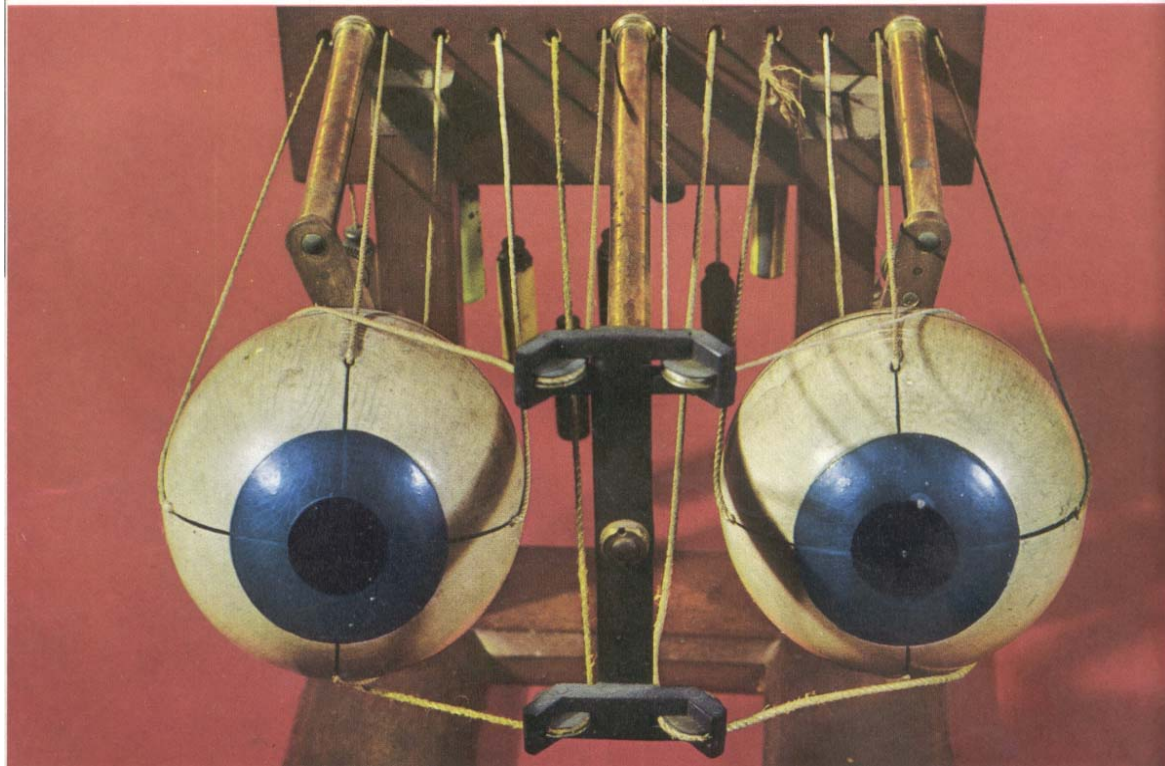


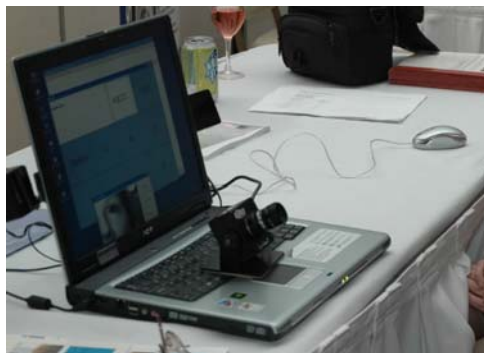
# Eye – tracking in usability testing and gaze interaction



Haakon Lund  
Royal School of Library and Information Science  
Copenhagen  
Denmark



# Remote systems / Mobile systems



tobii

TechnoWorks  
CO.,LTD.



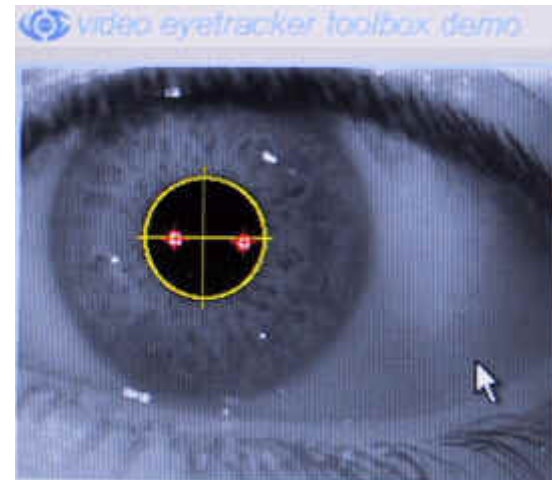
Price: 10.000 US \$ - 40.000  
US \$



# Technology

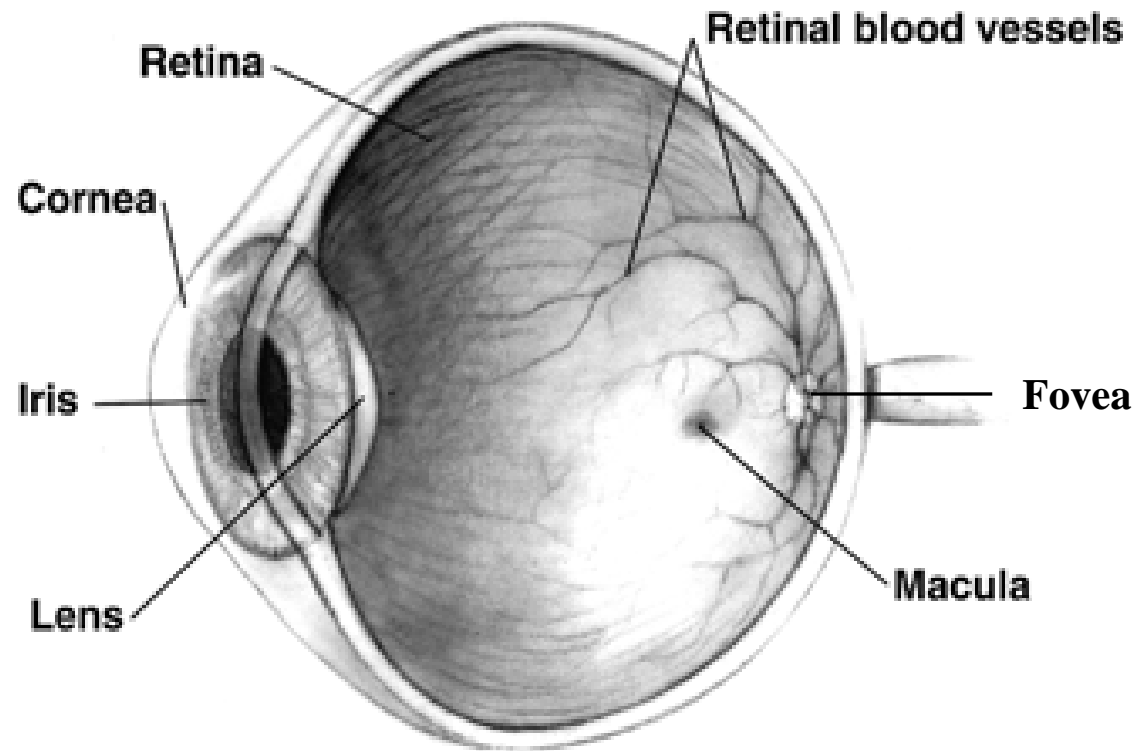
Near infra red (NIR) light is reflected in corona and / or iris

Binocular





# The eye



# Usability studies



Free examination.

1



2

Estimate material circumstances of the family



3

Give the ages of the people.



4

Surmise what the family had been doing before the arrival of the unexpected visitor.



5

Remember the clothes worn by the people.



6

Remember positions of people and objects in the room.



7

Estimate how long the visitor had been away from the family.

3 min. recordings of the same subject



## Eye tracking and usability

Web usability

Jacob Nielsen (Large scale experiment 250 + test subjects)

Poynter Institute (Web news paper reading)

Text reading

Computer games

Software (user interface design)

Physical space

Car driving

Interior design

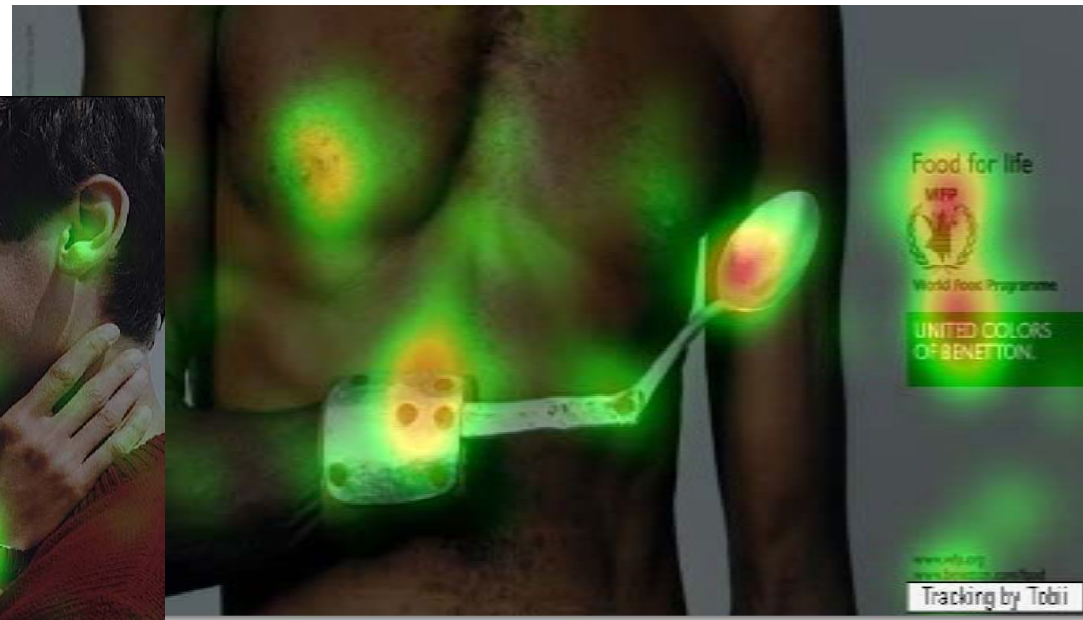
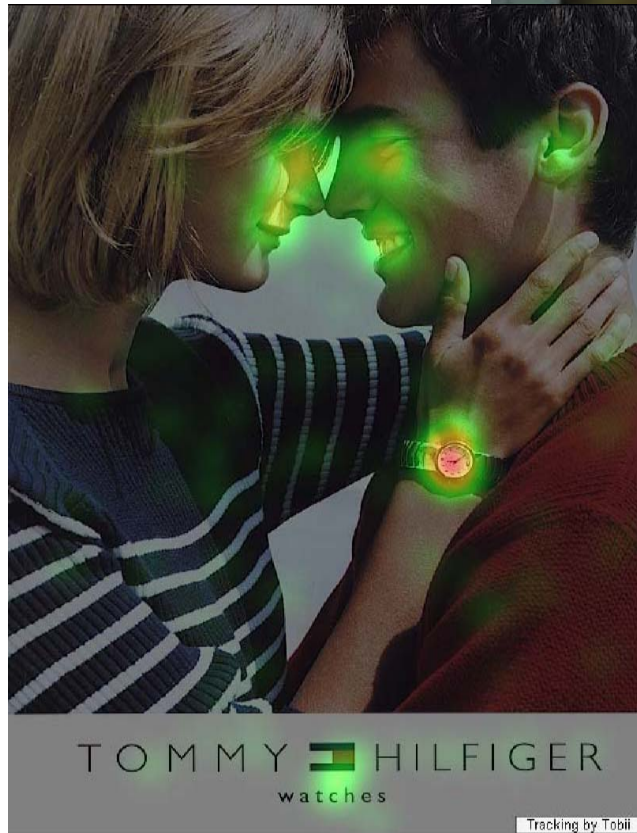




What captures our attention?



# Attention creating objects







SOLARI ANGSTROM.  
BELLEZZA E BENESSERE  
ALLA LUCE DEL SOLE.



Per la salute della tua pelle sotto il sole,  
non accontentarti di un semplice prodotto solare. Scegli Angstrom. Una  
linea di solari completa, frutto della ricerca Pfizer. Con Angstrom scoprirai  
il piacere di un'esposizione al sole tranquilla, un'abbronzatura  
bellissima e naturale, un benessere che va ben oltre la superficie.  
E da oggi, due novità in farmacia: gli Oli Secchi Angstrom per il corpo e  
per i capelli.



ANGSTROM

I SOLARI GIALLI E NERI CHE TROVI IN FARMACIA.



Farmacia M. del Corvo



## Concepts in eye tracking

Peripheral view

Saccadic eye motion

The image of an observed object is resolved by fovea

Re-orientation of the eye between fixations

Reduced vision during saccades

Fixation

Observing object ( - so we remember!)

40 – 600 ms (avr. 200 – 300 ms)

Fixation filtering

fixation time / fixation radius



## Fixation / saccades

What does it tell us

- Fixation length

  - Cognitive load

- Number of fixations

  - Importance

- Order of fixations

  - organisation



# Gaze plot

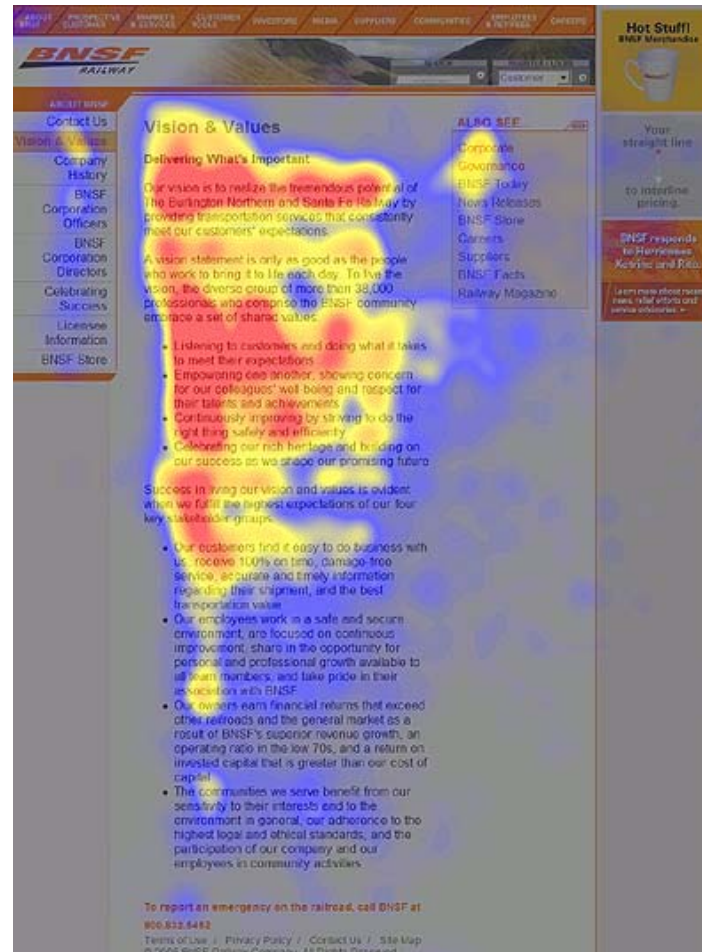


Tracking by Tobii

STUDY: hl\_test. STIMULUS: dst\_test. RECORDING: dst\_test. FRAME: <http://www.dst.dk/>.  
TIME SEGMENT: Only include fixations inside interval [1126,23436] ms.



## Heat-map (F – Pattern reading web pages)





## Tobii eye tracker and Clear View

High quality tracker

Head movements

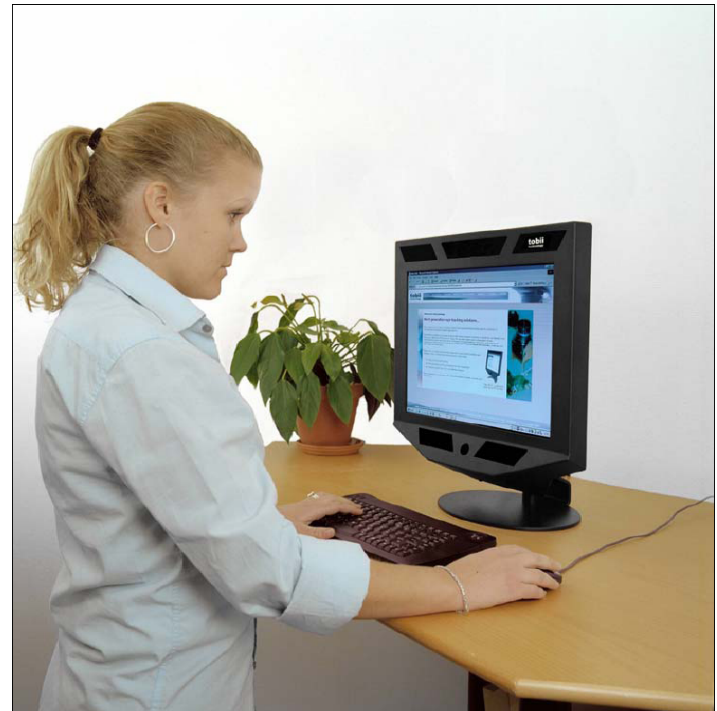
Error rate measured

gaze point / Intended  
gaze point = 0,5 cm

Sampling rate 50 Hz,

Latency 25 – 35 ms

Clear View for data  
analysis







# Eye tracking and usability studie

Supplement

Data analysis

Setup

- Task definition

- Test

- RTA (interview)



# Danish Statistical Bureau

*Test of certain design elements and access to database*

*10 user tasks*

*Retrospective think aloud*

*Task example*

*Question to subject:*

Find the page describing a given political reform.

Print the page

*Purpose:*

We would like to know if the user see's the print icon in the top right corner.

*History:*

According to web design guide lines the user should be given the possibility for printing the web page in a print friendly layout. Our expectation is that the user do not see the icon but uses the print possibility build into the browser.



**DANMARKS  
STATISTIK**

**Gratis statistik**

- Statistikbanken
- Nyt fra Danmarks Statistik
- Seneste nøgletal
- Nævne
- Prisindeks
- Anden gratis statistik
- Kommunalreform

**Statistik til salg**

- Abonnement
- Boghandel
- Forskningservice
- Køb af data og analyser

**Vejviser**

- Find rundt
- Søg om statistik
- Indberetning
- Presse
- Dokumentation
- Offentliggørelser
- Se flere...

**Om Danmarks Statistik**

- Organisation
- Direktion mv.
- Bibliotek
- Klare mål for 2006
- Job i Danmarks Statistik
- Se flere...

**Kommunalreform**

- Husstande og personer i de nye kommuner 1. januar 2005
- Nøgle mellem gamle og nye kommuner 1. januar 2005

Se hvordan de nye kommuner ville se ud med dagens folketal.  
Der er tale om en foreløbig opgørelse lavet i samarbejde med Indenrigsministeriet af befolkningen 1. januar 2005 hvor befolkningen i de 12 gamle kommuner er fordelt på nye kommuner

**Lav din egen tabel**  
Lav din egen tabel med befolkningen pr. 1. januar 2005 opgjort på kommuner og regioner 2007.  
Fordeling findes på civilstand, alder og køn.  
Tabellen findes på [www.statistikbanken.dk/bef1a07](http://www.statistikbanken.dk/bef1a07)

**Statistikbanken i en overgangstid**  
I en vis udstrækning vil vi supplere Statistikbankens kommunefordelte tabeller med et dobbeltår.  
Dvs når 2006 tallene er klar for disse tabeller, vil de blive vist med både den eksisterende kommunefordeling og den kommende 2007-fordeling.

Dette er gratis og vil gælde for et udvalg af de mest brugte tabeller inden for mange emner.  
Danmarks Statistiks ressourcer rækker ikke til, at vi kan yde denne service på hele Statistikbanken.

**For dem der har brug for mere**  
Mod betaling vil Danmarks Statistik kunne levere tabeludtræk omgrupperet til 2007 kommuner og regioner allerede nu.

Det kræver dog særlig programmering, og prisen for et udtræk vil være 5.000 kr. pr. datasæt. Datasæt vil være klar 1. marts.

Det vil være muligt at få følgende tabeller:

- FAMS: Husstande fordelt efter husstandstype og husstandsstørrelse.
- HFU1: Befolkningens højst fuldførte uddannelse (15-69 år) fordelt efter område, herkomst, alder, og køn
- RAS61: Beskæftigede personer fordelt efter bopæl, erhverv, socioøkonomisk status og køn
- PEND21: Beskæftigede personer fordelt efter arbejdsstedsområde, socioøkonomisk status, alder og køn
- BIL4: Antal husstande fordelt efter antal biler og husstandens samlede bruttoindkomst

Tabellerne bestilles hos Lotte Buchjerg [salg@dst.dk](mailto:salg@dst.dk), telefon 39 17 39 91 og kan leveres i forskellige filformater, som fx PEX, AXIS, Excel, csv.  
Herudover vil vi stadig kunne levere data til skræddersyede opgaver.

[Kommunekort 2007](#)

[Nøgle mellem gamle og nye kommuner 1. januar 2005](#)

[Nøgle mellem gamle og nye kommuner \(Excel\)](#)

Danmarks Statistik - Sejrsgade 11 - 2100 København Ø - [dst@dst.dk](mailto:dst@dst.dk) - Tlf. 39 17 39 17

Søg >

A - Å (Efter emneord)

[Sitemap](#)

[RSS](#)

[Skriv e-post](#)

[English version](#)

**Vidste du at ...**

der i hver sjette trafikuheld med personskade er tale om spirituskørsel? I gennemsnit bliver næsten fire personer i Danmark kvæstet om dagen som følge af spirituskørsel.

[Statistikbanken](#)

**Hot spots**

**Forskningservice**  
Vi har sammen med ministeriet for Videnskab, Teknologi og Udvikling etableret en særlig enhed der hjælper forskere

[Læs mere](#)

**Om denne side**

Siden er senest redigeret: 27. februar 2006.

Tracking by Tobii

STUDY: dst\_sæt\_1. STIMULUS: dst. RECORDING: user01\_1.1. FRAME: http://www.dst.dk/Statistik/ags/Kommunalreform.aspx. TIME SEGMENT: Only include fixations inside interval [17891,61647] ms.



## Text reading

Simplification of language = faster reading and improved understanding

Number of fixations and order

Reading time

(Control questions)



## Original bureaucratic text

I henhold til Miljøministeriets bekendtgørelse nr. 131 af 21. marts 1993 "Bekendtgørelse om bortskaffelse, planlægning og registrering af affald" § 23, har Xkøbing Bysråd vedtaget nærværende regulativ for renovationsordningen i Xkøbing Kommune.



## Re-written text

Nu indfører vi kildesortering af affald i Xskøbing  
Kommune. Fra den 1. januar næste år skal alle  
husstande sortere affaldet efter de regler, som  
læse i den vedlagte folder.

Byrådet har vedtaget kildesorteringen i henhold til  
Miljøministeriets bekendtgørelse nr. 13 af 21. marts  
1993 om bortskaffelse, planlægning og registrering af  
affald" § 21.

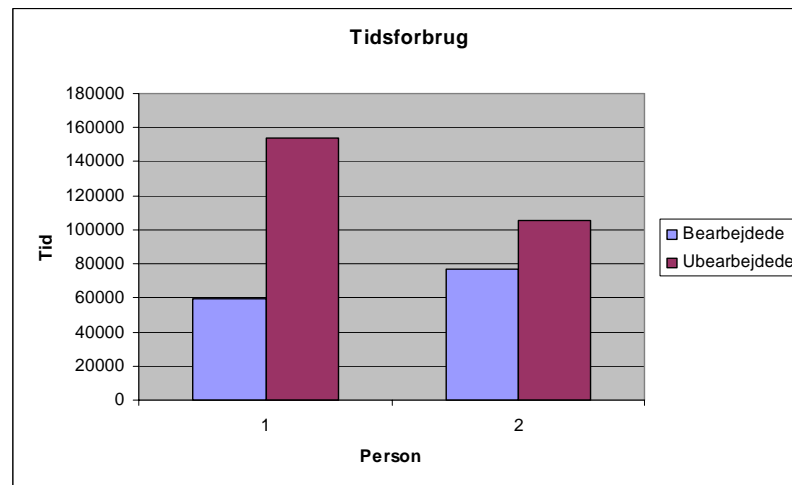
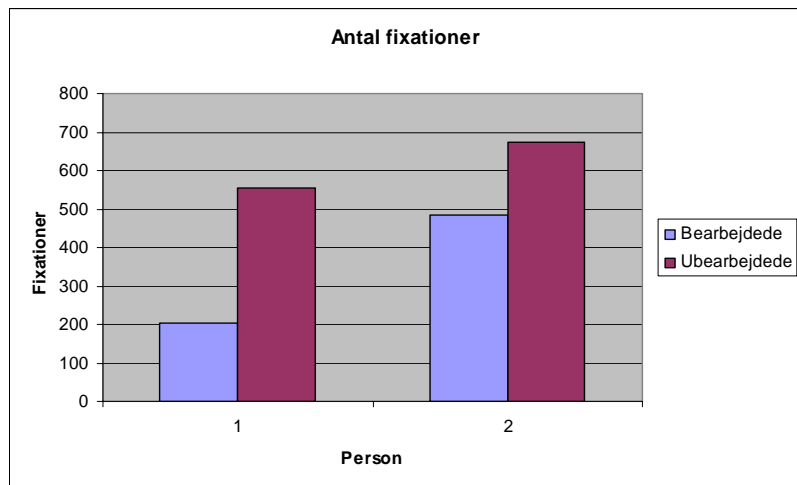
Tracking by Tobii

STUDY: nielschristian. STIMULUS: tekster\_slide. RECORDING: blar\_tekst. FRAME: Tekst9.jpg.  
TIME SEGMENT: Only include fixations inside interval [199397,217772] ms.





# Results



# Gaze Interaction

**Birger Bergmann Jeppesen**



1996 Diagnosed with ALS / MND

1998 Loss of muscle movement

Before he did loose his muscle control he went for a world travel.

Birger is living in is home and is provided with caretakers 24/7/365.

Yearly contribution from health authorities approx. 300.000 US\$

Birger is very active and he is the author of a book about his life with ALS and several DVD's.

Birgers quality of life depends on being able to communicate.

## ALS – Birger Bergmann Jeppesen



"Birger's quality of life depends on him to be able to communicate. I really hope his Birger keeps his ability to communicate. If it was taken away from him I know his quality of life would be reduced considerably"

# Arne Lykke Larsen



Diagnosed with ALS in 2000 at 35

Loss of muscle control 2002

Active GazeTalk user since 2002

Using GazeTalk for preparing his lectures at Odense University where he is working as professor in high-energy physics.

Arne uses GazeTalk for writing both danish and english.

He is now using a Quick Glance eye tracker at home and a Tobii system MyTobii P10 at work.

He has been using a BrainFinger EMG – switch for 6 month with GazeTalk.



How to communicate when you only can move your eyes?

# Numbers of ALS Patients in ALS/MND Alliance Countries and Regions



	Country, Region	Total No.	No. on Respirator	No. in TLS	Notes
<b>North</b>	<b>Canada</b>	<b>3,000</b>	<b>150</b>	<b>-</b>	
	<b>Mexico</b>	<b>1,040</b>	<b>31</b>	<b>0</b>	
	<b>U.S.</b>	<b>30,000</b>	<b>-</b>	<b>-</b>	
<b>Europe</b>	<b>Cyprus</b>	<b>40</b>	<b>5</b>	<b>0</b>	
	<b>Denmark</b>	<b>450</b>	<b>25</b>	<b>20</b>	
	<b>Germany</b>	<b>3,500</b>	<b>-</b>	<b>-</b>	
	<b>Iceland</b>	<b>20</b>	<b>-</b>	<b>-</b>	
	<b>Israel</b>	<b>600</b>	<b>-</b>	<b>-</b>	
	<b>Italy</b>	<b>5,000</b>	<b>-</b>	<b>-</b>	
	<b>Norway</b>	<b>200</b>	<b>17</b>	<b>0</b>	<b>Non Member</b>
	<b>Scotland</b>	<b>278</b>	<b>15</b>	<b>3</b>	
	<b>U.K.</b>	<b>4,000</b>	<b>40</b>	<b>0</b>	
<b>Asia</b>	<b>Japan</b>	<b>7,000</b>	<b>2,100</b>	<b>70</b>	
	<b>Korea</b>	<b>1,500-2,000</b>	<b>120</b>	<b>0</b>	
	<b>Singapore</b>	<b>10</b>	<b>-</b>	<b>-</b>	<b>Non Member</b>
	<b>Taiwan</b>	<b>250</b>	<b>69</b>	<b>25</b>	

**The investigation was done by e-mail. The numbers are not accurate.**



## Advantages of Gaze Communication



Relative fast typing + 10wpm

Easy to learn from zero to 2.5 hours

No muscle strain – several working hours possible

Can be used at late stages of ALS/MND

May give access to a range of PC applications

Very active research and production development in domain



# Communication speeds

Speech	150–250 wpm
Traditional typewriting	65 wpm
Stylus tapping on screen keyboard	9–30 wpm
Cursive handwriting	30 wpm
Morse code	25–30 wpm
Reading	200 - 400 wpm
Mobile phone: Multi Tap	8 wpm
Mobile phone: T9	20 wpm
Various AAC systems	2–8 wpm
Gaze typing with full on-screen keyboard	7 wpm
Gaze typing with large button keyboard	10 wpm
Gaze writing with Dasher	25 wpm

## Dis – advantages of Gaze Communication



Expensive hardware

Not possible to select small objects

Sensitive to sunlight or other light sources

Problem with vision correction means

- Bi-focal glasses

- Hard lenses

Physical limitations

May take to much time to master



## Effectiveness requirements for gaze communication system

Row – column manual scanning

High availability

Instant operation

Robust

Mobile

Affordable

Usable at all stages of ALS/MND

Easy to learn



## Stages of ALS/MND that gaze communication can support

Loss of voice

Deterioration of leg / arm movement

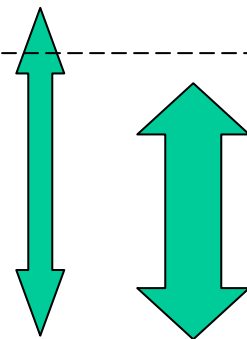
Limited movement of head / hand

Only eye movement / facial  
muscle control

No eye – movement (locked – in) EMG

Hitachi "Kokoro Gatari"

Brain Finger



# GazeTalk



Communication software  
On – screen key board  
    limited numbers of keys

Write  
Type – to – talk  
Prediction  
    Characters and words

Smooth reading PDF files  
Multimedia support  
    Movies – Music

Web – browser

Front end to full text database  
    Archive of Danish literature

Multi lingual

Developed in cooperation with 4 people with ALS





## Gazetalk – video demo



[gazetalk\\_jp\\_final.mov](#)



## Library access (OPAC)

Access to database's (Library indexes or Full-text journals)

Studies shows that even if database hosts follow accessibility standards for interface design the actual interface may not be usable

One host = one interface

People with little muscle control (locked-in syndrome)

Late stage Amyotrophic Lateral Sclerosis (ALS/MND)

Spinal core injuries

Alternative input devices



# Interfaces

ISI Web of Knowledge™

Web of Science

GO

HOME

LOG OUT

Web of Science®

Information for New Users

Coming soon: A new interface. A new approach.

Find out more and view a short recorded training session

Select a search option:

GENERAL SEARCH

CITED REF SEARCH

ADVANCED SEARCH

Quick search:

Enter a topic

SEARCH

Example: tuberculosis vaccine\*

Author Finder:

Need help finding papers by an author? Use Author Finder. **NEW!**

OPEN SAVED SEARCH

Open a previously saved search history.

Select database(s) and timespan:

Citation Databases:

☒ Science Citation Index Expanded (SCI-EXPANDED)--1945-present

☒ Social Sciences Citation Index (SSCI)--1956-present

☒ Arts & Humanities Citation Index (A&HCI)--1975-present

Latest

1 week

Year

2007

From

1945-1954

To remember these settings

NOTICES

TUTORIAL

EDUCATIONAL MATERIALS

TECHNICAL SUPPORT

The Notices file was last updated 4/3/2007

Please give us your [feedback](#) on using the ISI Web of Knowledge

[Acceptable Use Policy](#)

Copyright © 2007 The Thomson Corporation

Danmarks Biblioteksskoles Bibliotek

English

Bruger-id:

PIN:

Login

Biblioteksinformation

Nye bøger

Tilbage

Hjælp

Log ud

Bibliotekskatalog

Søgetips

Hjemmesiden

Bestillinger

Lånerstatus

Kontakt

Hyperion Digitalt Arkiv

Ord eller sætning

Forfatter

Titel

Emne

Serie

Tidsskrifttitel

UDK

Og

Og

Og

Og

Og

Og

Søg

Nulstil

Sprog: ALLE

Publikationstype: Alle

Placering: Alle

Materialekategori: Alle

Begræns til studenteropgaver: Alle

Match på: Stikord

Udgivelsesår:

Sortér efter: Ingen

Bladresonering

Bladre på hylden

Tilbage

Hjælp

Log ud



## Technologies available

### Low tech

- Human assistance

- Intrusive

- Slow

### High tech

- Gaze interaction

- Facial EMG-switch (Brainfingers)

- Autonomy

- faster



## Project

### Scope:

To design and test a generic interface for access to library resources  
In collaboration with the Royal Library in Copenhagen  
Archive of Danish Literature (ADL)

### Size

70 authors

App. 17000 works (books, poems etc.)

Text available in xml partially according to TEI-DTD (Text Encoding Initiative Document Type Definition)

<pb> (page break used for page numbers!!)

No MARC – records

Page by page storage



## Access

Library specific standards available

- Federated search

  - SRW based on Z39.50

- Retrieval of bibliographic records not full text

- Not supported by e-journals

A solution?

- Web-service technology

- SOAP – WDSL (REST) – XML –XSL(T)



## Web-service

*“A web service is a software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-processable format (Specifically WSDL). Other systems interact with the Web service in a manner prescribed by its description using SOAP-messages, typically conveyed using HTTP with an XML serialization in conjunction with other Web-related standards” (W3C, 2003)*

Used by

- Google

- Amazon

- Weather forecast services



## Web-service

+

Control of user interface design

One client – one design – many hosts

Adaptable

Tailored to the individual user

Standardized

-

Data intensive

Standardized





# Web-service

