



# Augmenting the Human Mind

Toward Technology  
to Track Cognitive Activities



Kai Kunze  
Graduate School of Media Design  
Keio University



# Background Info

Project Associate Professor

Keio University

Research Assistant Professor (since 2 years)

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







# wearable computing in 2006

Maintenance Scenario Collaboration with Zeiss, Oberkochen.



can you imagine your grandmother wearing this?





# maybe ...\*

\* if you do your working on a PhD. in wearable computing.







# cognitive activity recognition

Can we track what is 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.

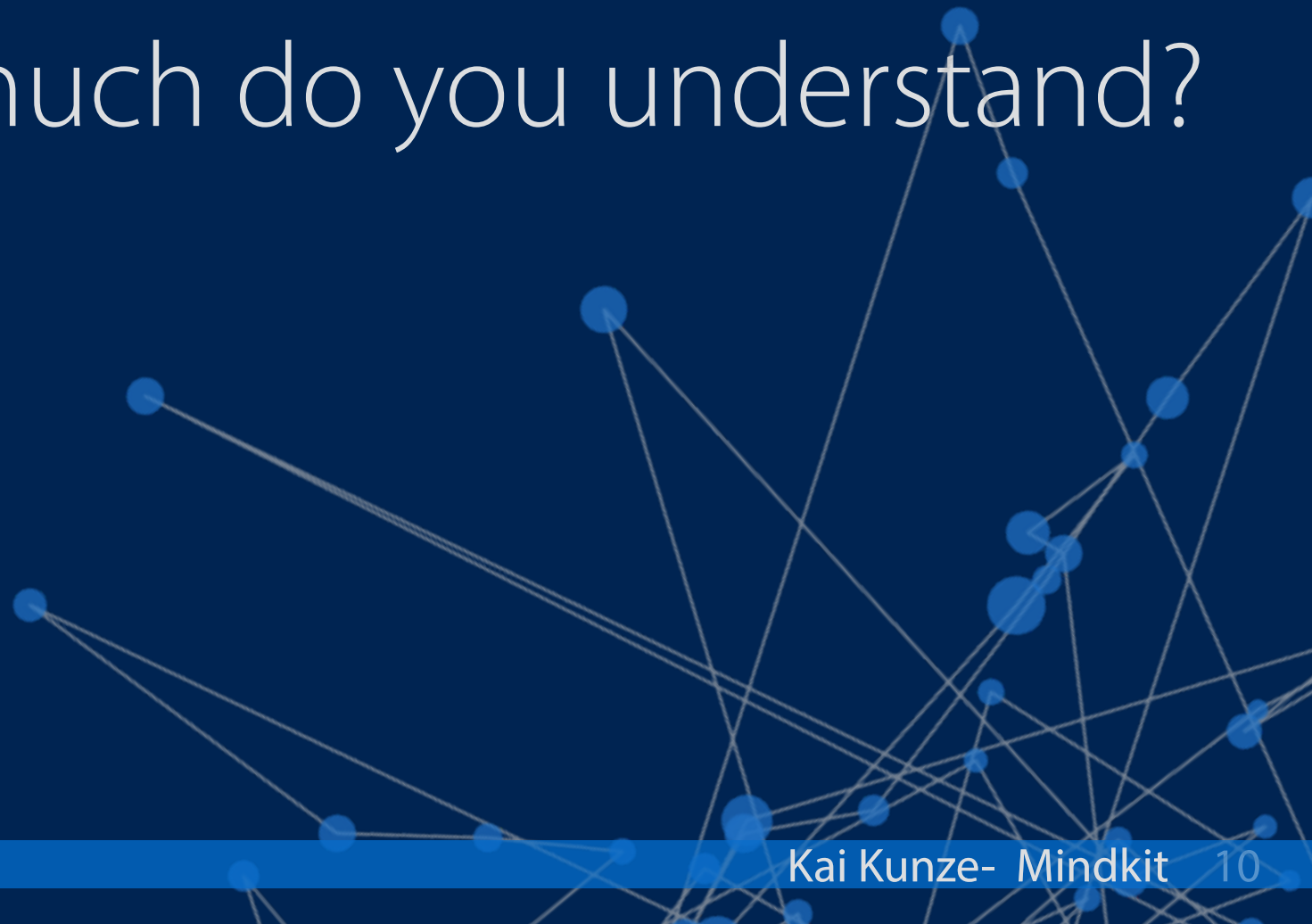


*“Can I copy the habits of my thesis advisor to become a better researcher?”*

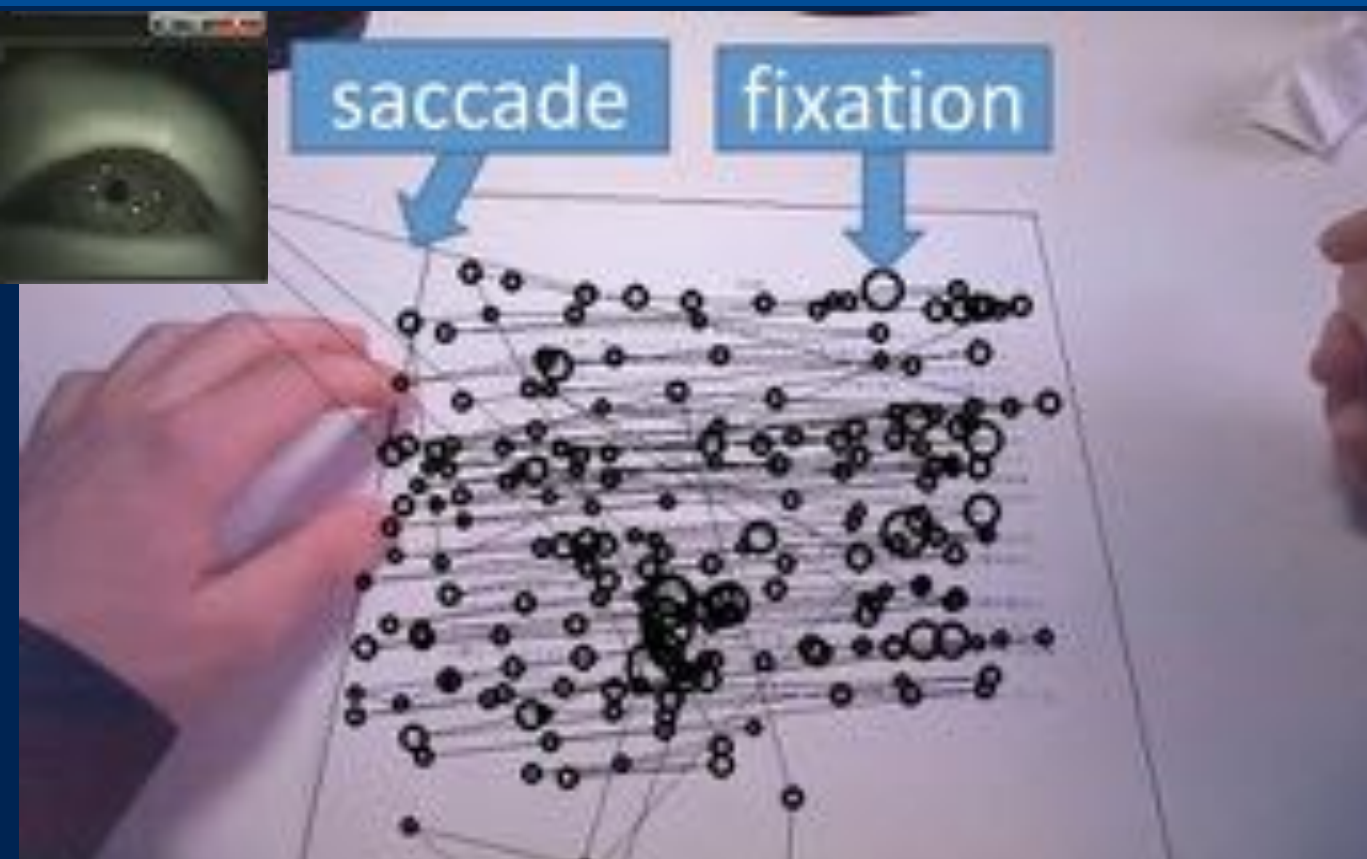
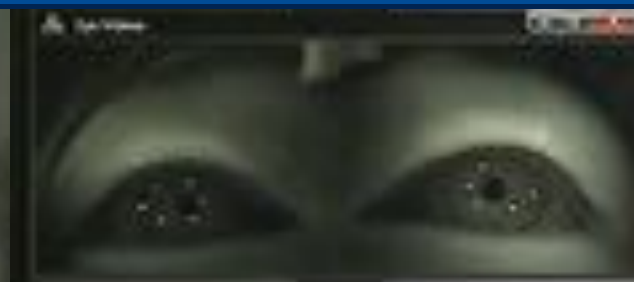
How much are you reading?

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 comedian for  
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

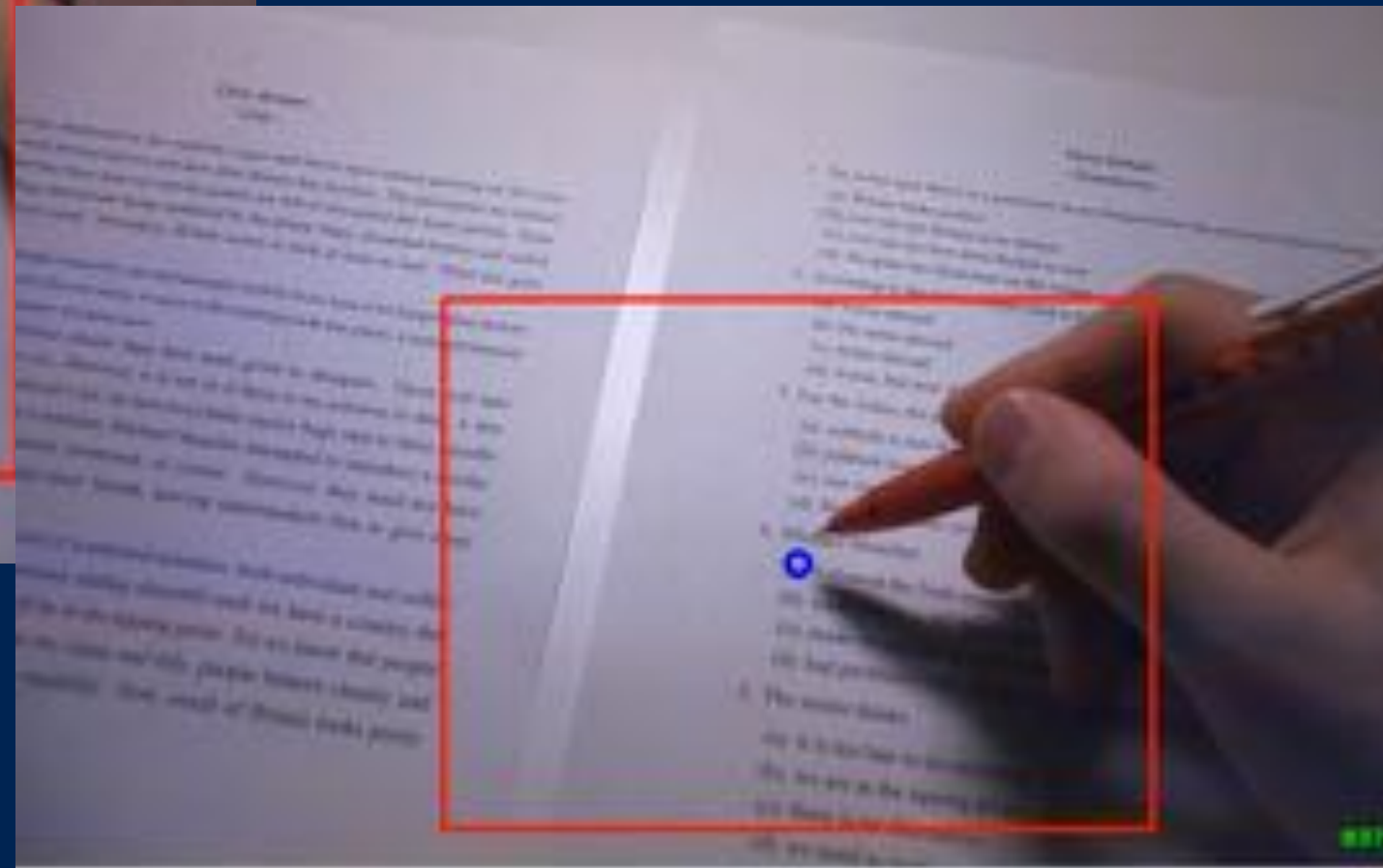
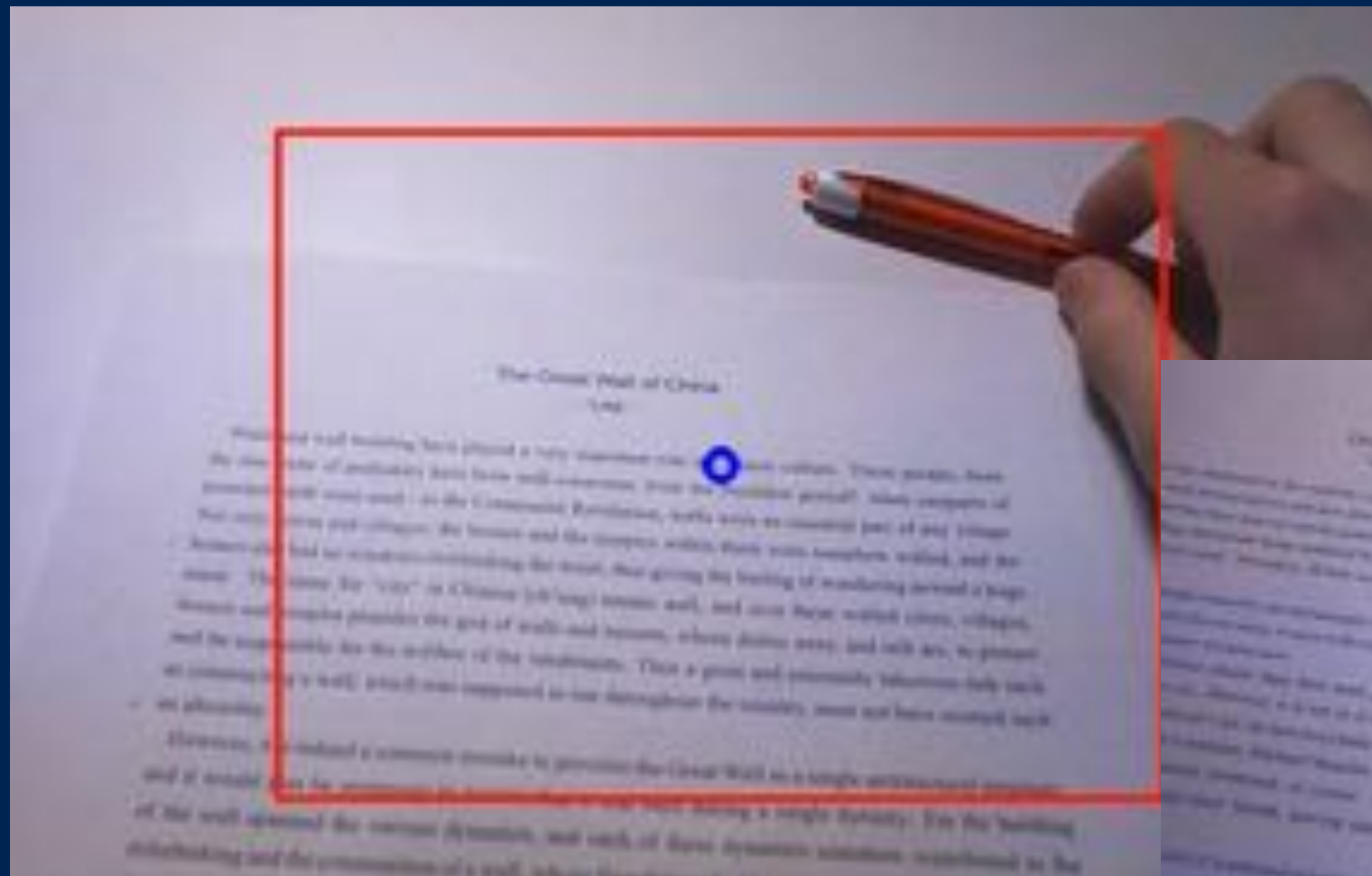


# Document Type Classification



72 % user independent recognition  
10 users, 5 document types, 5 environments  
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.

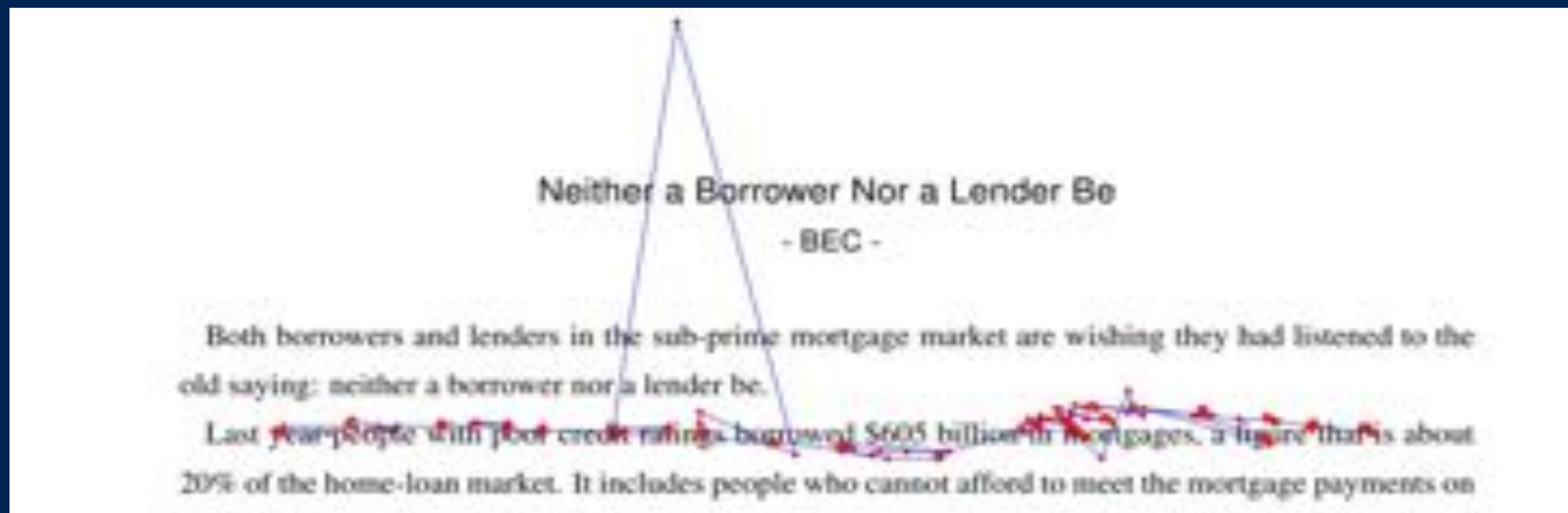
# How much do readers understand?



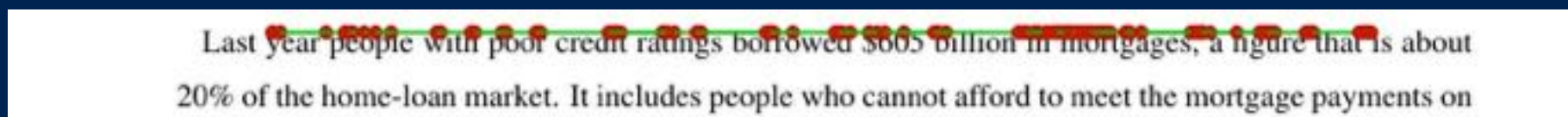
20 users reading TOEIC test  
comprehension parts with  
mobile eye tracker



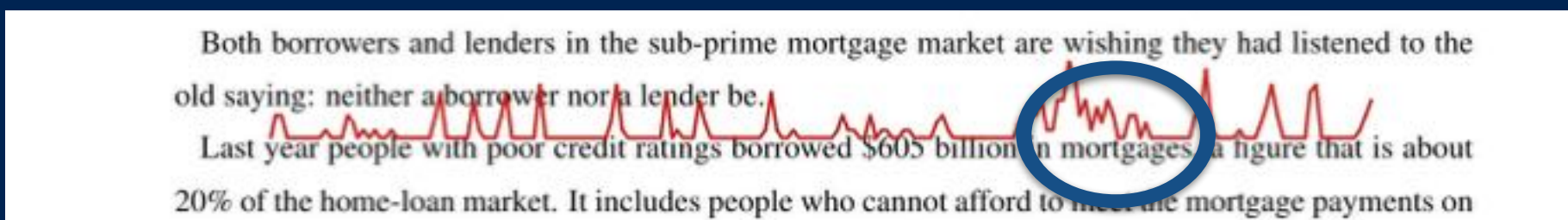
# Detecting Difficult Words - Trying to Infer TOEIC Scores



Eye-gaze translated to document coordinates



Horizontal projection



Histogram

K. Kunze, H. Kawaichi, K. Yoshimura, K. Kise. Towards inferring language expertise using eye tracking. WIP ACM SIGCHI Conference on Human Factors in Computing Systems, Paris, France 2013.

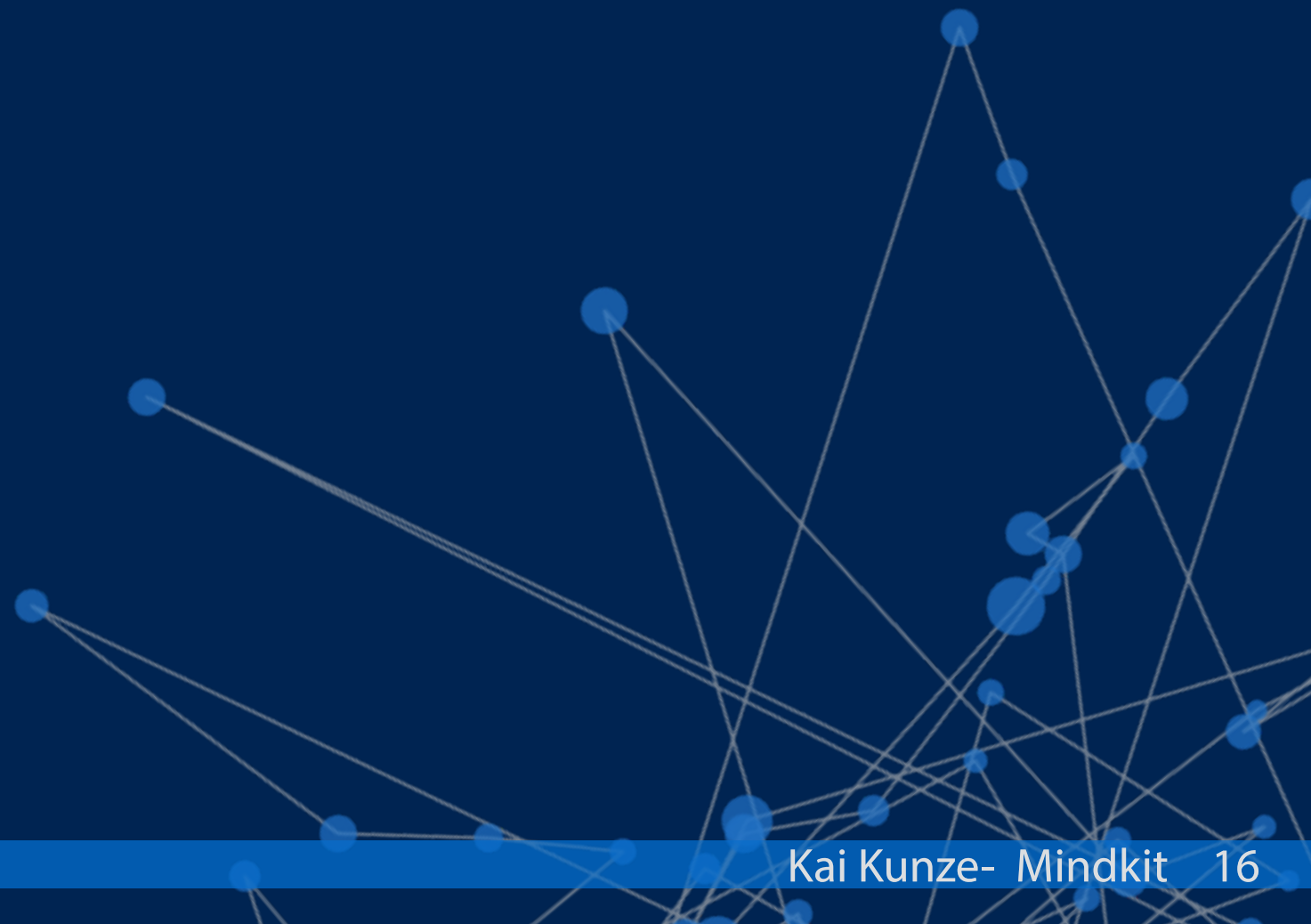


# Future Work: a fitbit for the mind?



Cognitive Activity Tracking,  
a First Step Towards a Goal:

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





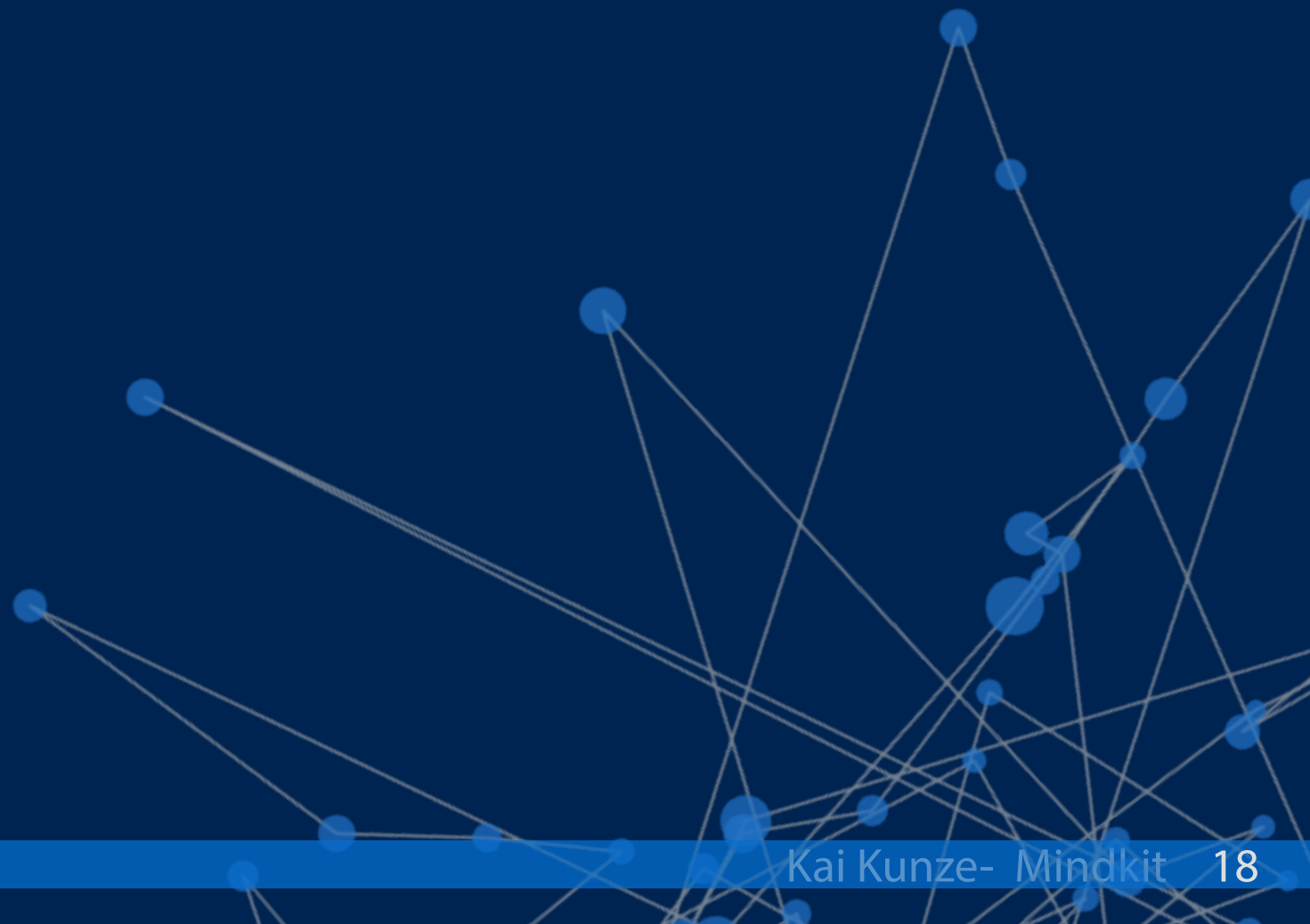
# Cognitive Activity Tracking for Everybody





Demo:

# Activity Recognition on Glass

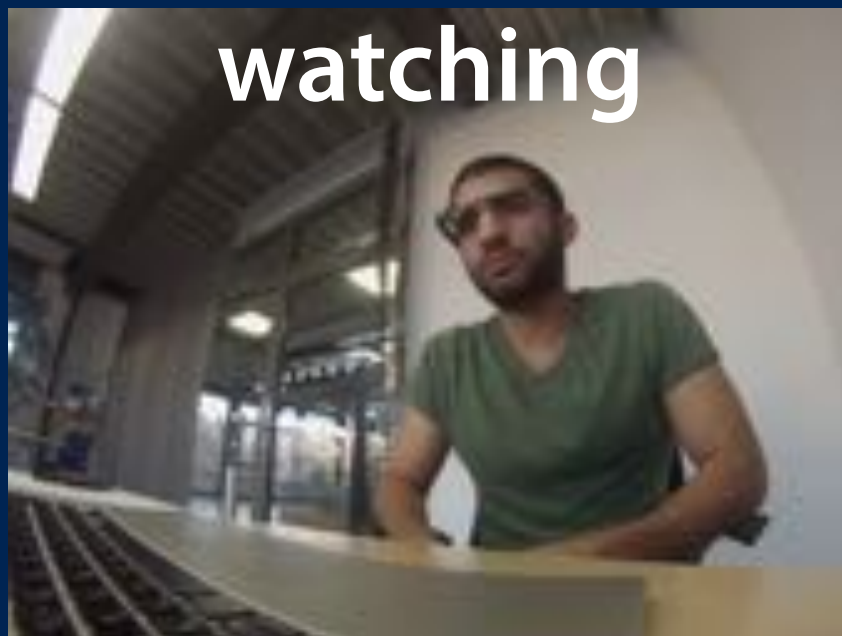


# Road Map: Cognitive activity tracking for everybody

**reading**



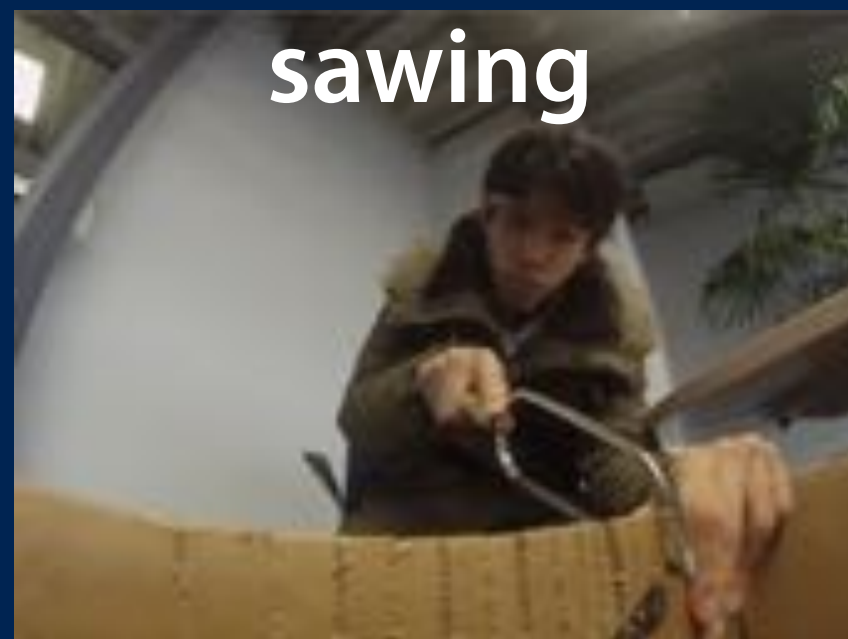
**watching**



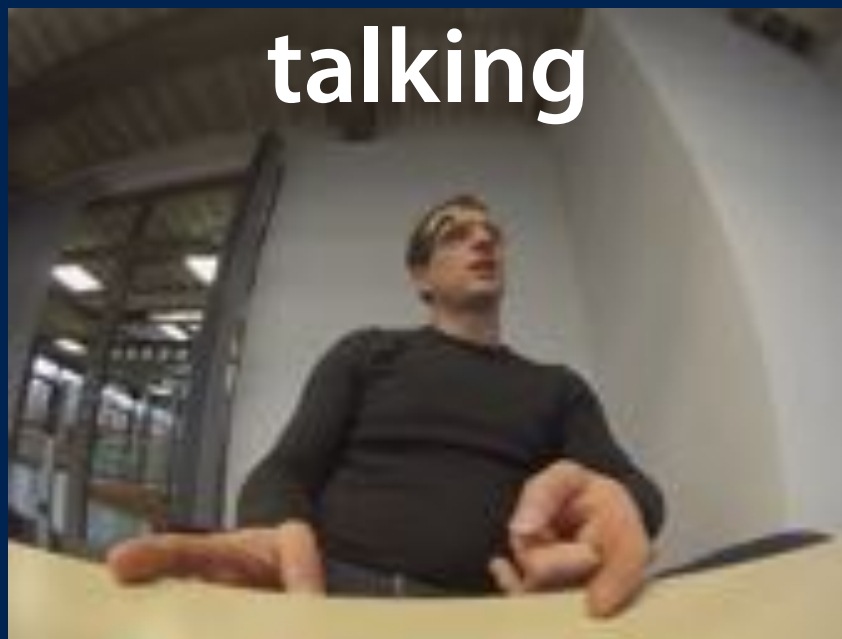
**solving**



**sawing**

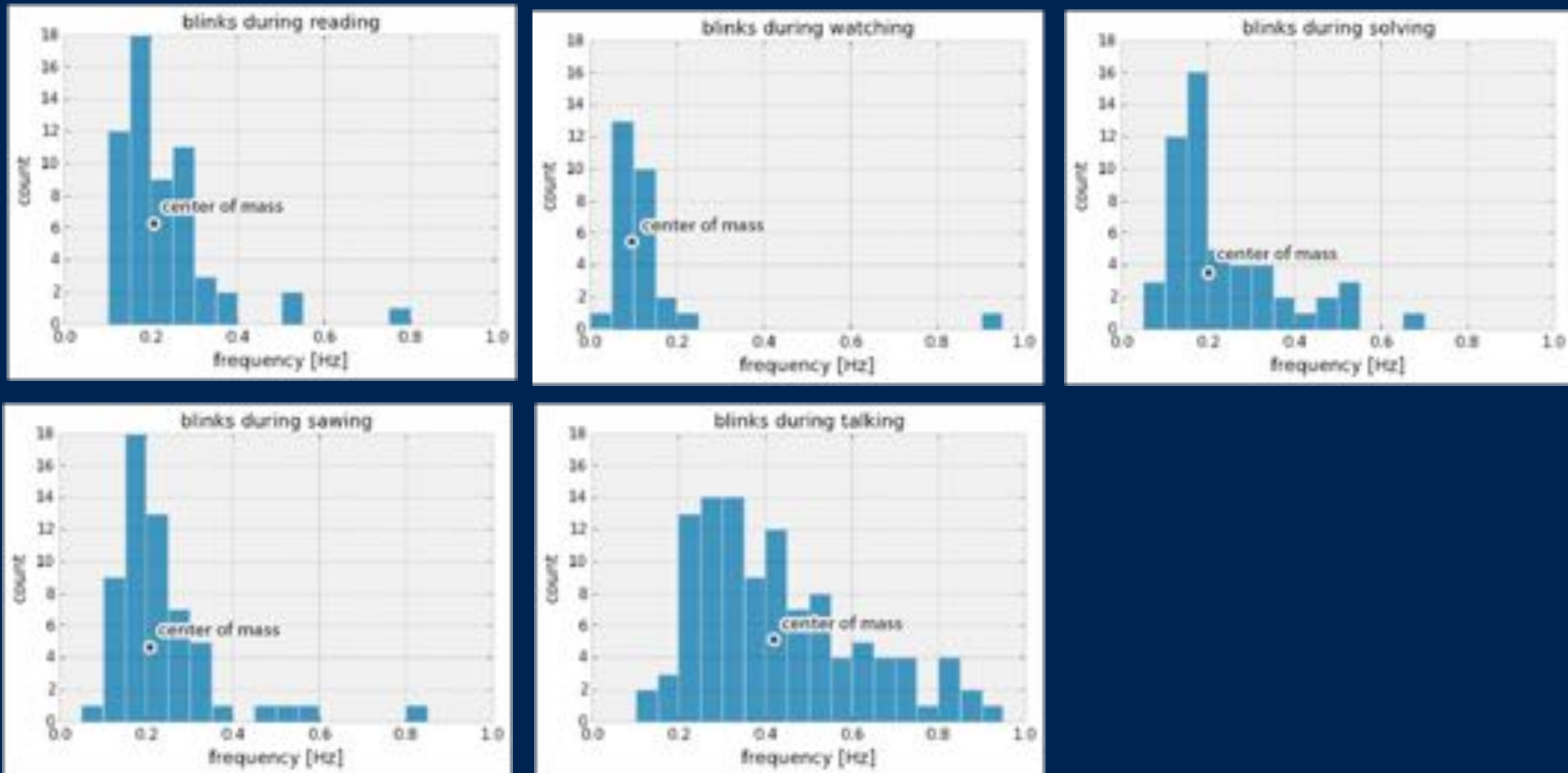


**talking**



**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.

# Road Map: Cognitive activity tracking for everybody



**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.



# J!NS MEME

most of our sensor inputs are on the head

most dominant: visual perception

very different idea from Google Glass

... not a full fledged computer,

no display, NO camera ...

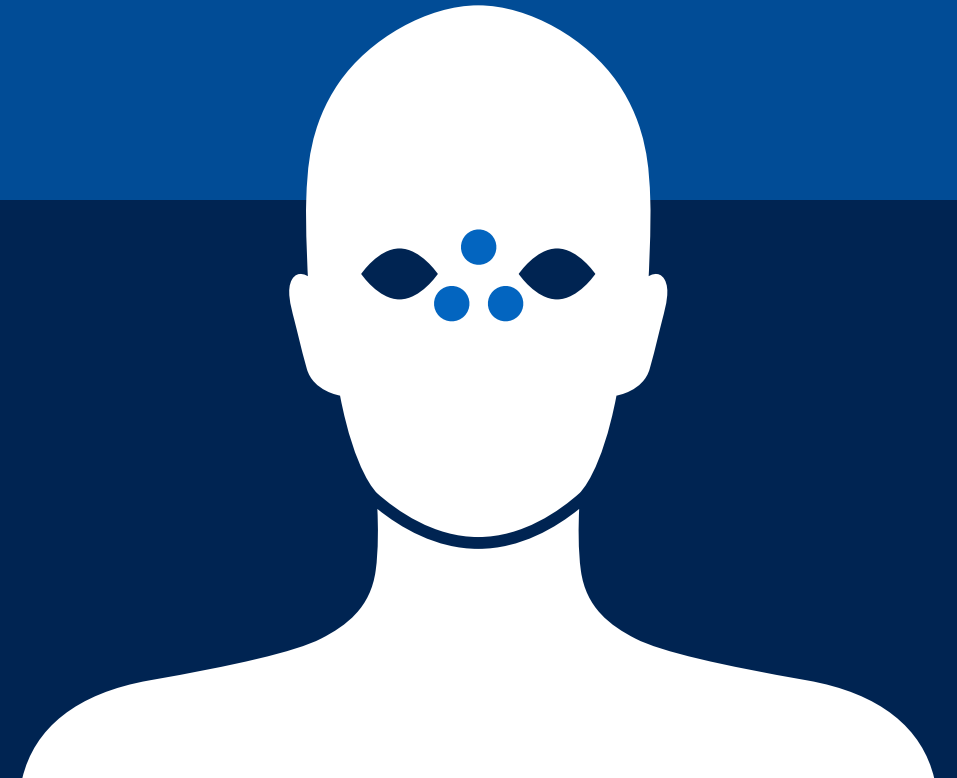
a sensing device connected to phone.

Electrooculography and motion sensors

(accelerometer and gyroscope)

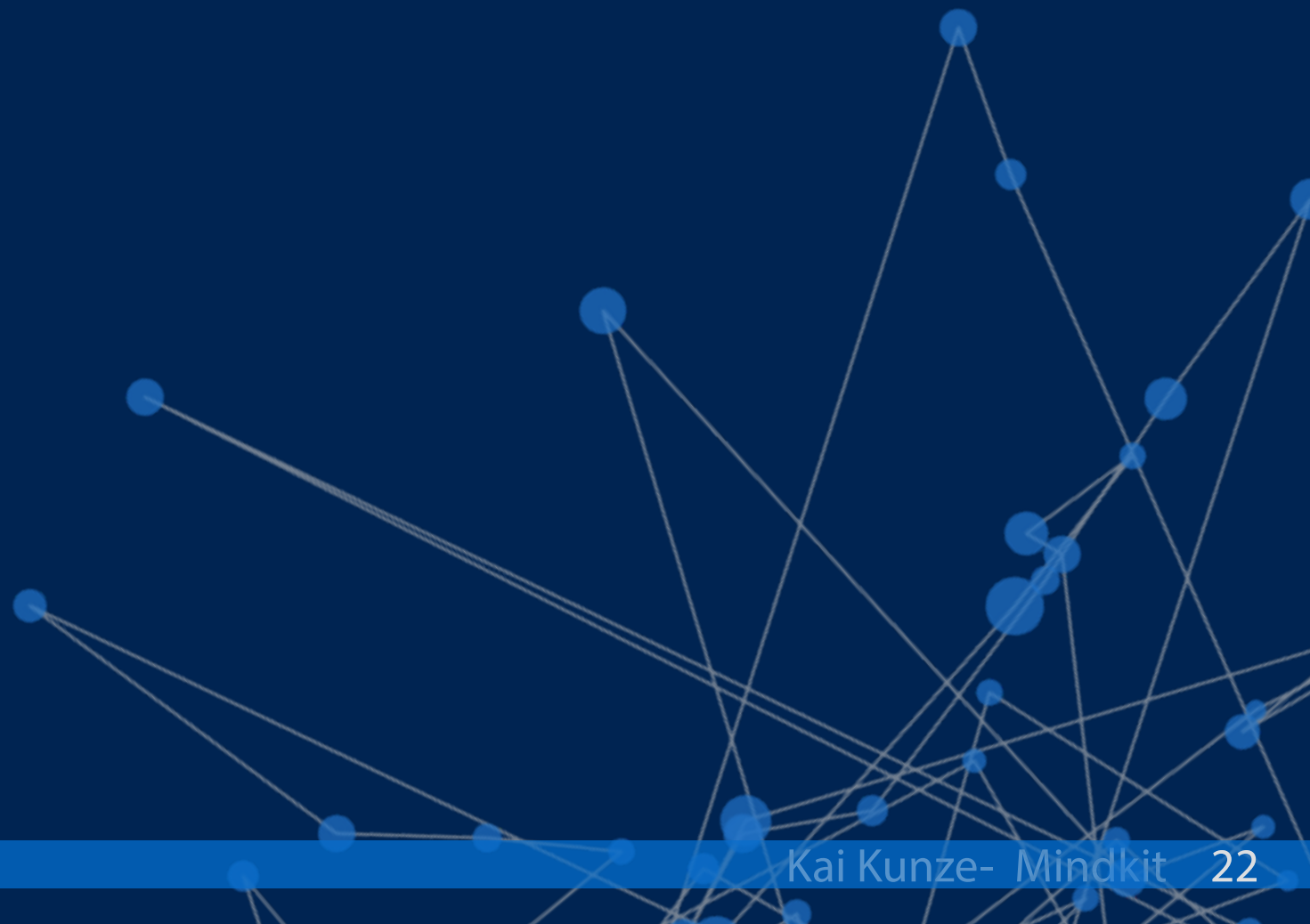
We are working with J!NS

directly on the prototype



# Demo:

## J!NS MEME





# Activity Recognition on MEME

# Brain Jogging: How?

read.it

Dashboard

Log

Community

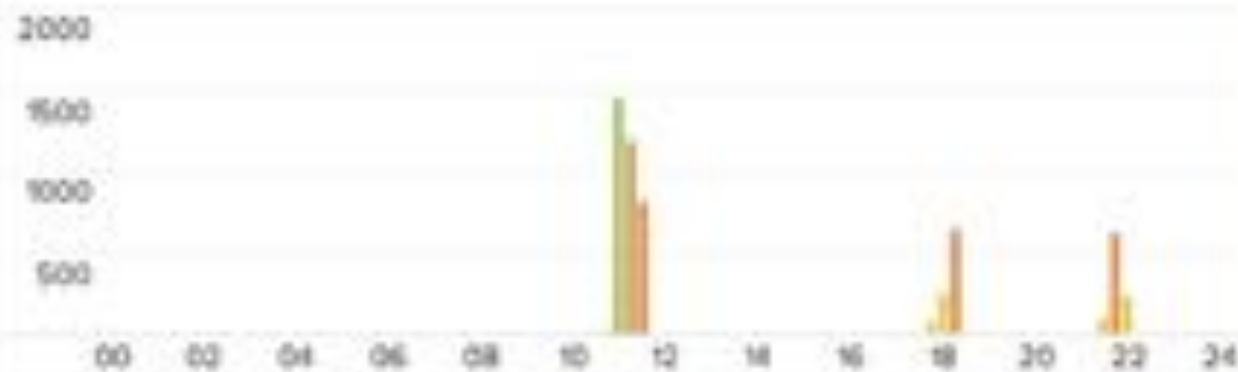
Premium

STORE



< > Sunday JUNE 30

## Activity



## Word Count



6707 words

## Friends



You  
67,071 words

1



codynumber  
36,155

2



Sulisty  
24,538

3



Jenny  
13,868

4



Shoya K.  
No recent activity



afriqulhondade  
No recent activity



James  
No recent activity

## New Words



170 words

## Reading Speed



210 words/min

## Concentrated Reading



30 min

Novel

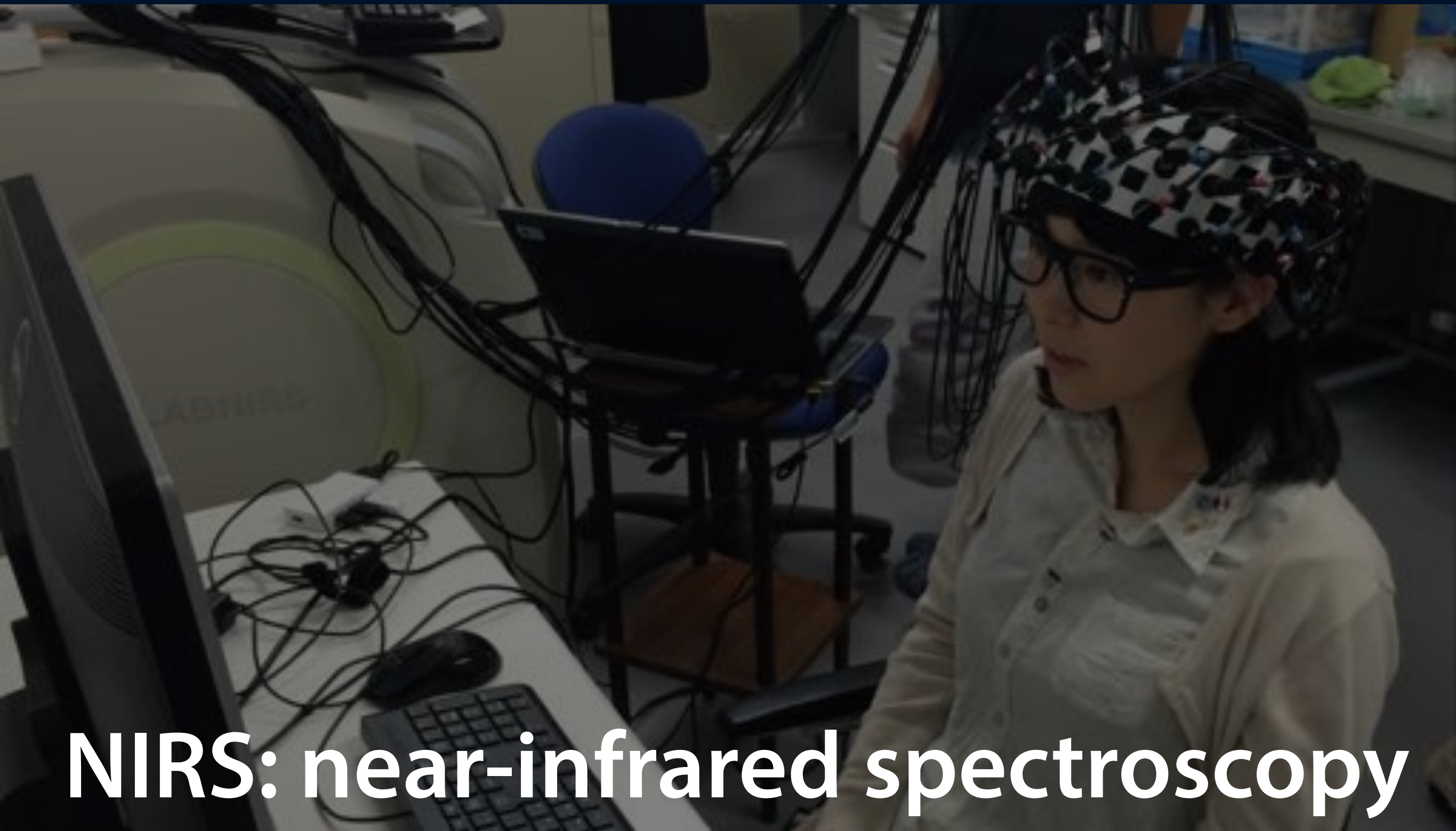
News

Science Papers

Manga

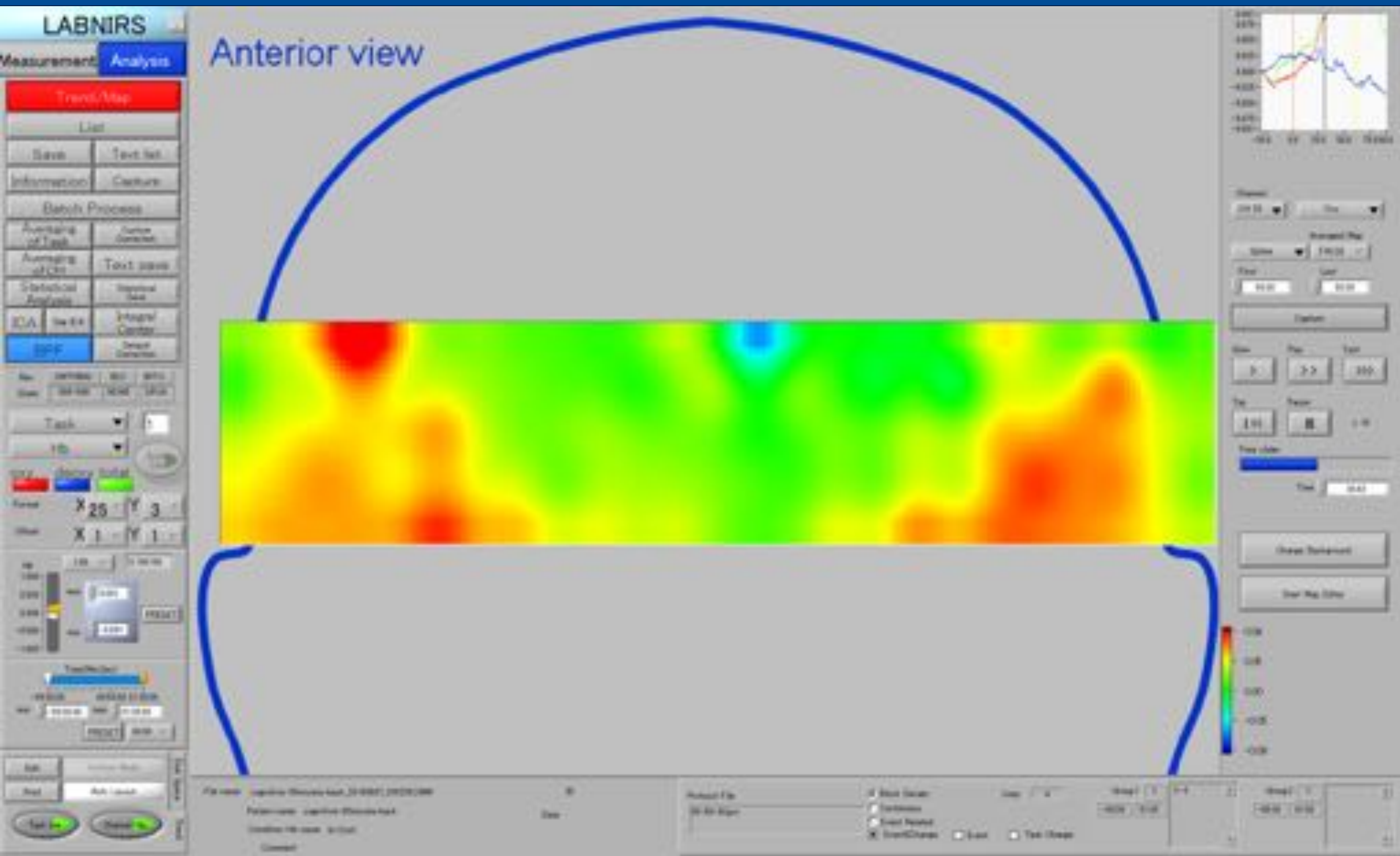


# Enabling Technologies: brain activation sensing



**NIRS: near-infrared spectroscopy**

# FNRIS





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

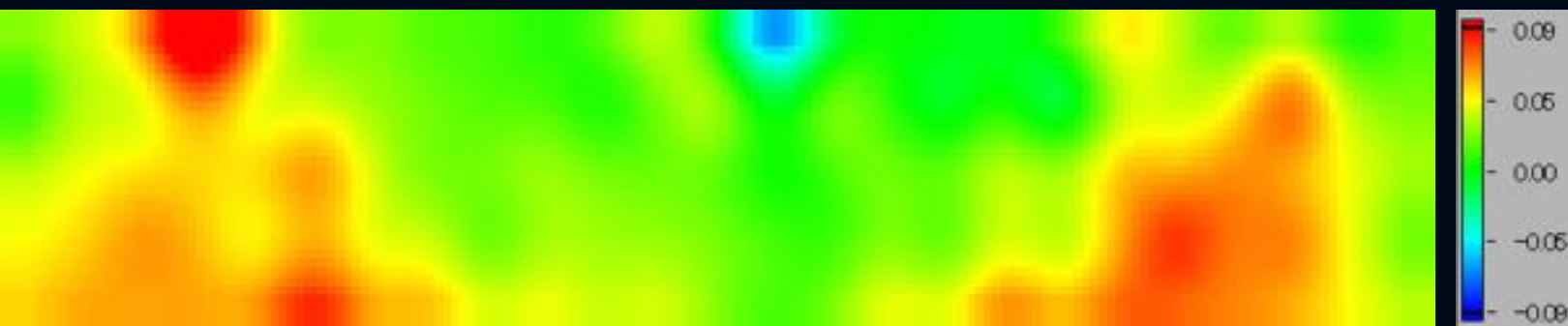
1-back



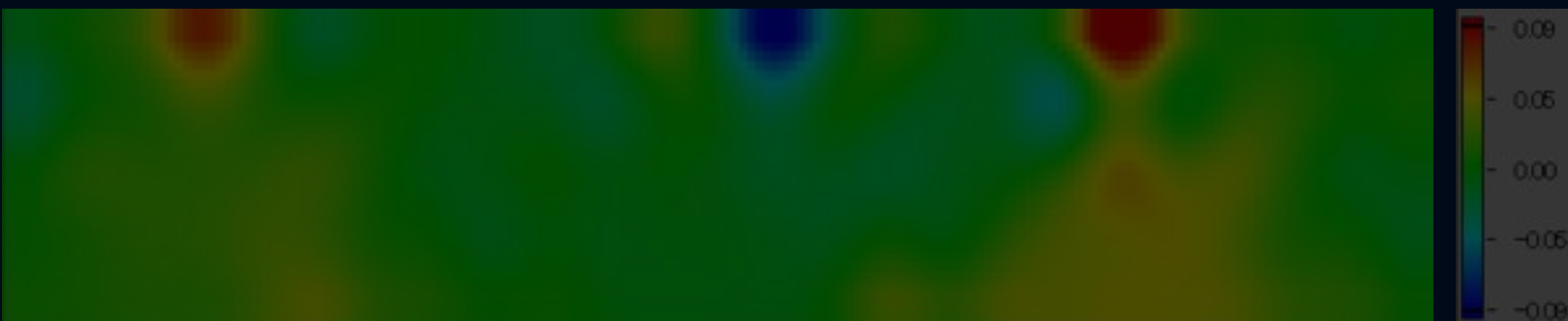
2-back



3-back

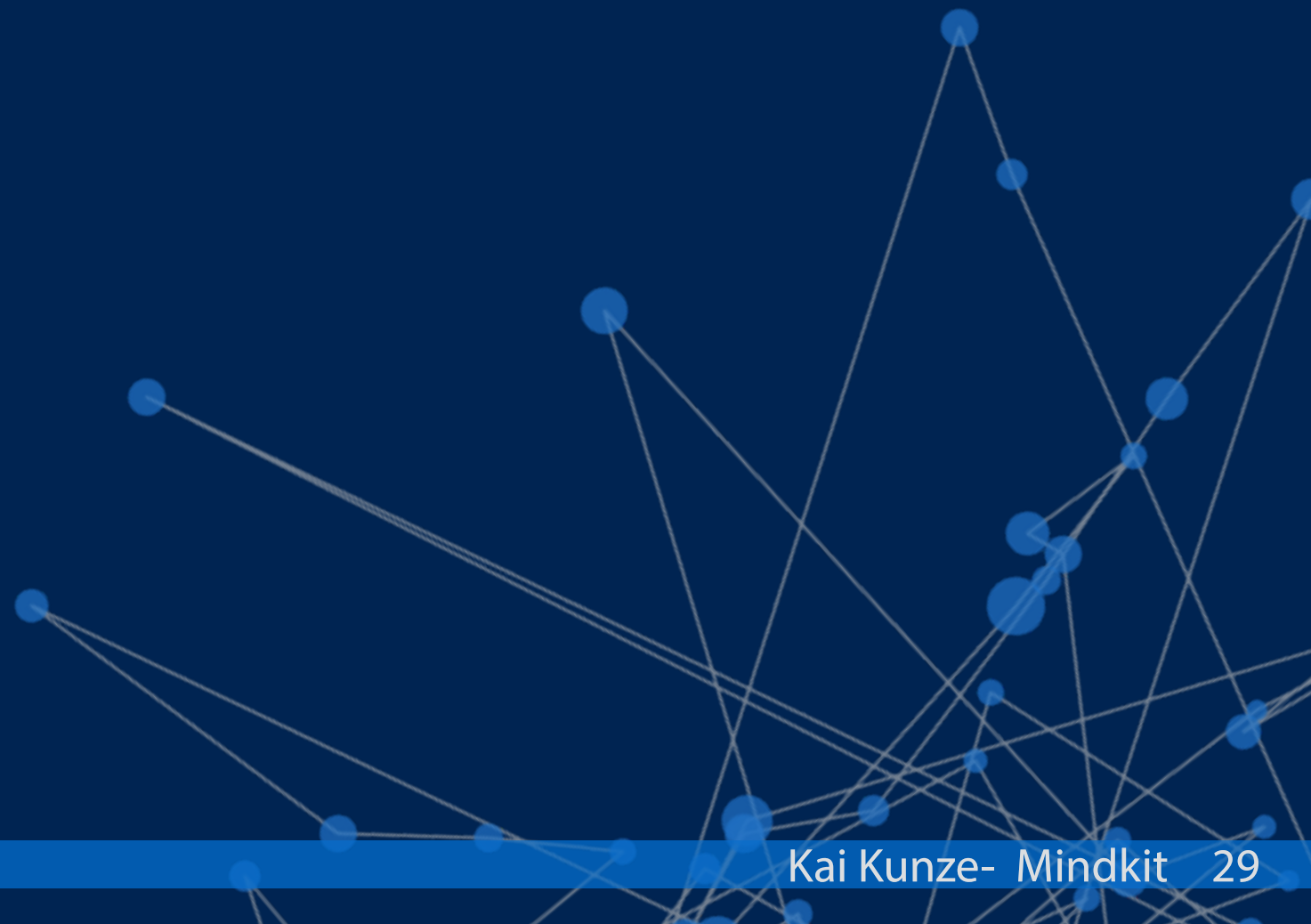


4-back



Cognitive Activity Tracking,  
a First Step Towards a Goal:

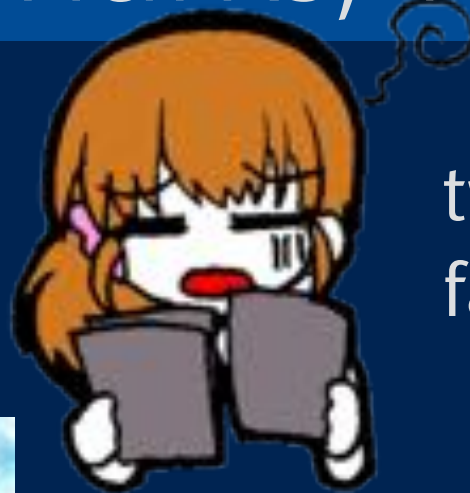
Improve the Collective Intelligence of Society  
Enhance our Critical Thinking Skills with Technology





# Questions, Remarks, Violent Dissent?

<http://kaikunze.de>



twitter: @k\_garten  
facebook: kai.kunze



Augmented Human 2015, Singapore  
<http://asg.sutd.edu.sg/ah2015/home>  
Deadline: 15 November



Pervasive Health, 2015, Istanbul  
<http://pervasivehealth.org>  
Deadline: 19 December



Superhuman Sports Committee  
<http://superhuman-olympic.org>

