



Lecture 11: Scientific Writing

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Schedule

Jan 14: Introduction Jan 21: Computational modeling Jan 28: Analytical methods Feb 4: User research Feb 11: Literature review Feb 18: Research strategy Feb 25: No meeting Mar 4: Research planning Mar 11: Guest lecture

Mar 18: Modeling clinic Mar 25: No meeting Apr 1: Modeling clinic **April 8: Scientific writing** Apr 15: Scientific presentation Independent study period May 14: Submission of paper (PDF) May 15: Dress rehearsal May 16: Final presentations



A warm up question

• What aspect of writing have you struggled with in this course?



Status with research

Anything you want to bring up?

If you get stuck:

- 1) Consult yourself, talk with a peer
- 2) Consult your coach
- 3) Email Antti



Preparation for this lecture

- 1. Pen and paper: Checklist of things you can improve
- 2. Your current manuscript





Scientific Writing

Q: Why do we learn to write in this course?

Writing communicates your work Writing makes it scrutinable by others Writing is research Writing is a skill

- You can develop it
- It is deceptively easy to read a well-written paper

Writing also teaches you how to read Writing in HCI poses some special requirements





Learning objectives

1. Understand scientific writing

- Beyond "reporting"
- Communication, argumentation, appeal
- 2. Understand basic structures and techniques *in an HCI paper*
- 3. Enhance the value of your research
- 4. Learn tips and avoid common pitfalls

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Evaluation form for your coach

```
Usefulness of outcomes (1 – 5)
```

"These results make a significant contribution toward solving the original problem"

```
Validity of methodology (1 - 5)
```

"The methodology followed is valid. I have high confidence in the obtained results."

```
Process (1 – 5)
```

"I am happy with how the research project was managed by the student."

```
Overall grade (1 – 5)
```

```
Free comments
```

Scientific Writing for HCI

Scope: HCI papers

grammar, style, scientific writing in general





Objectives for Writing in HCI

Four objectives for writing

Communication

• Get your reader to 1) attend to your point, 2) understand it, and 3) be able to act upon it

Scrutinability and replicability

 After reading this, will I be able to understand how you exactly did it and replicate it?

Follows tradition

• Follows the tradition in HCI in paper writing

Appeal

• Am I convinced that you have done this according to the highest standards of quality? Does this work excite me?

Grading: <u>Demonstrate</u> your acquired competences in...

- 1. Formulation of research problems
- 2. User research methods
- 3. Representations of user research data
- 4. Understanding the design space and tasks
- 5. Computational approaches
- 6. Research planning
- 7. Research strategy
- 8. Empirical methods
- 9. Data analysis and visualization
- **10. Scientific reporting and presentations**



Typical fallacies in student writing

Complicated writing

• Too many things are said. \rightarrow Focus on one main problem

Chronological writing

Reporting things in the order they occurred → Scientific argumentation is more important

Argumentative flow broken

- Sections don't flow well from one to another
- Argumentative elements missing

Depersonalized writing

• Not clear what the student did \rightarrow Explicate your own contribution

Inefficient writing

• Lots of space is wasted for less important points →Dedicate space according to importance

"The CHI Style"



CHI 2021

Making Waves, Combining Strengths



Type: Late Breaking Paper at CHI

Minimum length 6 pages - excluding Appendices and References. Maximum 10 apges

"A Late-Breaking Work submission is a concise report of recent findings or other types of innovative or thought-provoking work relevant to the CHI community. Late-Breaking Work submissions represent work that has not reached a level of completion or maturity that would warrant the full refereed selection process.

Appropriate submissions should make a contribution to the body of HCI knowledge, whether realized or promised. [..] Examples of work sought by this submission category include: emergent technologies, designs, empirical findings or theoretical contributions, preliminary studies, and ongoing work."



CHI author guidelines

- 1. Making a Significant Contribution
- 2. Offering Benefit to the Reader
- 3. Ensuring Results are Valid
- 4. Gaining Credit for Originality
- 5. Replicability
- 6. Describing the Work Clearly and Concisely





First page, Abstract, & Introduction

It's simple

You can follow a template

• It pays attention to the description of the **practical** problem and **research** problem



Use the beginning to communicate the main points

What interests readers is not what interests authors



Principae.be Het Pand

Abstract: What's in it?

Topic and problem

Motivation

• "Who cares about this problem and why?"

Inadequacy of existing solutions

• "Why could we not solve this straight away?"

Research problem

Your core concept/method/solution/knowledge

• "How did you solve this? Why does it work?"

Evidence for the solution

• "Why should I believe this?"

Benefit or "gain in problem-solving capacity"

• "So what?"

Example: Spotlights (CHI'16)





How to construct a Nature summary paragraph

Annotated example taken from Nature 435, 114-118 (5 May 2005).

One or two sentences providing a **basic introduction** to the field, comprehensible to a scientist in any discipline.

Two to three sentences of **more detailed background**, comprehensible to scientists in related disciplines.

One sentence clearly stating the **general problem** being addressed by this particular study.

One sentence summarizing the main result (with the words "here we show" or their equivalent).

Two or three sentences explaining what the **main result** reveals in direct comparison to what was thought to be the case previously, or how the main result adds to previous knowledge.

One or two sentences to put the results into a more general context.

Two or three sentences to provide a **broader perspective**, readily comprehensible to a scientist in any discipline, may be included in the first paragraph if the editor considers that the accessibility of the paper is significantly enhanced by their inclusion. Under these circumstances, the length of the paragraph can be up to 300 words. (This example is 190 words without the final section, and 250 words with it). During cell division, mitotic spindles are assembled by microtubulebased motor proteins^{1,2}. The bipolar organization of spindles is essential for proper segregation of chromosomes, and requires plusend-directed homotetrameric motor proteins of the widely conserved kinesin-5 (BimC) family³. Hypotheses for bipolar spindle formation include the 'push-pull mitotic muscle' model, in which kinesin-5 and opposing motor proteins act between overlapping microtubules^{24,5}. However, the precise roles of kinesin-5 during this process are unknown. Here we show that the vertebrate kinesin-5 Eg5 drives the sliding of microtubules depending on their relative orientation. We found in controlled in vitro assays that Eg5 has the remarkable capability of simultaneously moving at ~20 nm s⁻¹ towards the plusends of each of the two microtubules it crosslinks. For anti-parallel microtubules, this results in relative sliding at ~40 nm s⁻¹, comparable to spindle pole separation rates in vivo⁶. Furthermore, we found that Eg5 can tether microtubule plus-ends, suggesting an additional microtubule-binding mode for Eg5. Our results demonstrate how members of the kinesin-5 family are likely to function in mitosis, pushing apart interpolar microtubules as well as recruiting microtubules into bundles that are subsequently polarized by relative sliding. We anticipate our assay to be a starting point for more sophisticated in vitro models of mitotic spindles. For example, the individual and combined action of multiple mitotic motors could be tested, including minus-end-directed motors opposing Eg5 motility. Furthermore, Eg5 inhibition is a major target of anti-cancer drug development, and a well-defined and quantitative assay for motor function will be relevant for such developments.



Spotlights, a paper at CHI 2016

The paper contributes a novel technique that can improve user performance in skim reading. Users typically use a continuous-rate-based scrolling technique to skim works such as longer Web pages, e-books, and PDF files. However, visual attention is compromised at higher scrolling rates because of motion blur and extraneous objects with overly brief exposure times. In response, we present Spotlights. It complements the regular continuous technique at high speeds (2-20 pages/s). We present a novel design rule informed by theories of the human visual system for dynamically selecting objects and placing them on transparent overlays on top of the viewer. This improves the quality of visual processing at high scrolling rates by 1) limiting the number of objects, 2) ensuring minimal processing time per object, and 3) keeping objects static to avoid motion blur and facilitate gaze deployment. Comprehension levels for long documents were comparable with those in continuous-rate-based scrolling, but Spotlights showed significantly better scrolling speed, gaze deployment, recall, lookup performance, and user-rated com-



prehension.

Example

Spotlights, a paper at CHI 2016

	Topic statement
The paper contributes a novel technique that can improve	•
user performance in skim reading. Users typically use a	
continuous-rate-based scrolling technique to skim works such	
as longer Web pages, e-books, and PDF files. However, visual	
attention is compromised at higher scrolling rates because of	Problem statement
motion blur and extraneous objects with overly brief expo-	r iobiem statement
sure times. In response, we present Spotlights. It comple-	
ments the regular continuous technique at high speeds (2–20	
pages/s). We present a novel design rule informed by the-	
ories of the human visual system for dynamically selecting	Contribution statement
objects and placing them on transparent overlays on top of	
the viewer. This improves the quality of visual processing	Benefit statement
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ployment Comprehension levels for long documents were	
comparable with those in continuous-rate-based scrolling, but	Evidence statement
Spotlights showed significantly better scrolling speed gaze	
deployment recall lookup performance and user rated com	
probansion	





Introduction: Objectives

PROBLEM

What is the problem in terms of design / engineering / scientific knowledge? **MOTIVATION**

What do we lose when the problem remains unsolved? What should we achieve? **INADEQUACY OF EXISTING SOLUTIONS**

What have previous solutions achieved / failed to achieve?

YOUR SOLUTION/RESULT

How does it improve over state-of-the-art?

EVIDENCE FOR THE SOLUTION

What evidence decreases uncertainty over the your solution's capability?

CONTRIBUTION & BENEFIT

What is known now that was not known before

How is the reader now better able to solve the original problem?

Introduction: Exercise (8 mins)

PROBLEM

What is the problem in terms of design / engineering / scientific knowledge?

MOTIVATION

What do we lose when the problem remains unsolved? What should we achieve?

INADEQUACY OF EXISTING SOLUTIONS

What have previous solutions achieved / failed to achieve?

SOLUTION/RESULT

How does it improve over state-of-the-art?

EVIDENCE

What evidence decreases uncertainty over the your solution's capability?

CONTRIBUTION & BENEFIT

What new knowledge is produced?

How is the reader now better able to solve the original problem?

- 1. Two-person rooms in Zoom
- 2. Provide your paper to the pair
- 3. Circle these elements from the Introduction
 - Do you find them?
 - Are they well expressed?
- 4. Report back after 8 mins





Communicating structure & argument



Figure 1. KALQ (pronounced as in "*calc*ulated") is a soft keyboard designed to improve two-thumb text entry on tablet devices. Its design considers grip, coordinated performance of the two thumbs, and linguistic and motor errors.

ABSTRACT

We study the design of split keyboards for fast text entry with two thumbs on mobile touchscreen devices. The layout of KALQ was determined through first studying how users should grip a device with two hands. We then assigned letters to keys computationally, using a model of two-thumb tapping. KALQ minimizes thumb travel distance and maximizes alternation between thumbs. An error-correction algorithm was added to help address linguistic and motor errors. Users reached a rate of 37 words per minute (with a 5% error rate) after a training program.

Author Keywords

Soft keyboards; keyboard optimization; two-thumb text entry; touchscreen devices; bimanual performance

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Tablet computers and large smartphones with touchscreens are commonly interacted with using two thumbs. Use of the thumbs has an intuitive appeal: the grip is stable and supports typing while walking, sitting, or lying down. Despite these advantages, the low rate of text entry is a recognized problem. Reported rates (in *words per minute*, wpm) for two-thumb typing on a touchscreen range from 14 wpm [24] to 31 wpm [8]. Compare this range to ther input techniques with mobile devices: 55 wpm with 8–10 fingers on a

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full claimton on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. *CHI 2013.* April 27–May 2, 2013, Paris, France. Copyright © 2013 ACM 978-1-403-1899-01/304...\$1500. tablet placed on a surface [15], 44 wpm with stylus [22], and 60 wpm with two thumbs on a physical mini-CWERT keyboard [4]. With such rates, two-thumb text entry on touchscreens may be limited to simple tasks such as entry of messages, addresses, calendar events, and names [2].

Our goal is to investigate the <u>upper limit</u> of typing performance via methods known to improve typing performance. We address two major issues. First, no convention exists comparable to touch typing with physical keyboards that informs how to hold the device or how to move the thumbs. Touchscreens offer poor tactile feedback for keypresses, and the touch sensor does not allow the thumb to rest on its next target while the other thumb is moving, a technique known to boost rates with physical buttons [5]. Moreover, users may grip the device in ways that are detrimental to performance. Second, it is not known whether the QWERTY layout, traditionally used such that both thumbs are responsible for a single key, is efficient when the thumbs do all the presses.

The design of KALQ, shown in Figure 1, is informed by a series of studies that shed light on these open questions:

- Button size, keyboard shape, and position are informed by a study of symmetric two-hand grips (N=6).
- Letter-to-key assignment is resolved computationally, informed by a model of two-thumb performance acquired from a bimanual tapping task (N=20).
- 3. Online error correction is based on a large corpus of mobile text and by modeling tap inaccuracies.

To evaluate KALQ we trained users (N=6) longitudinally in the new layout using a number of performance-enhancing strategies. Users reached 37 wpm upon completion of the training. We conclude by discussing performance gains brought about by each design decision. **Title** communicates the topic, objective or outcome of your work

Abstract provides an overview of the whole argument and contribution

Figure 1 (teaser; optional)
 shows the main outcome or
 approach

Redundancy: The same thing is said many times but increasing level of detail

REDUNDANCY





Figure 1. KALQ (pronounced as in "calculated") is a soft keyboard designed to improve two-thumb text entry on tablet devices. Its design considers grip, coordinated performance of the two thumbs, and linguistic and motor errors.

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Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full cliation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. *CHI 2013*. April 27–May 2, 2013, Paris, France. Copyright © 2013 ACM 978-1-4030-1899-01/304-..\$1500. tablet placed on a surface [15], 44 wpm with a stylus [22], and 60 wpm with two thumbs on a physical mini-QWERTY keyboard [4]. With such rates, two-thumb text entry on touchscreens may be limited to simple tasks such as entry of messages, addresses, calendar events, and names [2].

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Expressing your work

Use clear statements and active voice ("we", "I") to describe recognizable elements of your research

"Our goal is to ..."

"The design of X is informed by ..."

"To evaluate X, we ..."

"We cast the problem of ... as ..."

"Our design process consists of..."



Use figures & tables to convey the story

Example: How we type (CHI'16)

MAIN TOPIC AND PROBLEM



Figure 1. Four users showing different typing behaviours involving different numbers of fingers and movement strategies. This paper reports typing rates, gaze and movement strategies for everyday typists, including both professionally trained and self-taught typists. We explain how untrained typists are able to type at very high rates, which were previously attributed only to the touch typing system that enforces the use of all 10 fingers.

Phenomenon or Measure	м	SD	Ref			
Background Factors: Studies were usually conducted with professionally trained and employed typists.						
Participants touch typing (%)	100	0				
Weekly amount of typing (h)	11	19	[23]			
Performance: Average inter-key interval (IKI) is a fraction of lypical choice-reaction times (e.g. 560 ms). The typing rate is slowed for random letter sequences.						
Words per minute	75	9.7	[13]			
IKI easy prose (ms)	140	-	[29]			
IKI random strings (ms)	326	-	[29]			
KI random strings (ms) Hand- and finger alternation by fingers of different hands typed by the same hand.	326 1: Le is 30	- tter pairs (bigrams) typed -60 ms faster than those	[29]			
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Iki random strings (ms) Hand- and linger alternation by lingers of different hands typed by the same hand. Bigrams typed by: Hand alternation (%) - IKI (ms) Same finger (%) - IKI (ms) Letter repetition (%)	326 1: Let is 30 48 155 34 194 4.6 223 n/a		[29] [24] [23] [25] [23] [5] [23]			



Figure 2. Experimental setup: The typing process of 30 participants was captured using a motion capture system and eye tracking glasses. In addition, keypress timings were logged and a reference video recorded.

SETUP

PREVIOUS WORK



PARTICIPANTS



Figure 4. Characteristics of eye gaze during text input. Left: Touch typists spent less time looking at the keyboard (visual attention) and required less gaze shift. Right: Gaze switches and visual attention correlate with the average inter-key interval, increasing as performance gets slower.

	Touch		Non-Touch		M-W Stat			
Measure	M	SD	M	SD	11	D		
Background						<u> </u>		
Benorted strategy (%)	43.33	-	56.66	-	-			
Years touch typing	16.96	9.66	-	-	-			
Age	33.00	9.15	28.82	7.59	O 75	0.07		
Comp. experience (v)	21.69	7.73	16.38	3.95	O 64	0.053		
Weekly typing (h)	47.15	20.63	44.56	18.39	O 98	0.44		
Performance								
WPM	57.83	15.25	58.93	10.82	O 103	0.38		
- Bandom	27.43	873	27.02	8.46	0 96	0.28		
Avg IKI (ms)	176.39	44.31	168.91	33.22	O 103	0.38		
- Bandom (ms)	382.31	122.56	399.36	133 70	O 100	0.34		
Error rate (%)	0.76	0.62	0.47	0.42	0.82	0.13		
- Bandom (%)	0.98	0.86	0.72	1.08	60	0.02		
Efficiency	0.88	0.03	0.89	0.04	O 100	0.34		
Eve gaze								
Gaze shift	0.92	0.99	1.20	0.94	96	0.03		
Visual attention	0.20	0.27	0.41	0.33	85	< 0.01		
Motion Analysis				0.00				
#Fingers used	8.54	1.08	6.24	0.94	16	< 0.01		
- Left hand	4.46	0.63	3.47	0.70	• 37	< 0.01		
- Right hand	4.08	0.73	2.76	0.73	• 23	< 0.01		
Keys per finger	3.64	0.74	5.65	1.51	• 16	< 0.01		
- pres, by both hands	1.15	1.17	4.41	2.35	• 24	< 0.01		
Hand alternation (%)	46.50	0.61	48.26	2.35	• 50	< 0.01		
- IKI (ms)	150.64	31.78	141.28	32.53	O 90	0.2		
Finger alternation (%)	35.94	6.08	26.42	10.76	• 44	< 0.01		
- IKI (ms)	161.61	31.66	161.10	41.38	O 99	0.32		
Same finger (%)	11.05	5.88	18.67	9.87	 50 	< 0.01		
- IKI (ms)	194.90	26.60	202.75	34.24	O 98	0.31		
Letter repetition (%)	6.71	0.10	6.68	0.12	O 91	0.2		
- IKI (ms)	159.30	25.36	145.16	12.59	0 72	0.06		
Hand alt. benefit (ms)	16.96	15.83	28.72	23.48	O 82	0.12		
Entropy	0.26	0.18	0.38	0.20	• 71	0.047		
Global mov. left (cm)	0.02	0.06	0.01	0.01	O 110	0.50		
Global mov, right (cm)	1.05	0.80	0.81	0.38	O 104	0.40		
Dist. to next key (cm)	1.94	0.41	2.41	0.59	60	0.02		
Significant difference Significant difference C : No significant difference Table 2. Overview of results. comparing touch- and non-touch typists.								

Table 2. Overview of results, comparing touch- and non-touch typists Statistical significance is tested at the 5% level using the Mann-Whitney signed rank test and reported in the last two columns.

RESULTS OVERVIEW

Clear Visual Design of Figures



Use figures and tables to support quick absorption of your main message.

You can skim the paper just by looking at them

Informative Headers

Use brief, recognizable section/subsection headers

CLUSTERING OF MOVEMENT STRATEGIES

To identify similarities among typists, we performed hierarchical clustering on the finger-to-key mappings of each user. Clustering in this space groups users with similar mappings, revealing the *input strategies* used by multiple users. As described above, we found notable differences in behaviour between the left and right hands — the right hand has higher global movement, while the left hand typically has more active fingers, independent of the handedness of the participant. Given these differences, we decided to cluster the finger-to-key mappings for each hand separately to uncover subtle withinhand effects that might be masked in a joint analysis.

Input Data and Clustering Method

For each user, the feature vector consisted of 10 entries per key, giving the proportion of total presses by each finger. We performed Hierarchical Clustering [16] since it is powerful, flexible and makes no assumptions about the distribution of the data. We used a Euclidean distance measure and Ward's linkage criterion [33] to create compact clusters with minimum internal variance.



"Paper gestalt"

Paper gestalt refers to the visual flow and layout of elements.



Typing Performance

We compute the following measure of typing performance for the random and sentences condition: Words per minute (wpm): based on the raw typing log, without

exclusion of outliers. For each sentence we find the time between the first and last keypresses and divide it by the length of the final input given in number of words (any 5 characters). Inter-key interval (IKI): in milliseconds, average interval

between all keystrokes in the preprocessed data, including presses of modifier keys and error correction

Uncorrected error rate (%): the Damerau-Levenshtein edi distance between the stimulus and entered text and dividing it by the larger number of characters.

Keyboard efficiency: the ratio of number of characters in the input and number of keystrokes. Characterises the accuracy during the typing process. A value close to 0 corresponds to a

In addition we compute the percentage difference in WPM between the two conditions, which further characterises the typing skill of participants.

Eve Gaze

Due to varying tracking quality, analysis was done manually based on the video recordings of the eve tracking glasses.

Gaze shifts: the average number of gaze shifts from the monitor to the keyboard during a sentence Visual attention: ratio between the time spent looking at the

keyboard and the time a sentence was displayed. Between 0 and 1, where 0 means no time spent looking at the keyboard.

Motion Analysis

In the following analysis we only consider the letters common to both the Finnish and English sentences and exclude control keys, space, and punctuation

Number of keys: operated by each finger and hand.

Keys per finger: the avg. number of keys mapped to each

Aalto University

Percentage and average IKI of letter pairs (bigrams) typed by: 1. Hand alternation: fingers of different hands, 2. Finger alternation: different fingers of the same hand, 3. Same finger: typing different letters with the same finger.

Entropy of the finger-to-key mapping: the finger-to-key mapping describes which finger a participant uses to press each key. The entropy tells how consistently a key is pressed with the same finger. For each key k, given a frequency distribution over the 10 fingers we compute the entropy as:

(1)

 $H_k = -\sum_{f \in Ormute} p_f \log_2(p_f)$

4. Letter repetition: pressing the same key twice.

where p_f is the probability that finger f presses key k. The average entropy of a finger-to-key mapping is then computed as sum over the entropies of each key weighted by the frequency of the corresponding letter. The touch typing system has 0 entropy, as each key is pressed by only one finger.

Global movement: of each hand, computed at each keypres as the average of the standard deviations of the ratio value of the coordinates of the two markers on the back of the hand.

Distance to the next key: the average distance of the executing finger to its target at the time of the preceding keypress Measures the preparation of upcoming keystrokes by moving a finger to to its target during the execution of a preceding keypress.

RESULTS

We collected 93, 294 keypresses over the three conditions, and 36,955 in the sentences condition. Results of all statistical tests are summarised in Table 2. It compares participants trained in the touch typing system (hereinafter called touch typists) and those that never took a typing course (non-touch typists) in several dependent variables. The classification was based on the self-reports of participants. Statistical signifi-cance was tested at the 5% level using the the Mann-Whitney signed rank test as required by the data which are not nornally distributed and have different cell sizes. Whe tribution of the data allowed, we performed a 2-way ANOVA with language and touch/non-touch as factors. However, it showed no effect on any metric, except the reported hours of weekly typing. Detailed results per participant are provided in the HOW-WE-TYPE dataset.

Based on the survey, 43% of participants learned and used the touch typing system. The average amount of touch typing experience was 17 years (SD = 9.7). The mean age of touch typists and non-touch typists was not significantly different. More background factors are shown in Table 2

Surprisingly, we did not find a significant difference in input performance between touch typists and non-touch typists. Average entry rate and IKI were found to be 57.8 WPM and 176.39 ms for touch typists, and 58.93 WPM and 168.91 ms for non-touch typists. The performance in wpm of each particis shown in Figure 3. Touch typists and non-touch typists had statistically similar uncorrected error rates - mea errors remaining in the final input - of 0.76 % and 0.47 % for respectively. Both groups typed with high efficiency, making few mistakes and requiring few keystrokes to correct them.

The common understanding in the literature was that touch typists could type faster and operate with higher accuracy. ever, the presented findings show that touch typists and non-touch typists have comparable speed and efficiency in transcribing sentences.

Effect of random strings

When typing random letter sequences entry rate dropped on average by ~50% compared to the sentences condition. The change was similar across both groups, with no significant dif-ference between their performances in the random condition. The average uncorrected error rate was 0.98 % for touch typists and 0.72 % for non-touch typists, a significant difference. rate in the random condition was 11%

Figure 3 shows how the loss of performance changes as typing skill increases. The faster typists can type random material faster, not only in absolute terms but also as a percentage of their typing speed. This can be explained with the findings of Salthouse [23]. He states that high performance text entry cannot only be attributed to well practiced motor patterns orresponding to larger units of language, such as words or phrases. Instead he finds that skilled typists show more consistency in their inter-key interval when typing the same letter repeatedly in the same context. This consistency may still be observed in the random condition.

Eye Gaze The analysis of eye gaze found that non-touch typists spent a significantly higher amount of time looking at the keyboard, as shown in Figure 4. The average number of gaze switches within a sentence was 0.92 for touch typists and 1.2 for nontouch typists, a significant difference. The ratio of time spent looking at the keyboard was 0.2 for touch typists and 0.41 for non-touch typists, also a significant difference. We found a orrelation between the average IKI and eye gaze, as shown in the right plots of Figure 4. Correlation between IKI and gaze switch was 0.81 for touch typists and 0.32 for non-touch



Table 2. Organization denomination of the registry of the second second

typists. For visual attention the correlation was 0.69 for touch typists and 0.53 for non-touch typists.

Although touch typing is not necessarily faster, it allows ma taining visual attention on the display. Often self-taught ty ists, even fast ones with unambiguous mappings, are m reliant on visual attention to the keyboard. However, the tr lines in Figure 4 indicate that IKI of touch typists incr ore rapidly as visual attention increases typists can maintain high performance under gaze sw

Motion Analysis

Hand and finger usage Somewhat unsurprisingly, touch typists use more igers that non-touch typists (8.5 vs. 6.2). As a consequence a non-touch typists needs to operate more keys per finger than touch-typists (3.6 vs. 5.6). Touch typists have a clear separation between left and right hand, whereas for non-touch wpists there are more keys that fingers of both hands operate All participants used significantly more fingers of the left than of the right hand. In the Section Clustering of Movement Strategies we report on the differences of hand- and inger usage in more detail by clustering the finger-to-key mappings.

No orphans / widows

Figures and tables on top / bottom



Middle part

Approach & Results

OVERVIEW OF APPROACH

This section describes your approach to solving the problem. It describes only the highest-level choices and justifies them if needed. Most of this content will come from your research plan and research strategy (latter part of the course). This section is optional. Suggested length: 2-4 paragraphs.

METHOD/PROTOTYPE/MODELING/...

This section describes the core of your research work, whether it is an empirical study (method), design (prototype), or model (modeling). Subsections should follow the conventions of the corresponding paper type. Suggested length: 20-40% of total paper length.

RESULTS/EVALUATION

This section describes the obtained results or evaluation of the final result. Again, subsections should follow the conventions of the corresponding paper type. Suggested length: 20-40% of total paper length.

Specific to the type of work

See assignments from first weeks where we identified example papers for you.





Ending

Discussion & Conclusion

DISCUSSION

This section discusses how well you achieved the original objectives. It should first summarize the main outcome. It should then assess its pros and cons. Discuss benefits to practitioners. Finally, it should discuss limitations. Limitations can be phrased as challenges for future work. Be clear about what you learned. Suggested length: 2-4 paragraphs.

CONCLUSION

A one paragraph summary of what you conclude based on the study. This should go beyond what was said in the beginning.



"Hourglass structure"

A paper starts with broad ambitions, narrows down to the particularities of its study, only to become back to the broadest issues in the end



Other goals

Balanced sections

• Do not need to be equally long, but ensure there is a balance between the importance of a section and its length

Use Appendices for materials that are not necessary for your argumentation

• This does not count for total page count

Find 2-3 well-written papers and learn from them





Process

Process writing

Aalto University

"There is no perfect writing, only perfect rewriting"



http://www.bcsc.k12.in.us/cms/lib/IN01000842/Centricity/Domain/1072/Writing-Process_05-219rszm.jpg



Write daily

Set explicit goals for writing outcomes

• E.g., "Tomorrow I'll write Method"

Accept imperfection & and embrace iteration

- Do not expect high quality writing during the first pass
- Allow enough time for polishing, getting feedback etc.

Aim at having first full version of your manuscript ready 1 week before the deadline





Assignment 11

8.4.2021 44

Assignment 11

I will send 5 points to focus on in this round Based on the lecture

Upload PDF by Wed 14 March