

EYEWEAR COMPUTING

Augmenting the Human Mind

Kai Kunze kai@kmd.keio.ac.jp

Keio Media Design, Japan

OVERVIEW



Background

Physical Activity Recognition becomes mainstream

Cognitive Activity Recognition

Focus on Reading Activities

Cognitive Activity Recognition for Everybody

Demos (hopefully ...)

Outlook: Enabling Technologies



Bavaria from Passau, Bavaria.



BACKGROUND



Project Associate Professor

Graduate School of Media Design, Keio University

Research Assistant Professor

Osaka Prefecture University

Visiting Researcher at MIT Media Lab

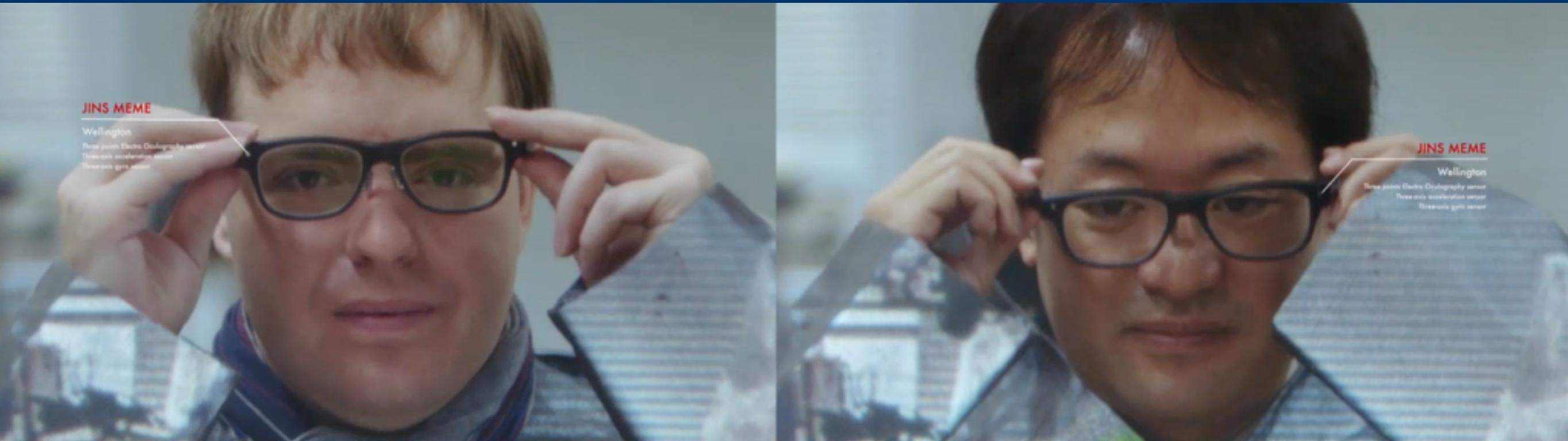
MIT, Cambridge, USA

phD in Ubiquitous/Wearable Computing

University Passau, Germany

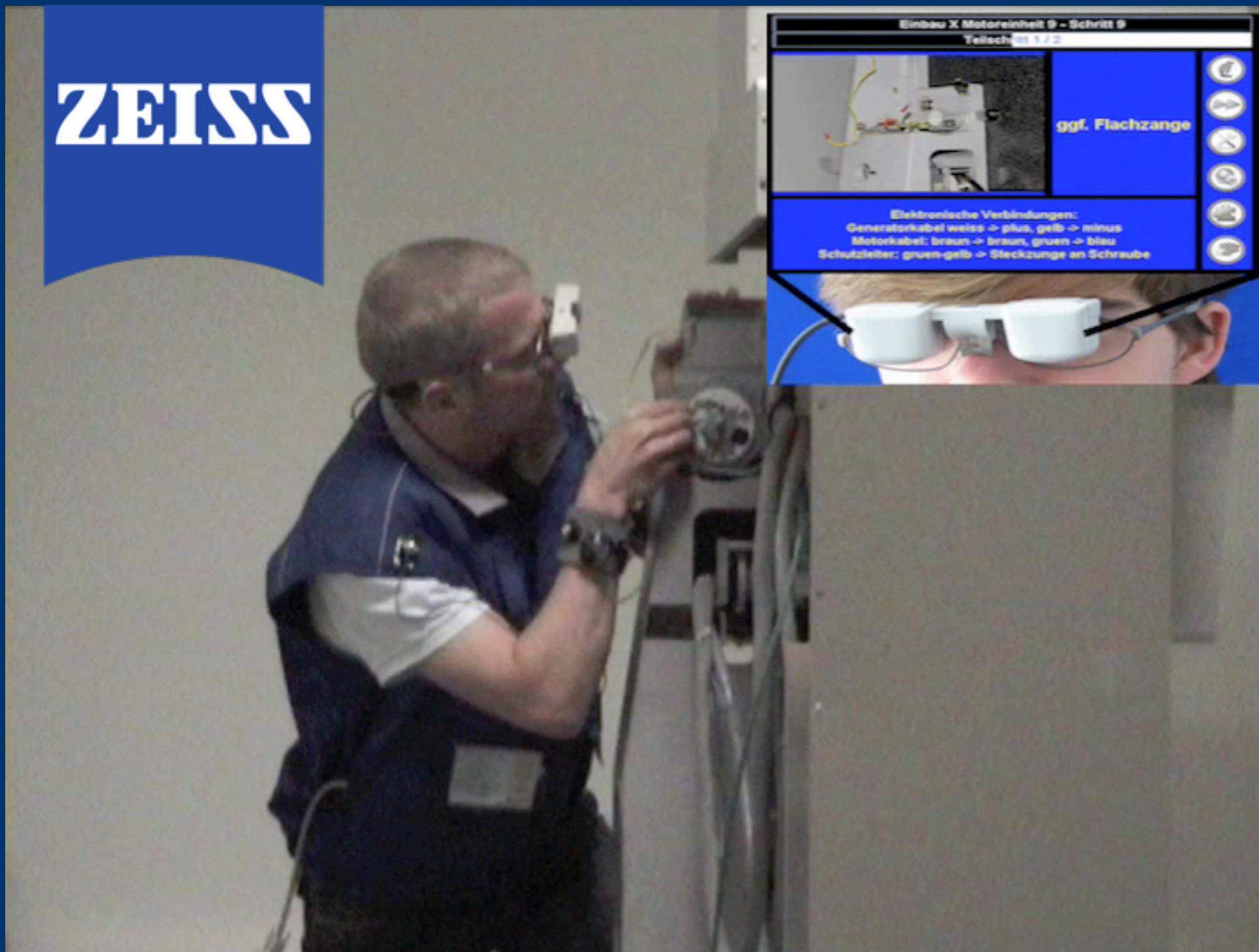
Collaborations with PARC, SUN, Deutsche Börse ...

Palo Alto, Grenoble , Frankfurt



WEARALBE COMPUTING ~2006

Maintenance Scenario Collaboration with Zeiss, Oberkochen.



*Kai Kunze, Florian Wagner,
Ersun Kartal, Ernesto
Morales Kluge, Paul
Lukowicz: Does Context
Matter ? - A Quantitative
Evaluation in a Real World
Maintenance Scenario.
Pervasive 2009, Nara, Japan.*

PHYSICAL ACTIVITY RECOGNITION BECOMES MAINSTREAM



Kunze Kai. Compensating for On-Body Placement Effects in Activity Recognition, 2011.

Cognitive Activity Recognition

Can we get some hints on what's going on in your mind using simple sensors during everyday life?

We started with tracking reading habits (reading life log)

People who read more

higher vocabulary skill

higher general knowledge [1]

If you give quantified feedback people can improve their habits
similar to apps/devices that track fitness and health
quantify progress education and life-long learning



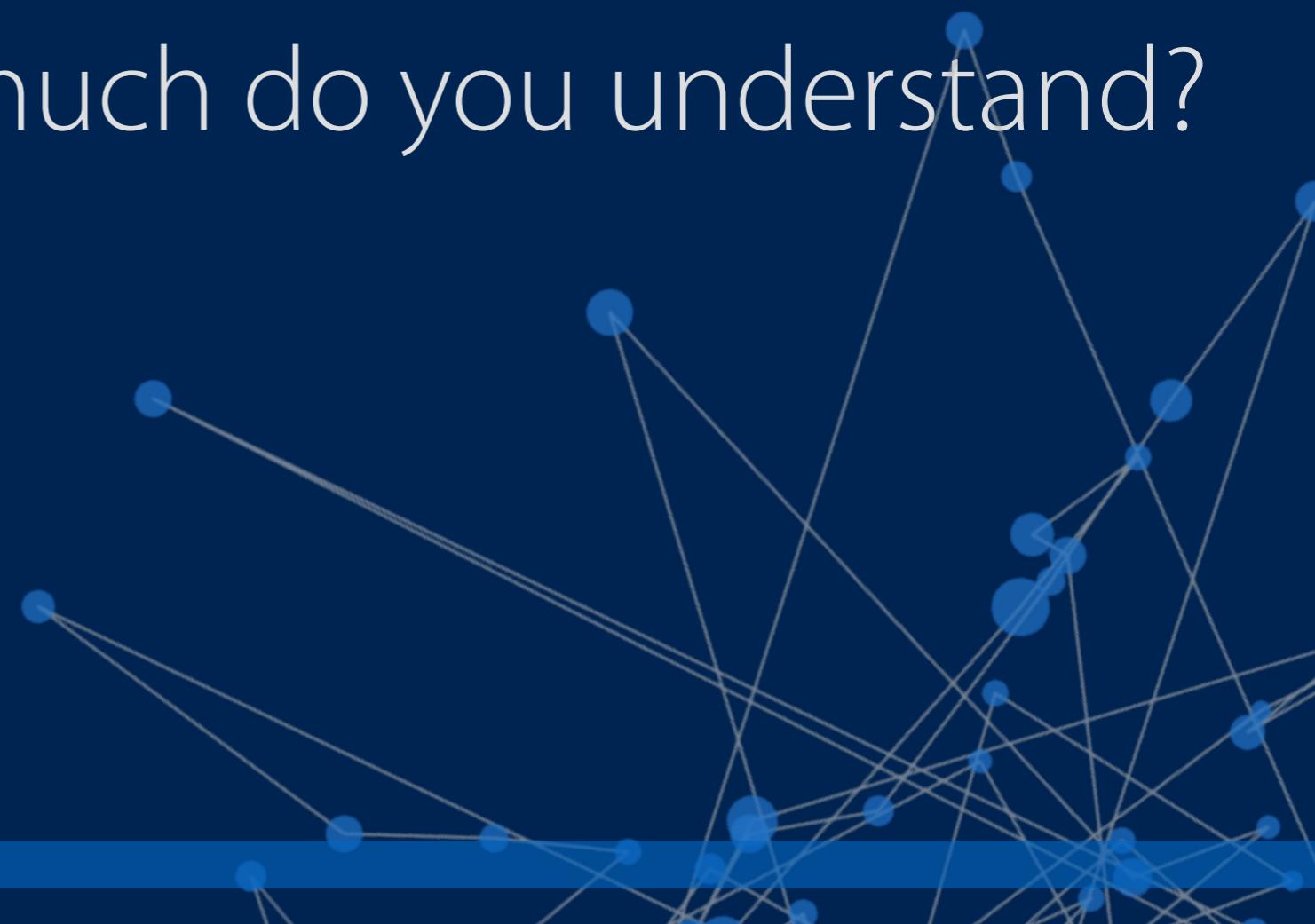
[1] A. Cunningham and K. Stanovich. What reading does for the mind. *Journal of Direct Instruction*, 1(2):137–149, 2001.

“Can I copy the habits of my thesis advisor to become a better researcher?”

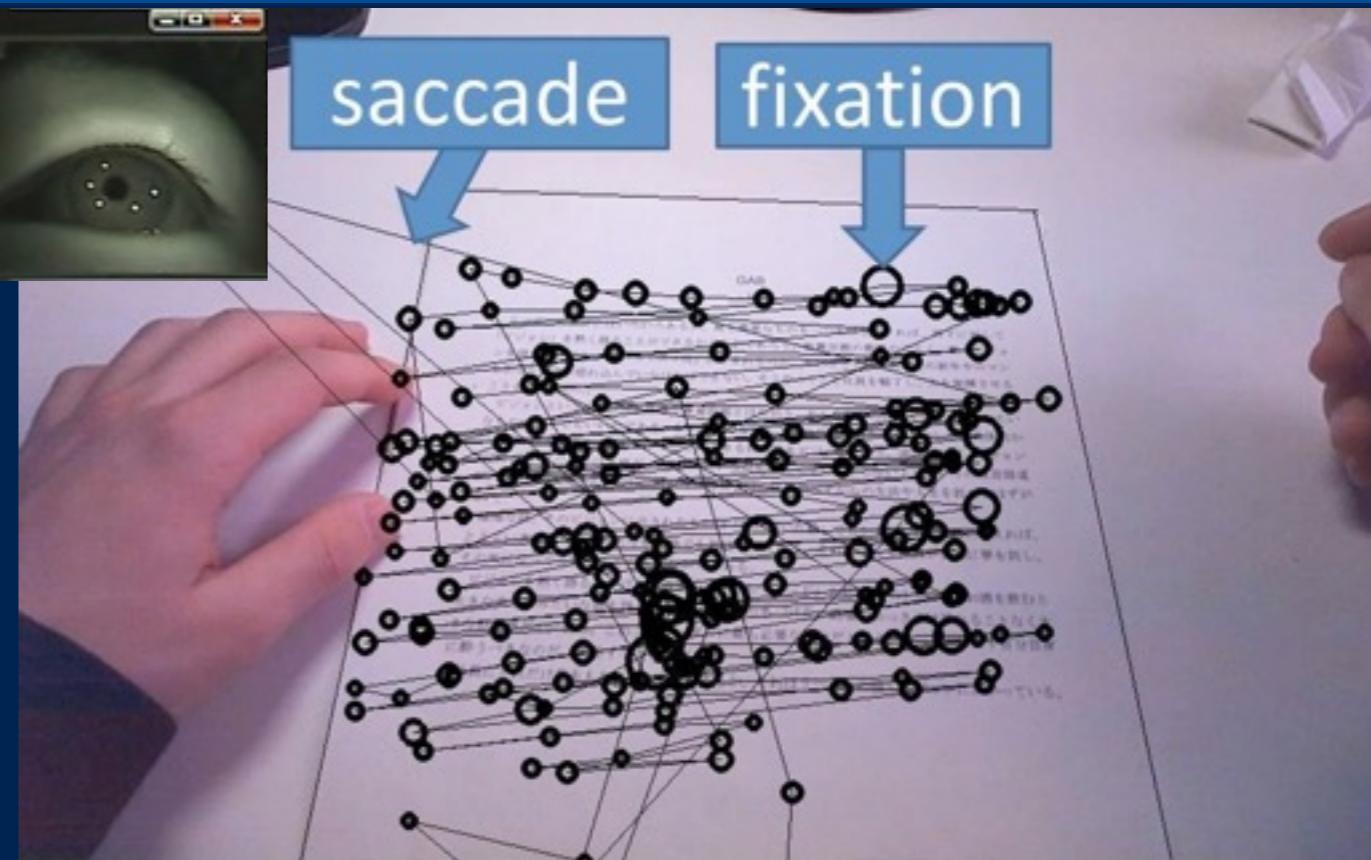
How much are you reading?

What are you reading?

How much do you understand?



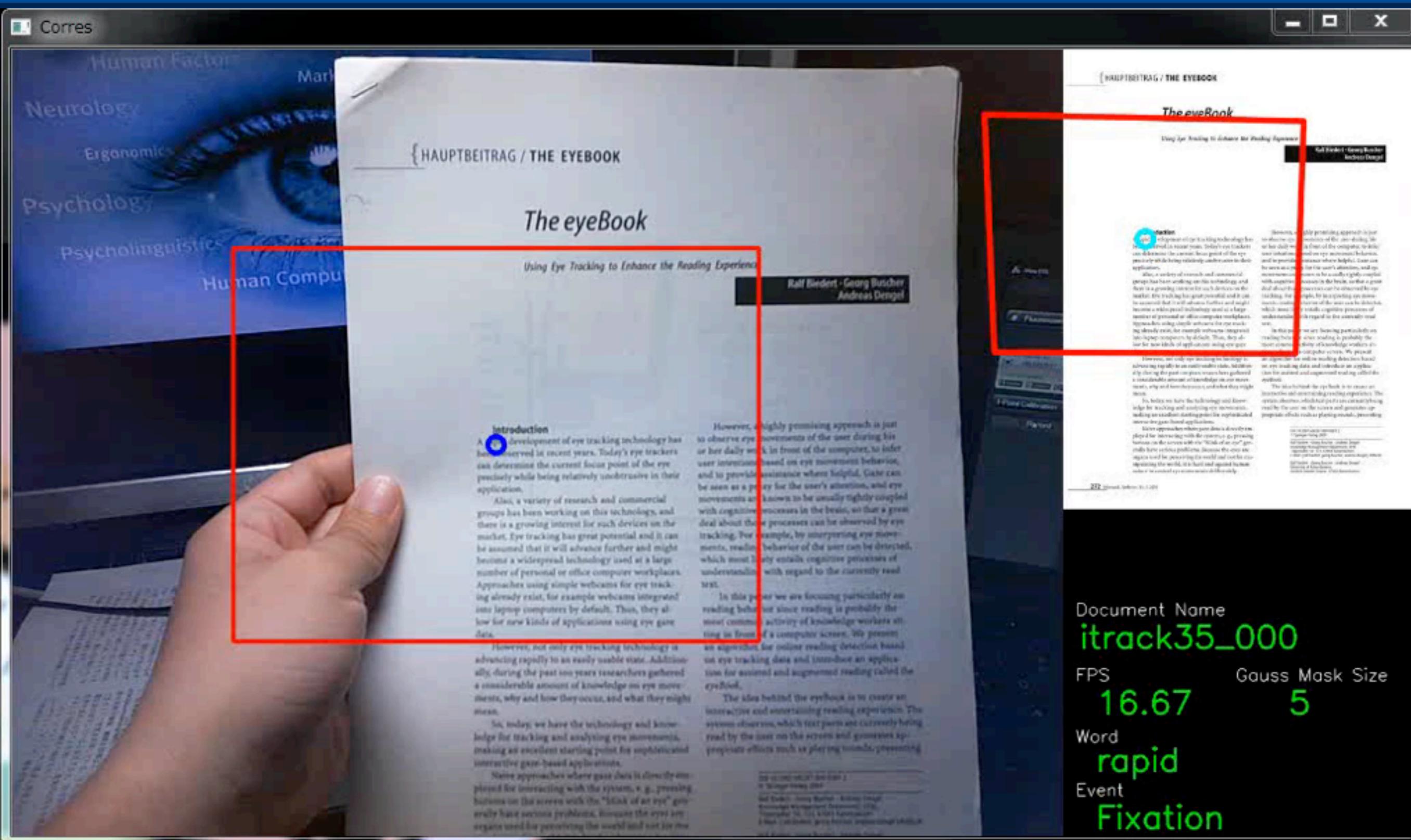
Wordometer - Count how much words you read



I always been a bit of an entertainer and played the funny man. I was a part-time media or , so I learned how to stand in front of audiences. It made me sure of myself. I like being liked and I love making everyone smile.

K. Kunze, H. Kawaichi, K. Yoshimura, K. Kise.
The Wordometer – Estimating the Number of Words Read
Using Document Image Retrieval and Mobile Eye Tracking
ICDAR 2013. Best Paper Award

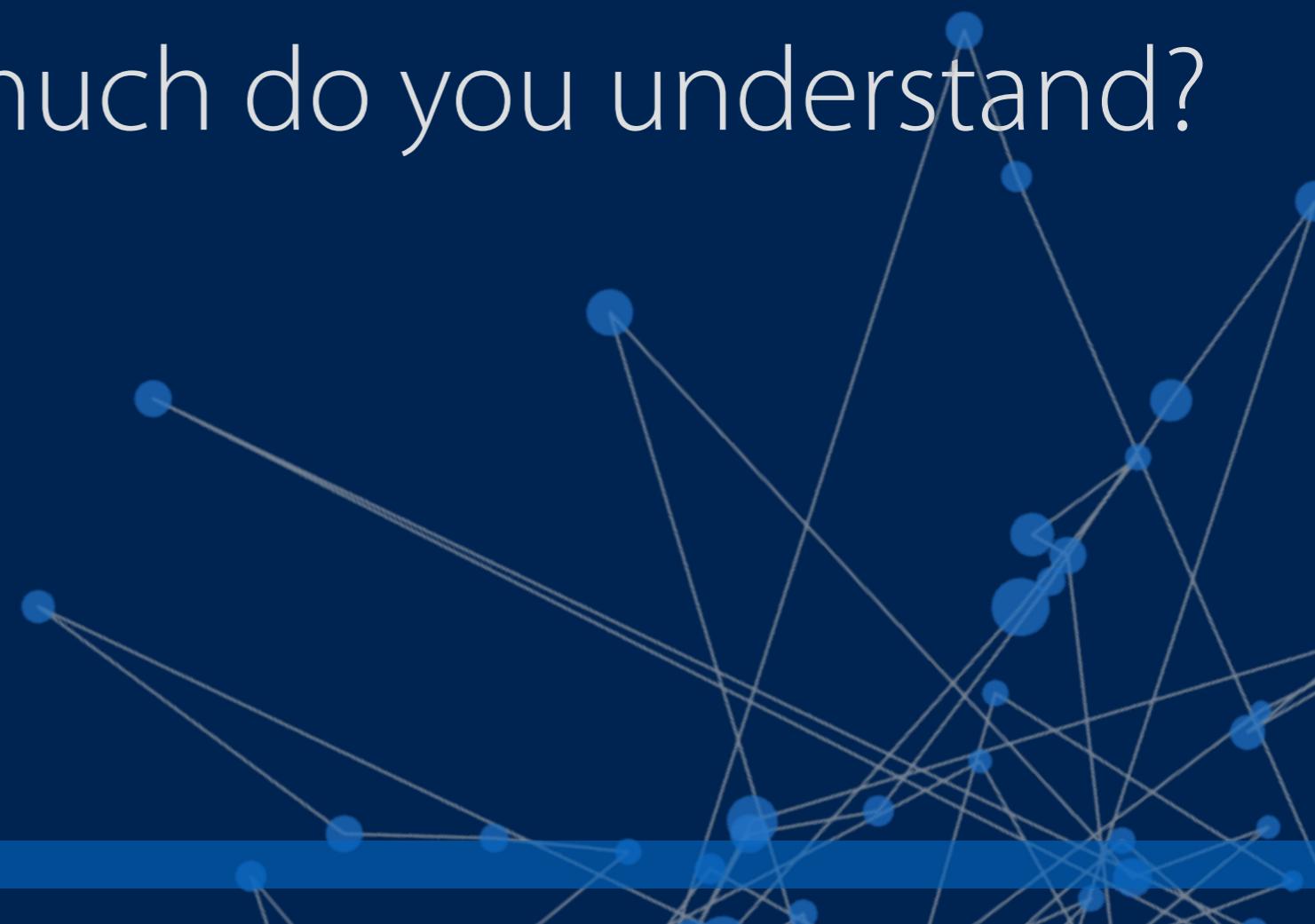
Reading Life Log - Document Image Retrieval and Eye Gaze



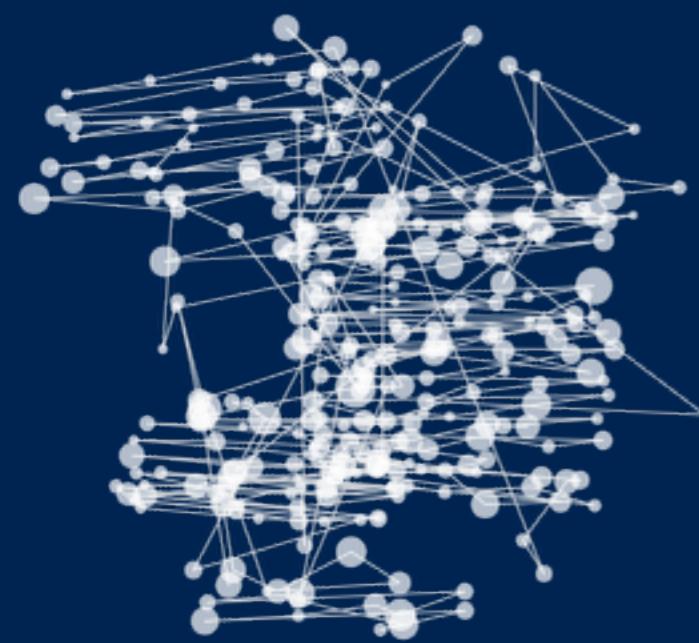
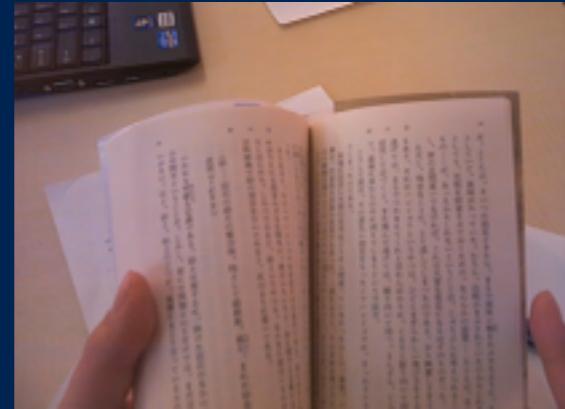
How much are you reading?

What are you reading?

How much do you understand?



Document Type Classification

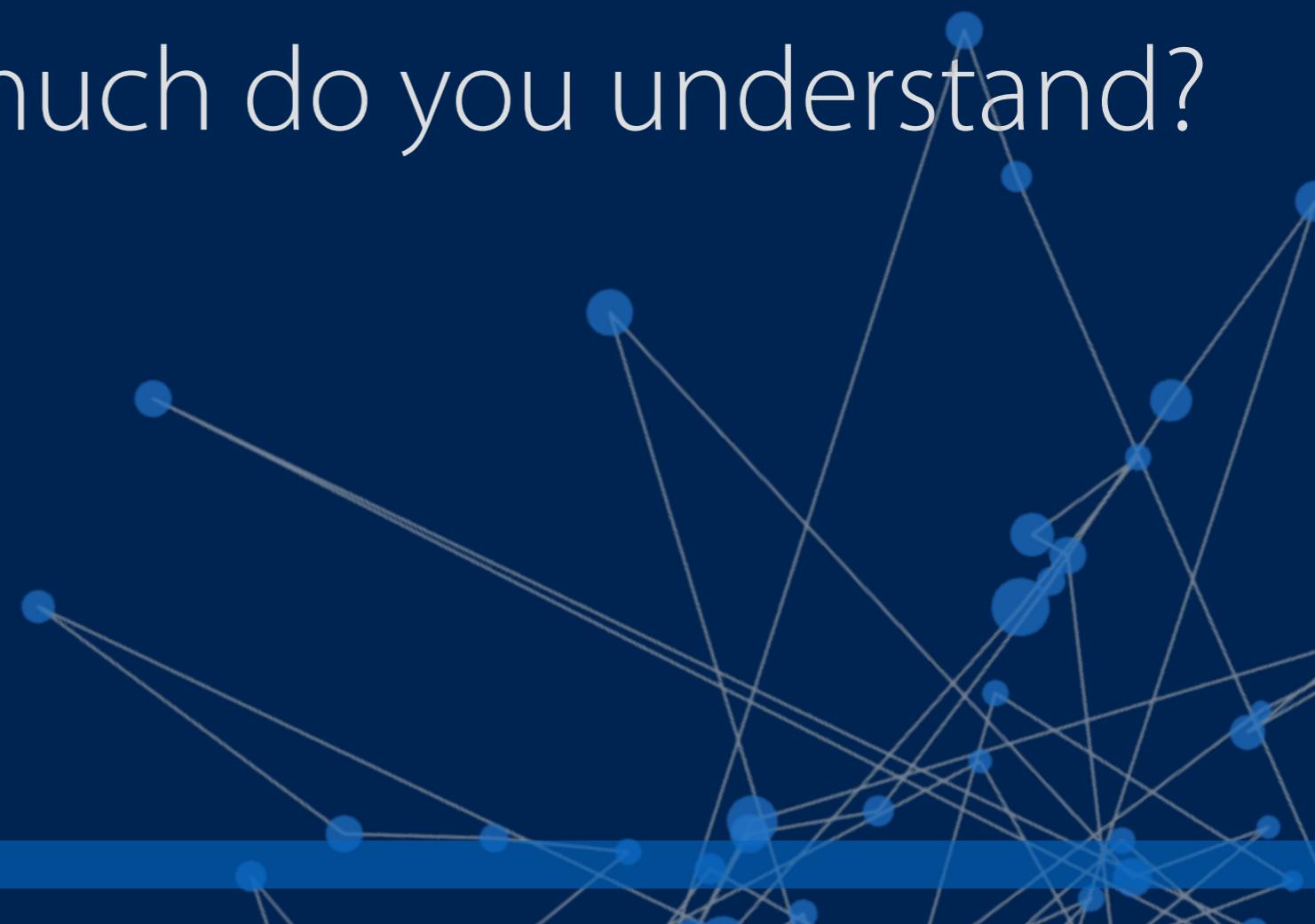


Kai Kunze, Andreas Bulling, Yuzuko Utsumi, Koichi Kise. I know what you are reading – Recognition of document types using mobile eye tracking, ISWC 2013, Zurich.

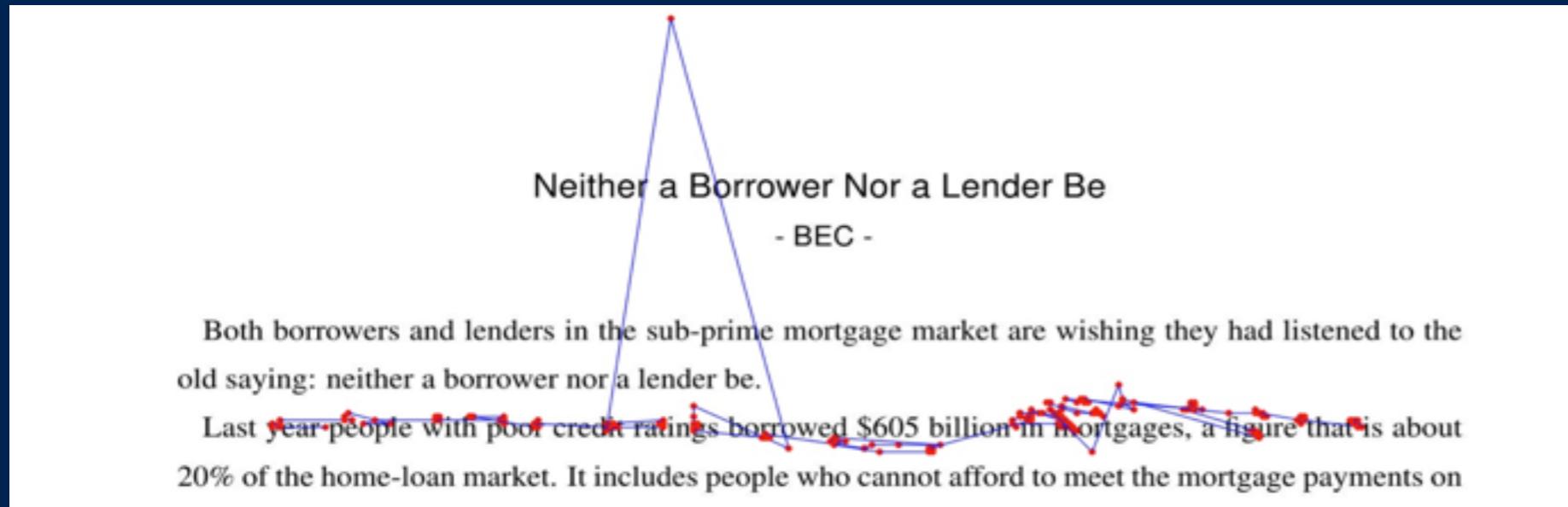
How much are you reading?

What are you reading?

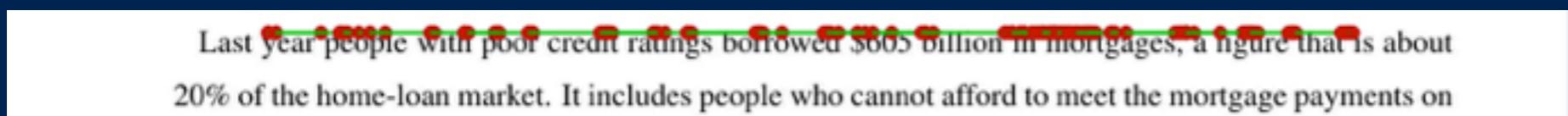
How much do you understand?



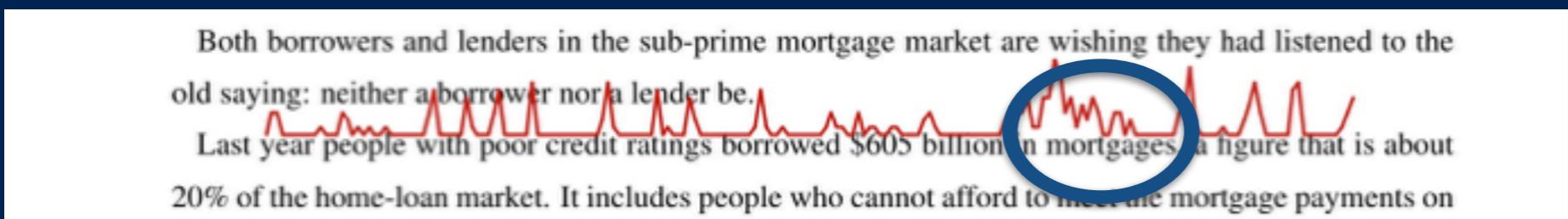
Detecting Difficult Words - Trying to Infer TOEIC Scores



Eye-gaze translated to document coordinates



Horizontal projection



Histogram

future work: a fitbit for the mind?

The screenshot shows the read.it dashboard interface. At the top, there's a navigation bar with icons for back, forward, search, and user profile, followed by links for Dashboard, Log, Community, Premium, STORE, and a user icon. Below the navigation is a date header 'THURSDAY August 08' with arrows for navigation.

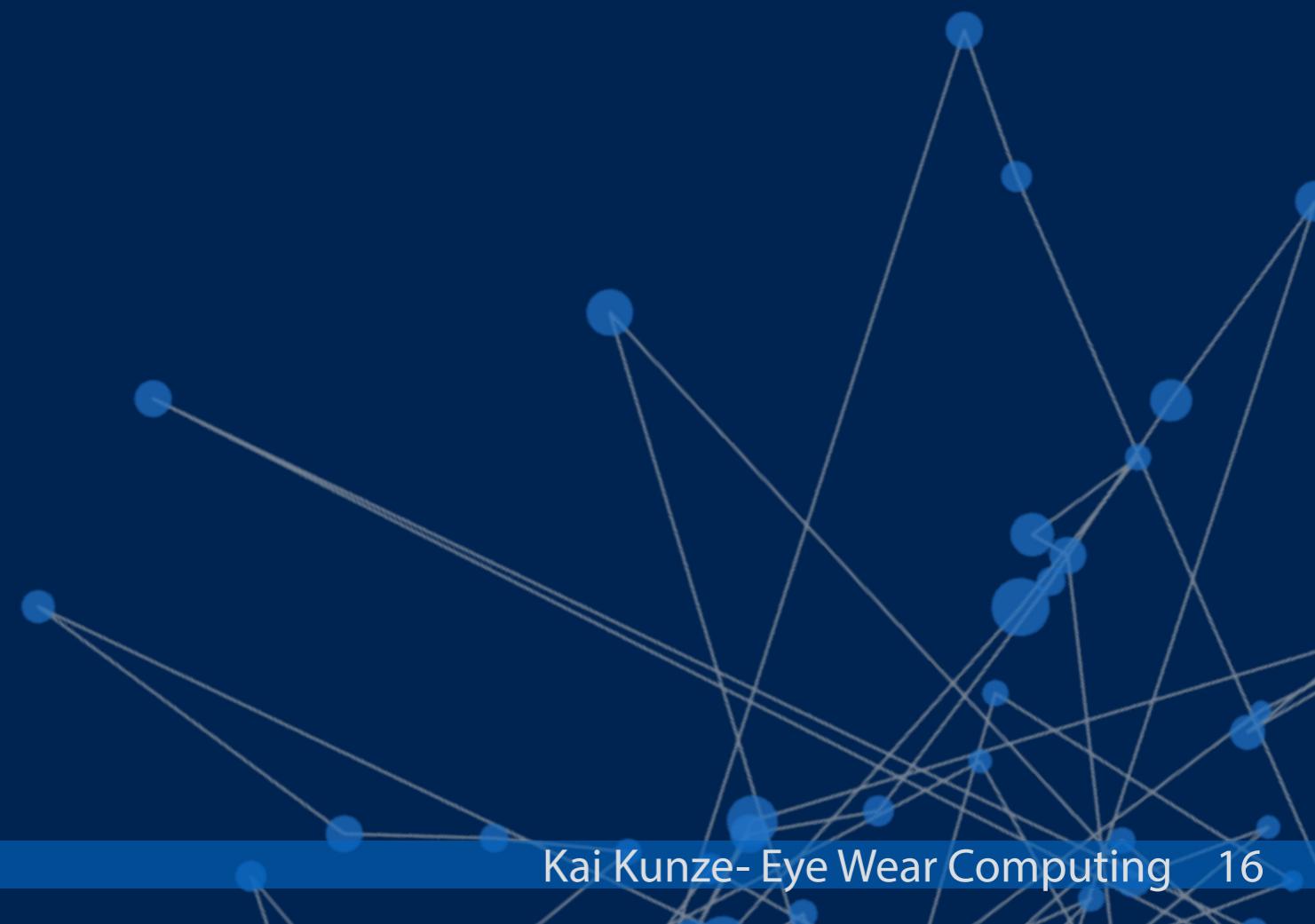
The main area is divided into several sections:

- Activity**: A bar chart titled "words read" showing word count over time from 00 to 24 hours. The y-axis ranges from 0 to 1,500. The chart shows peaks around 10:00, 12:00, 13:00, 18:00, and 22:00.
- word count**: A circular gauge with a book icon in the center, showing a value of 8497.
- Manga**: A circular gauge with a manga character icon, showing 15 pages.
- Science Papers**: A circular gauge with a laboratory flask icon, showing 20 pages.
- Concentrated Reading**: A circular gauge with a brain icon, showing 30 min.
- Friends**: A list of friends with their activity counts:
 - You: 67,071
 - codysumter: 36,155
 - Sulistyo: 24,538
 - Jessy: 13,868
 - Shoya I.: No recent activity
 - ubiquitousdudu: No recent activity
 - James: No recent activityA cartoon illustration of a girl thinking is positioned next to the friend list.
- Overview**: A blue bar at the bottom left.
- Top Badges**: A blue bar at the bottom right.

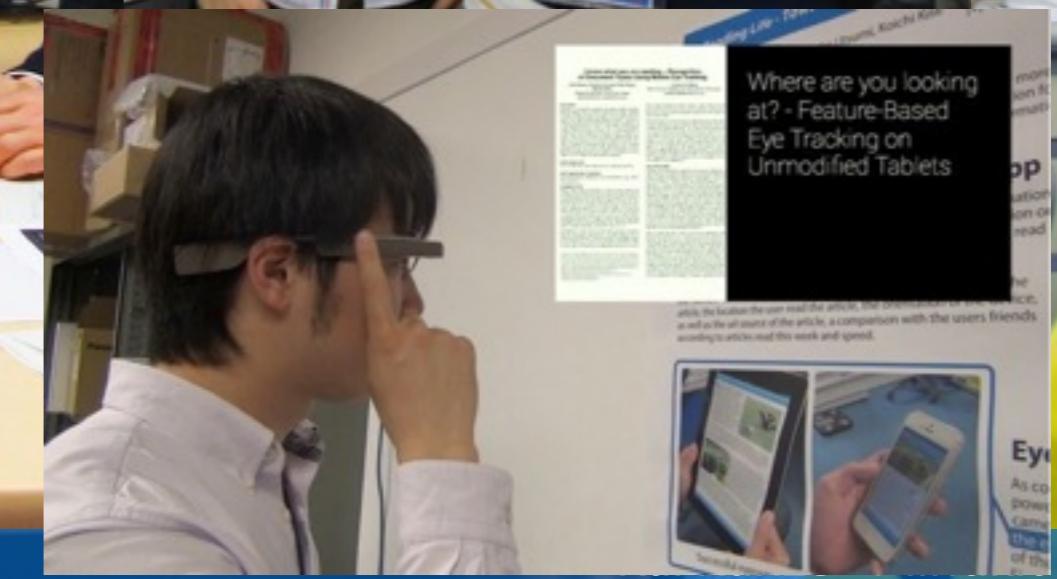
At the very bottom, the text "Kai Kunze- Eye Wear Computing" and the page number "15" are visible.

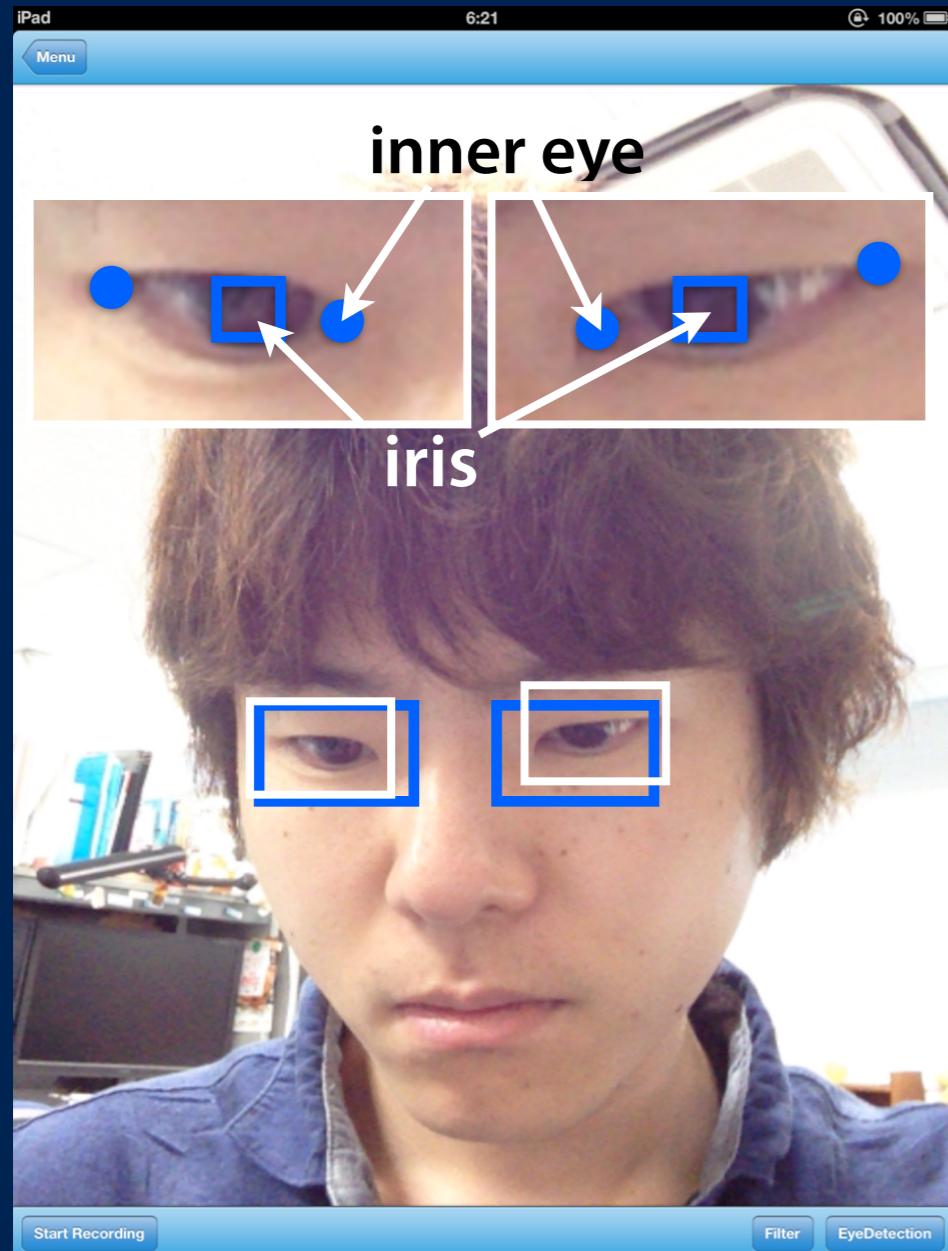
Cognitive Activity Tracking,
a First Step Towards a Goal:

Enhance our Critical Thinking Skills with Technology
Improve the Collective Intelligence of Society



Cognitive Activity Tracking for Everybody





Demo: Towards Eye-tracking on Tablets/Phones

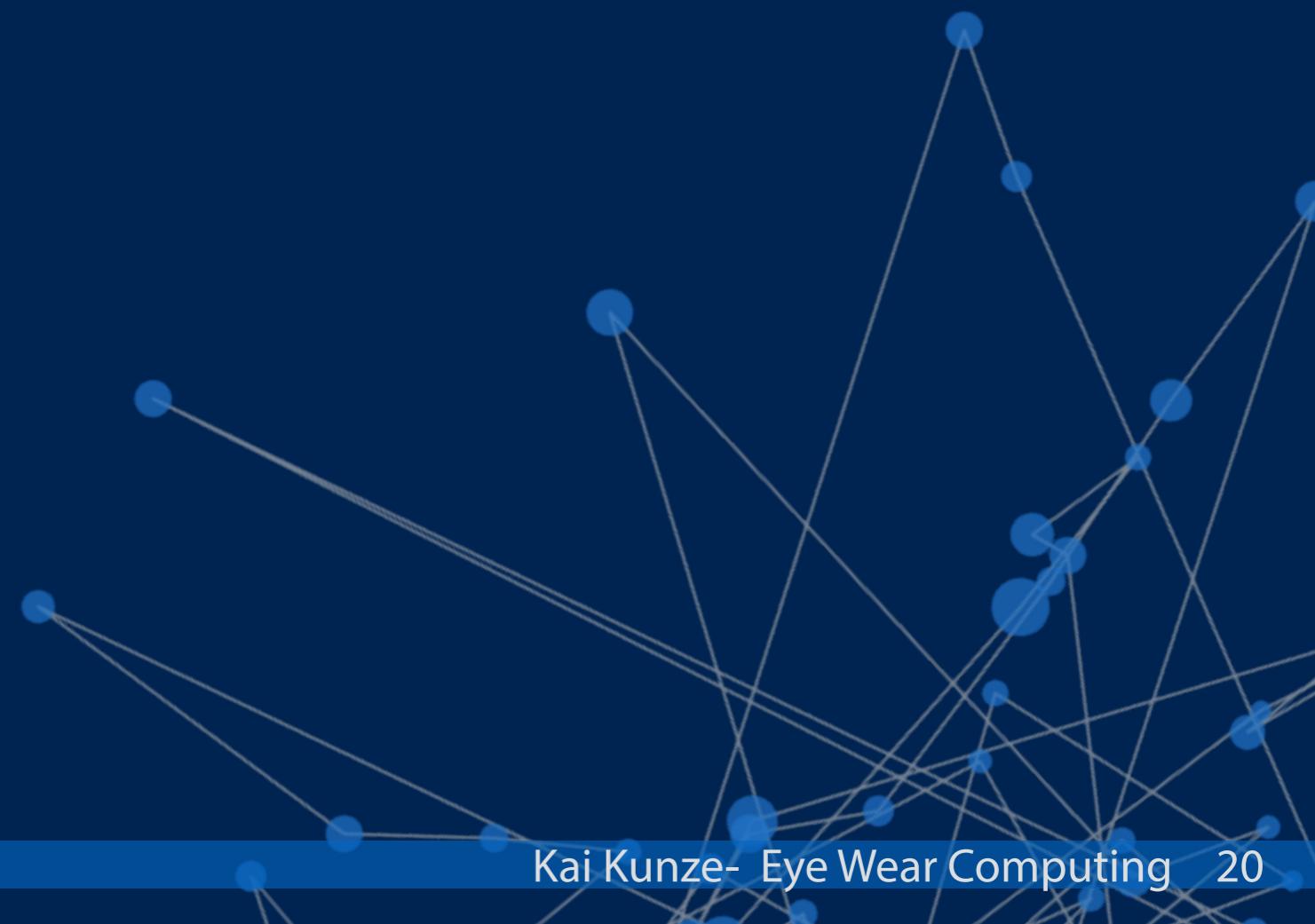


Cognitive Activity Tracking for Everybody



Demo

Blink Detection and Activity Recognition on Google Glass



Blinks and Head Motions

Distinguishing closely related activities



reading



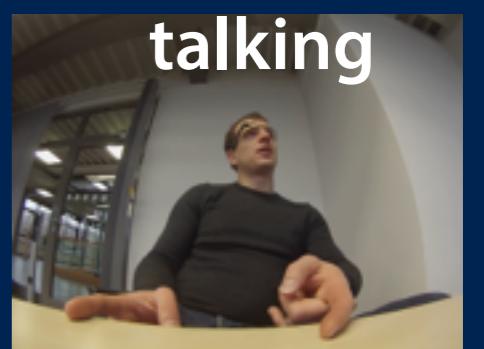
watching



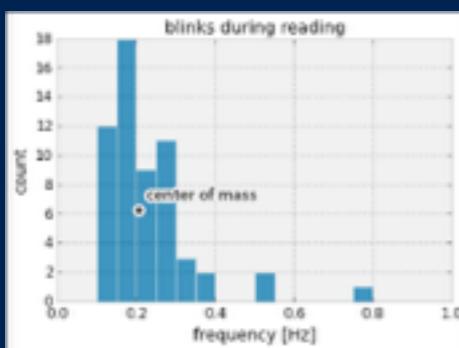
solving



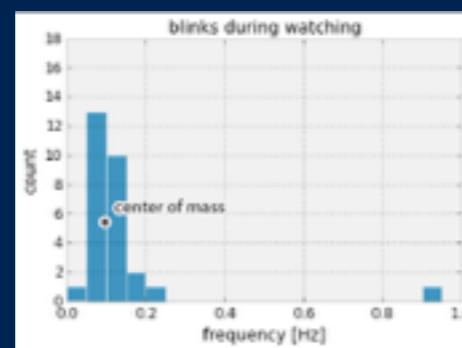
sawing



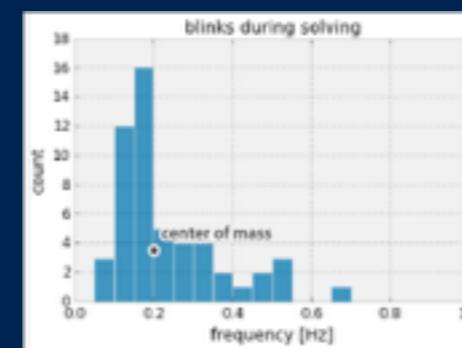
talking



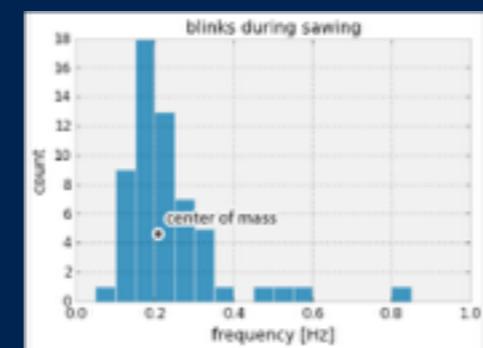
blinks during reading



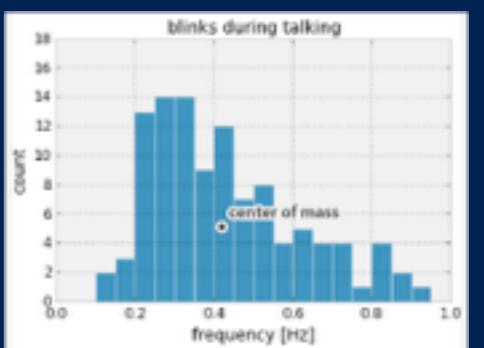
blinks during watching



blinks during solving



blinks during sawing



blinks during talking

67 % recognition accuracy for eye blink only, 82 % with head motion patterns

*In the Blink of an Eye - Combining Head Motion and Eye Blink Frequency for Activity Recognition with Google Glass.
Shoya Ishimaru, Jens Weppner, Kai Kunze, Andreas Bulling, Koichi Kise, Andreas Dengel and Paul Lukowicz.
Proceedings of the 5th Augmented Human International Conference. 2014.*

Cognitive Activity Tracking for Everybody



J!NS M3ME

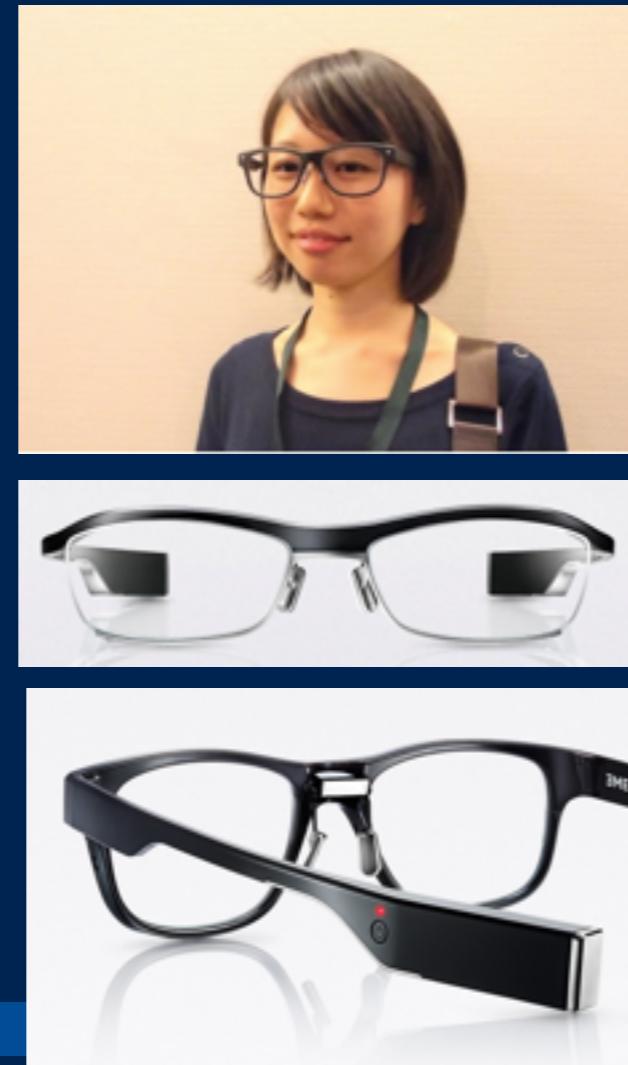
J!NS MEME

J!NS: a Japanese glasses company
very different idea from Google Glass
Not a full fledged computer!
no display, NO camera
a sensing device connected to phone.

Electrooculography
(detects eye movements)
and motion sensors
(accelerometer and gyro)

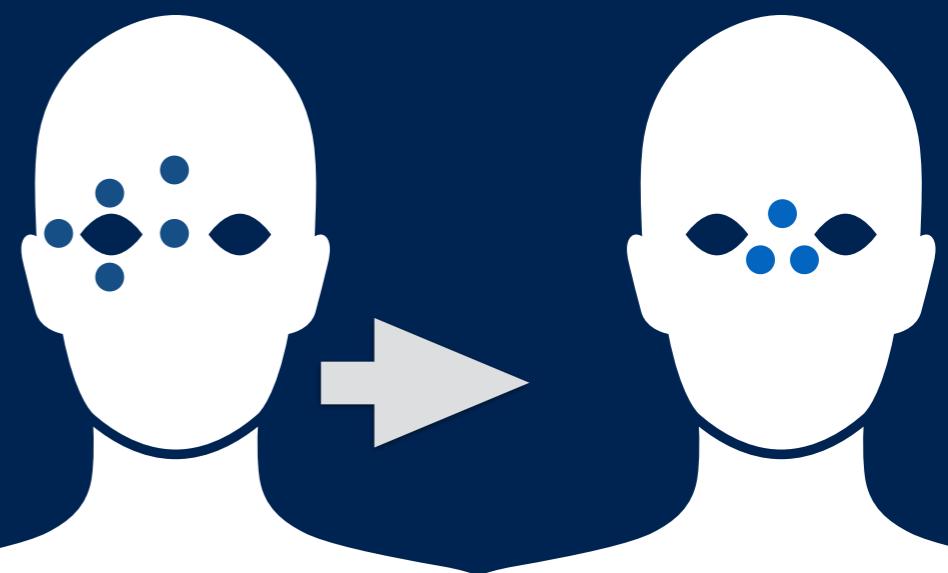
We are working with J!NS
on MEME research

[https://www.jins-jp.com/
jinsmeme/en/](https://www.jins-jp.com/jinsmeme/en/)



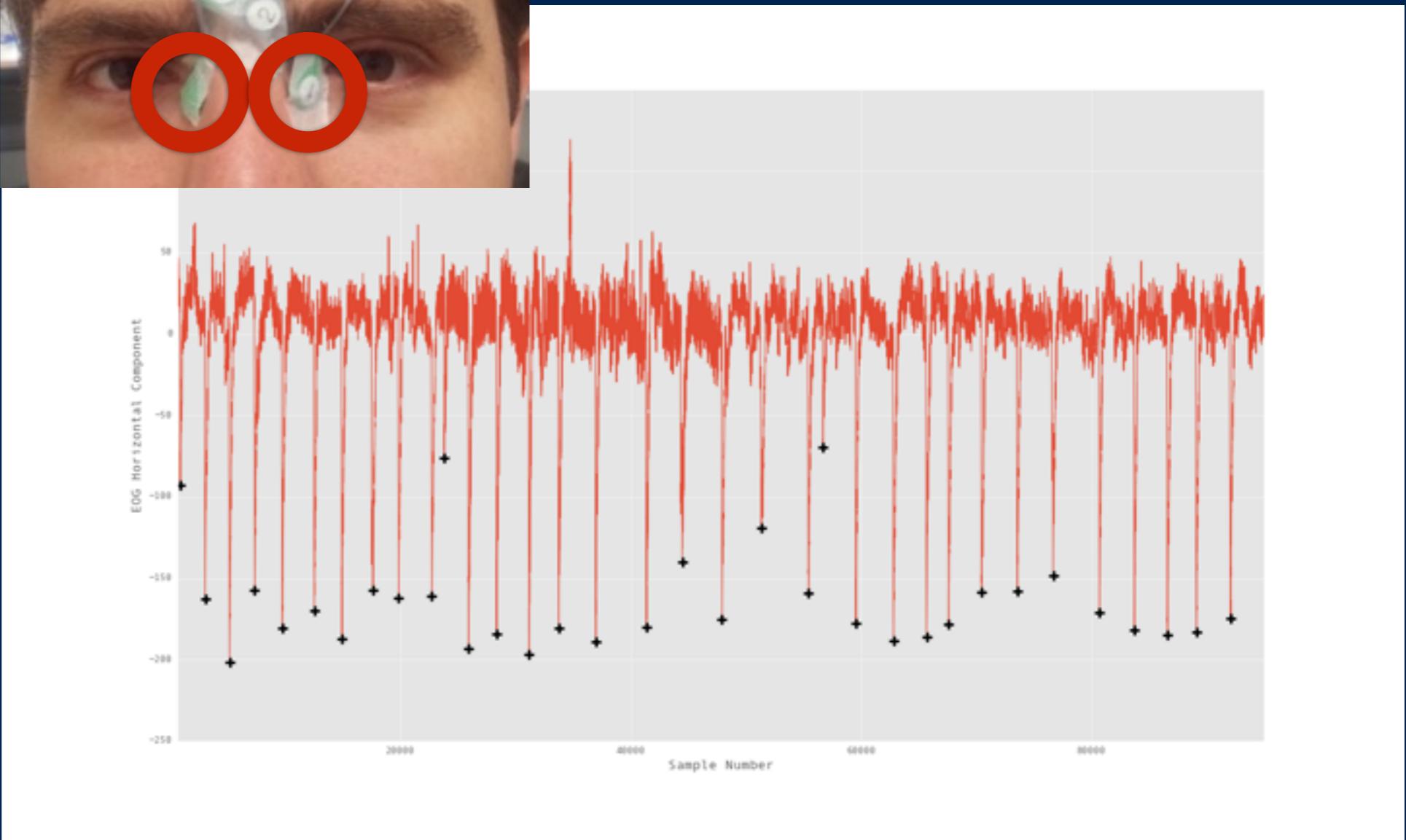
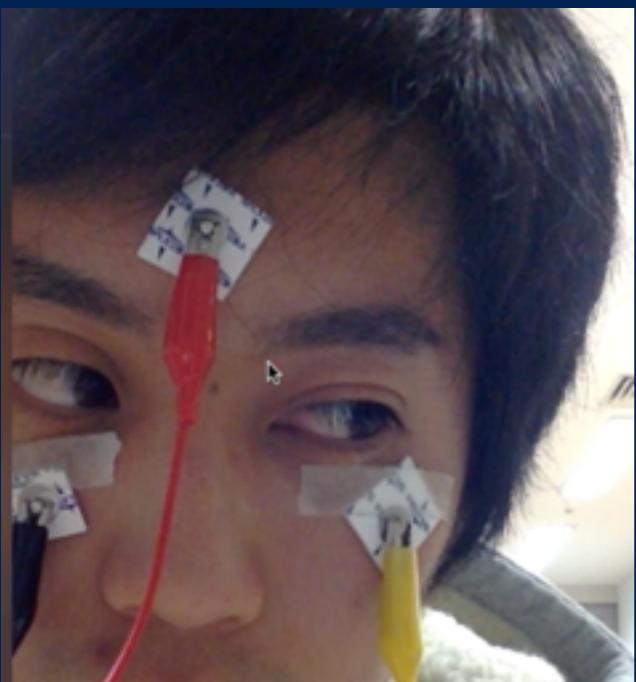
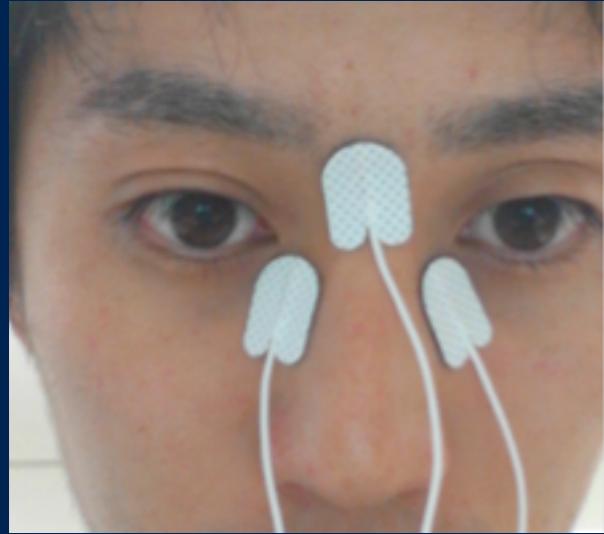
Innovative Tech Price
Digital Content Expo, Tokyo
<http://www.dceexpo.jp/?lang=en>

[http://www.digitaltrends.com/ces/
top-tech-of-ces-2015-award-
winners/](http://www.digitaltrends.com/ces-top-tech-of-ces-2015-award-winners/)



Activity Recognition on MEME

Can EOG be used for Reading Tracking?



Media Echo



Reading The Reader. New Scientist, Print Feb. 2014



Bits and Bytes instead of the bookshelf. Die Woche from Spektrum der Wissenschaft (German issue of the Scientific American). Oct. 2014



Article about future of reading Stuttgarter Zeitung. Dec 2013

01.01.2015 13:16

 « Vorige | Nächste »

31C3: Mit smarten Brillen das Gehirn ausforschen UPDATE

worlesen / MP3-Download



Mit intelligenten Augengläsern lassen sich nicht nur Pupillen- und Lidbewegungen verfolgen sowie Ermüdungserscheinungen feststellen, sondern auch Gehirnaktivitäten messen, weiß Informatikprofessor Kai Kunze.

Wearable Sensing in Spare-time Sports. Newton- Science Magazine, ORF 1st Austrian TV Channel, 2009.

“Wir sind die Borg” - Wearable Computing Interview with ComputerWoche (biggest German IT Newspaper), Dec. 2008.

Helmet to offer tongue-in-cheek gadget control, New Scientist Website, Apr.2014.

• •

Brain Jogging: Fitbit for the Mind, How?

read.it

Dashboard

Log

Community

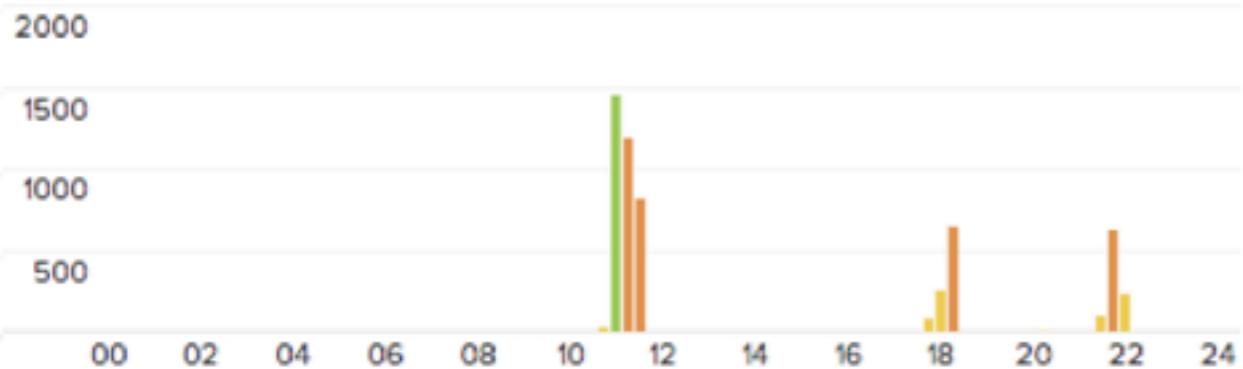
Premium

STORE



< | > Sunday JUNE 30

Activity

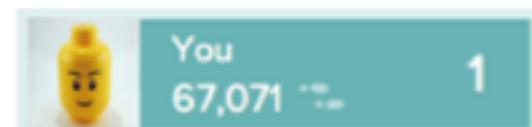


Word Count

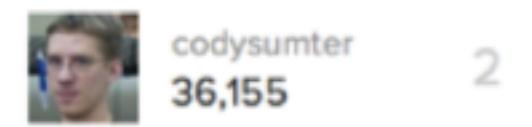


6707 words

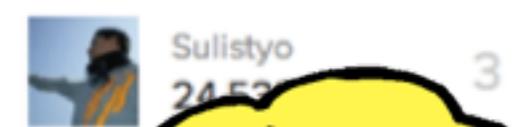
Friends



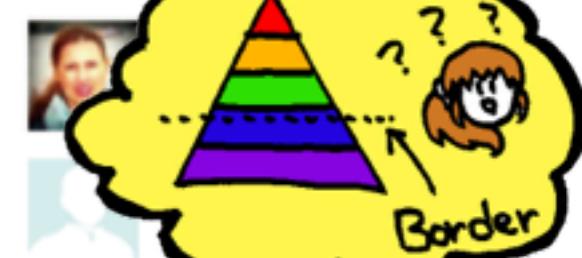
You
67,071



codysumter
36,155



Sulistyo
24,523



New Words



170 words

Reading Speed



210 words/min

Concentrated Reading



30 min

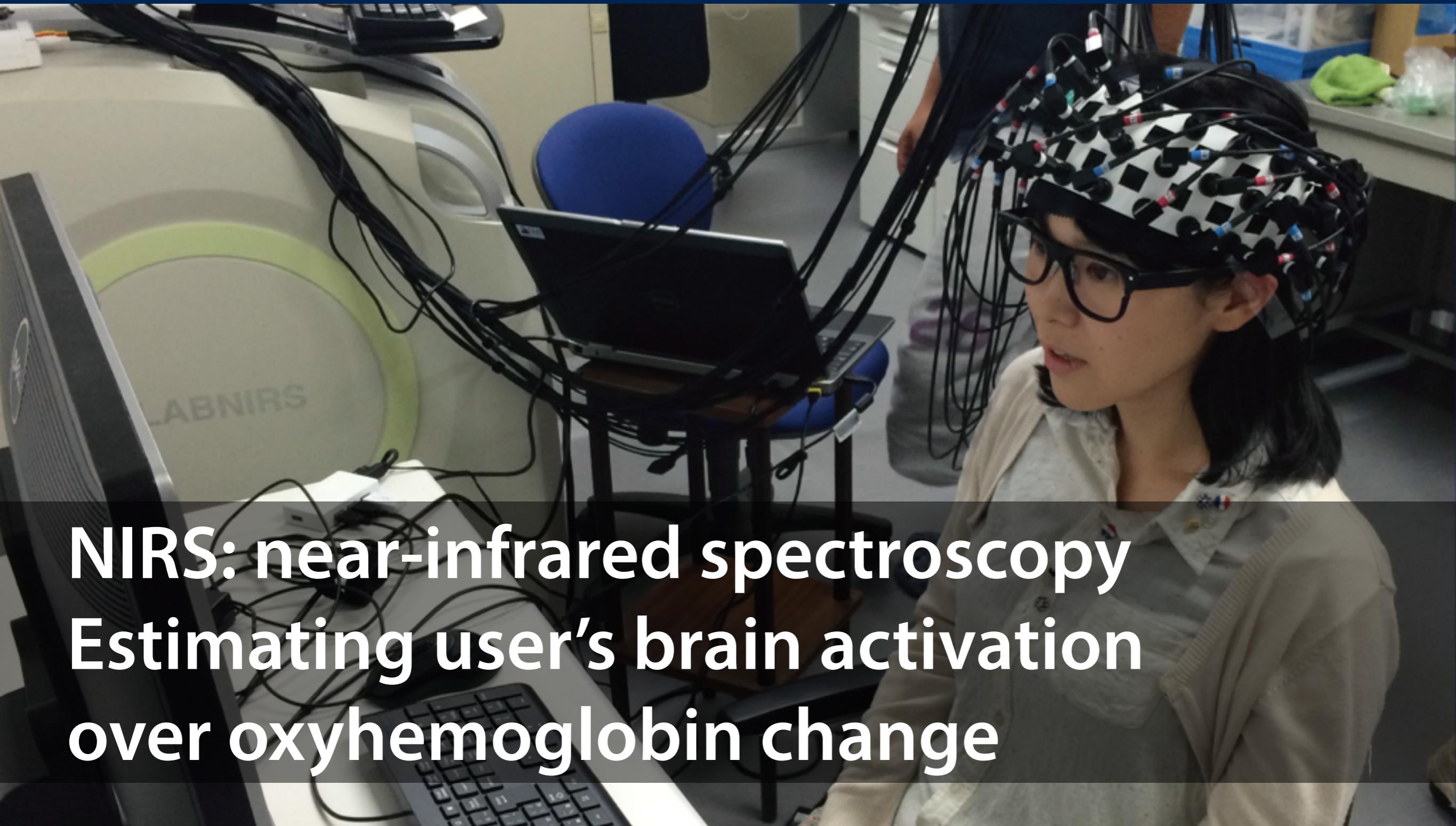
Novel

News

Science Papers

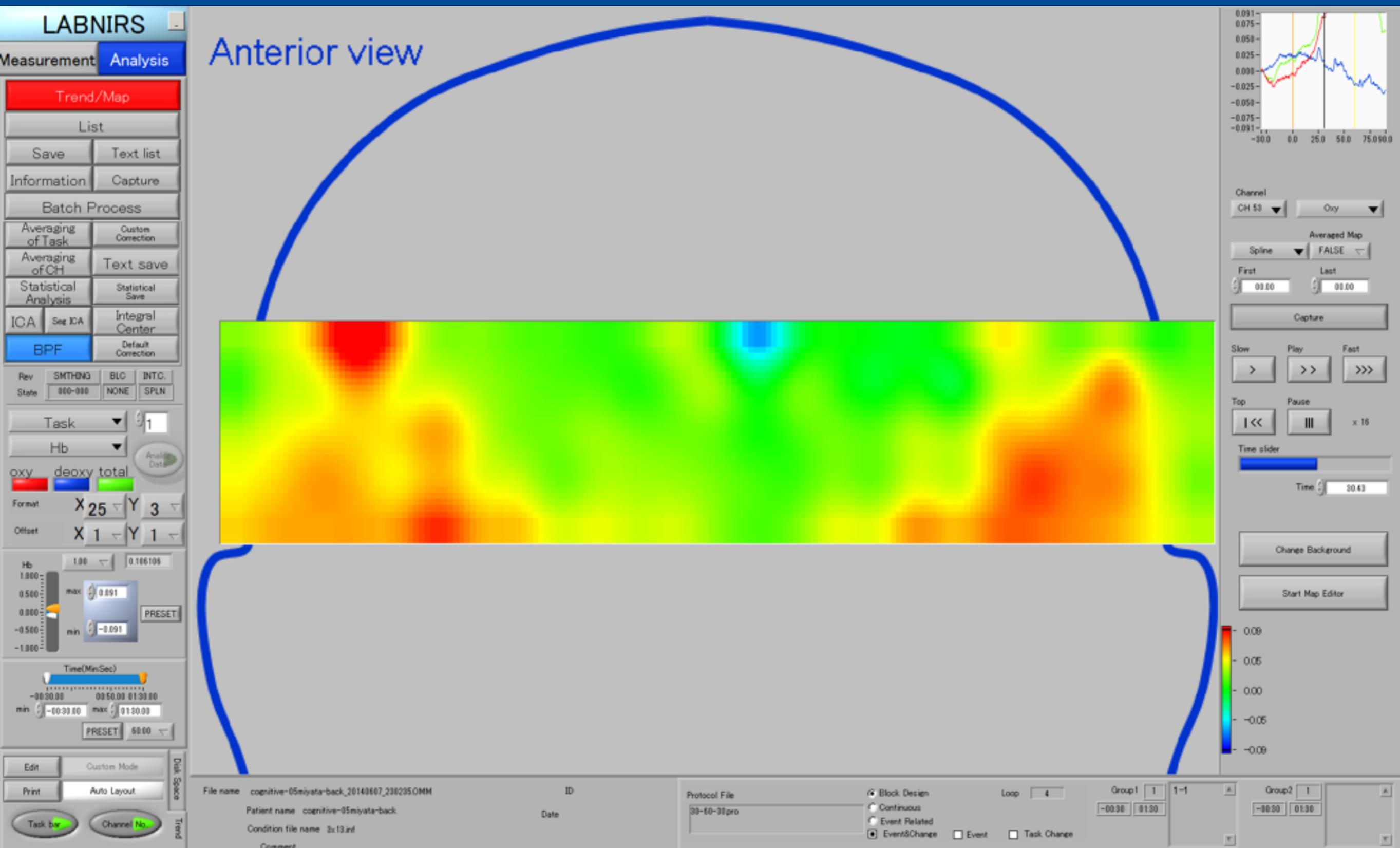


Enabling Technologies: brain activation sensing



**NIRS: near-infrared spectroscopy
Estimating user's brain activation
over oxyhemoglobin change**

FNRIS



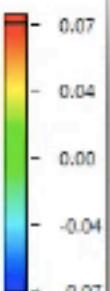
Firefox 00:00:18:1
file:///C:/Users/View X/Desktop/app/reading/lv1.html

Google

Originally scheduled to open in November of this year, the new museum and its facilities will now open on March 1 next year. Hawas said the delay was due to the unexpected challenges of moving the nation's treasures from across the country to the new museum in a safe manner. 'We did not expect that the transfer of some larger artifacts and sculptures would be so difficult. But we don't want to rush the process and risk damage to any of our nation's treasures.'

According to the article, why was the opening rescheduled?

- a. There were problems relocating some items.
- b. There were insufficient funds to complete the building.
- c. There was a problem caused by government policy.
- d. there was a security system malfunction.



Enabling Technologies: brain activation sensing

brain activation during dual n-back problems

work load

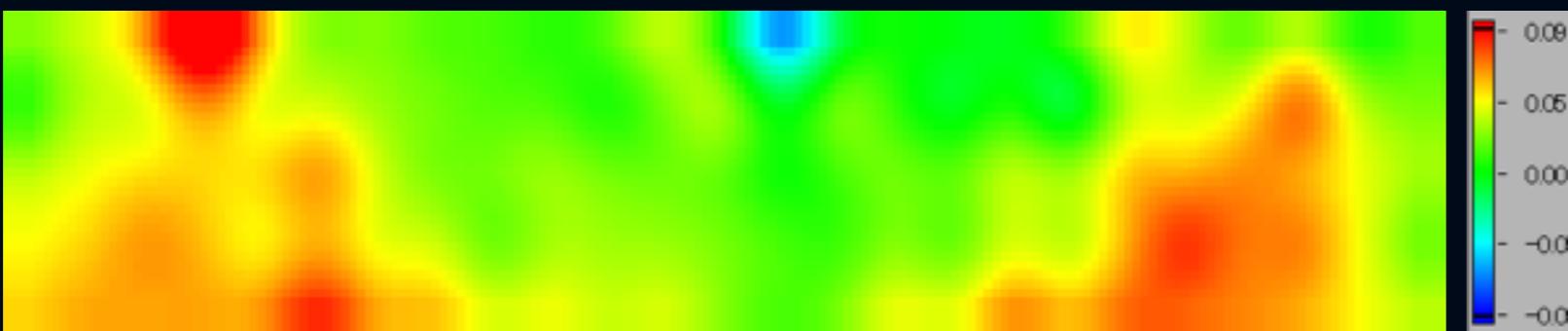
1-back



2-back



3-back



4-back



In Summary

previous centuries:

faster

higher

more comfortable ...



www.nih.gov/science/brain/
\$3 billion for ten years



www.humanbrainproject.eu
\$1.9 billion for ten years

Last centuries: trying to overcome our physical limitations ...

Now: overcoming our cognitive limitations.

THANKS TO ...

*Yuji Umea, Yuta Sugiura, Masahiko Inami, Masa Inakage,
Kazutaka Inoue, Masato Kimura, Rina Kanno, Oliver Amft,
Koichi Kise, Masakazu Iwamura, Motoi Iwata, Yuzuko Utsumi,
Andreas Dengel, Andreas Bulling, David Bannach, Takumi Toyama,
Tsutomu Terada, Seiichi Ushida, Stephan Sigg, Christoph Schuba,
Cody Sumter, Paul Lukowicz, Bernhard Sick, Jingyuan Cheng,
Kamil Kloch, Gerald Pirkl, Albrecht Schmidt, Michael Beigl,
Niels Henze, Alireza Sahami, Tilman Dingler, Bastian Pfleging,
Dawud Gordon, Till Riedel, Ulf Blanke, Yusuke Sugano,
Hans Gellersen, Christian Weichel, Anton Dollmaier,
Gernot Bahle, Josef Neuburger*

SPECIAL THANKS TO

*the students who do the work ...
(alphabetic order)*

Ayano Okoso

Eria Chita

Hiroki Fujiyoshi

Katsuma Tanaka

Kazuyo Yoshimura

Masai Katsutoshi

Mizuki Matsubara

Shoya Ishimaru



QUESTIONS, REMARKS, VIOLENT DECENT?



<http://kaikunze.de/>



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github.com/kkai



Shamless Advertisements:

Augmented Human 2015, Singapore

Pervasive Health 2015, Istanbul

*FOSS Asia 2015, 13th-15th March,
Singapore*

Superhuman Sports Committee

<http://superhuman-olympic.org>

