs.uta.fi

<http://www.cs.uta.fi/hci/gaze/>

**See you in Tampere at
NordiCHI 2004!**

