



Je computer besturen met je  
ogen en je hersenen

Jaap Ham

# Introductions

- Jaap Ham
- [j.r.c.ham@tue.nl](mailto:j.r.c.ham@tue.nl)
- Social Psychology
- Persuasive technology
- Social Robotics



“You should not have another drink!”



**Associate editor of the  
International Journal on Social Robotics**

**Program Chair**

Persuasive 2018, April 18-19, Waterloo, Canada





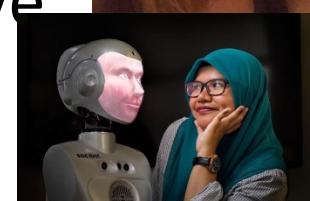
**Jaap Ham**

[j.r.c.ham@tue.nl](mailto:j.r.c.ham@tue.nl)

Research Group: Human Technology Interaction  
Eindhoven University of Technology

PhD students:

- Sofia Fountoukidou: Personalization of Persuasive Technology
- Aimi Ghazali: Persuasive Social Robots
- Hanne Spelt: Psychophysiology and PT
- Caixia Liu: Facial Expression Identification



# MAMEM: Multimedia Authoring and Management using your Eyes and Mind (EU--H2020)

[www.mamem.eu](http://www.mamem.eu)

# MAMEM Visie



# MAMEM Visie

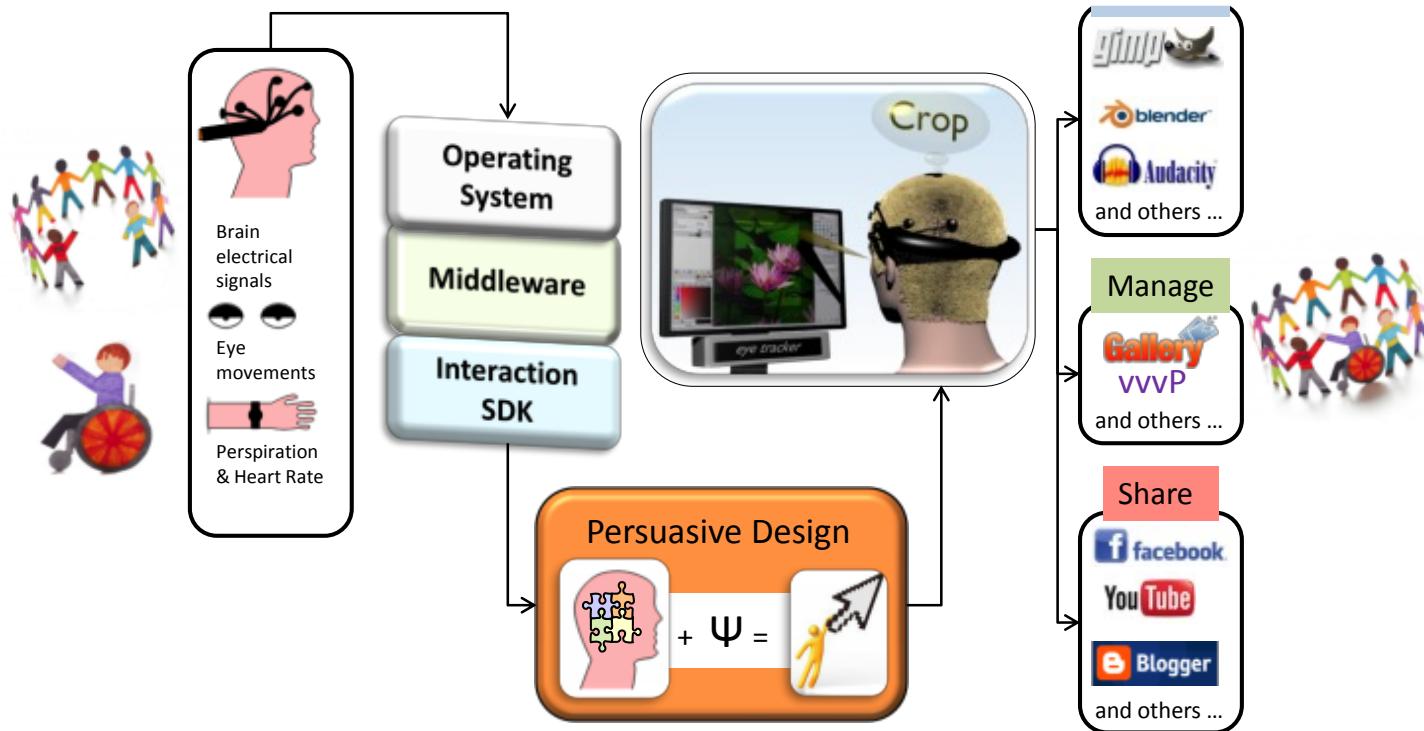
Patient & Clinician

Academia & Research

Industry & Society



# MAMEM Visie



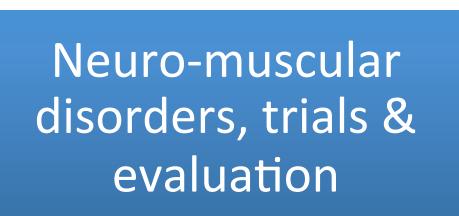
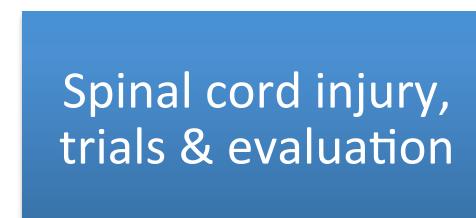
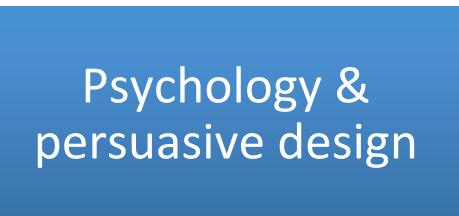
# Consortium



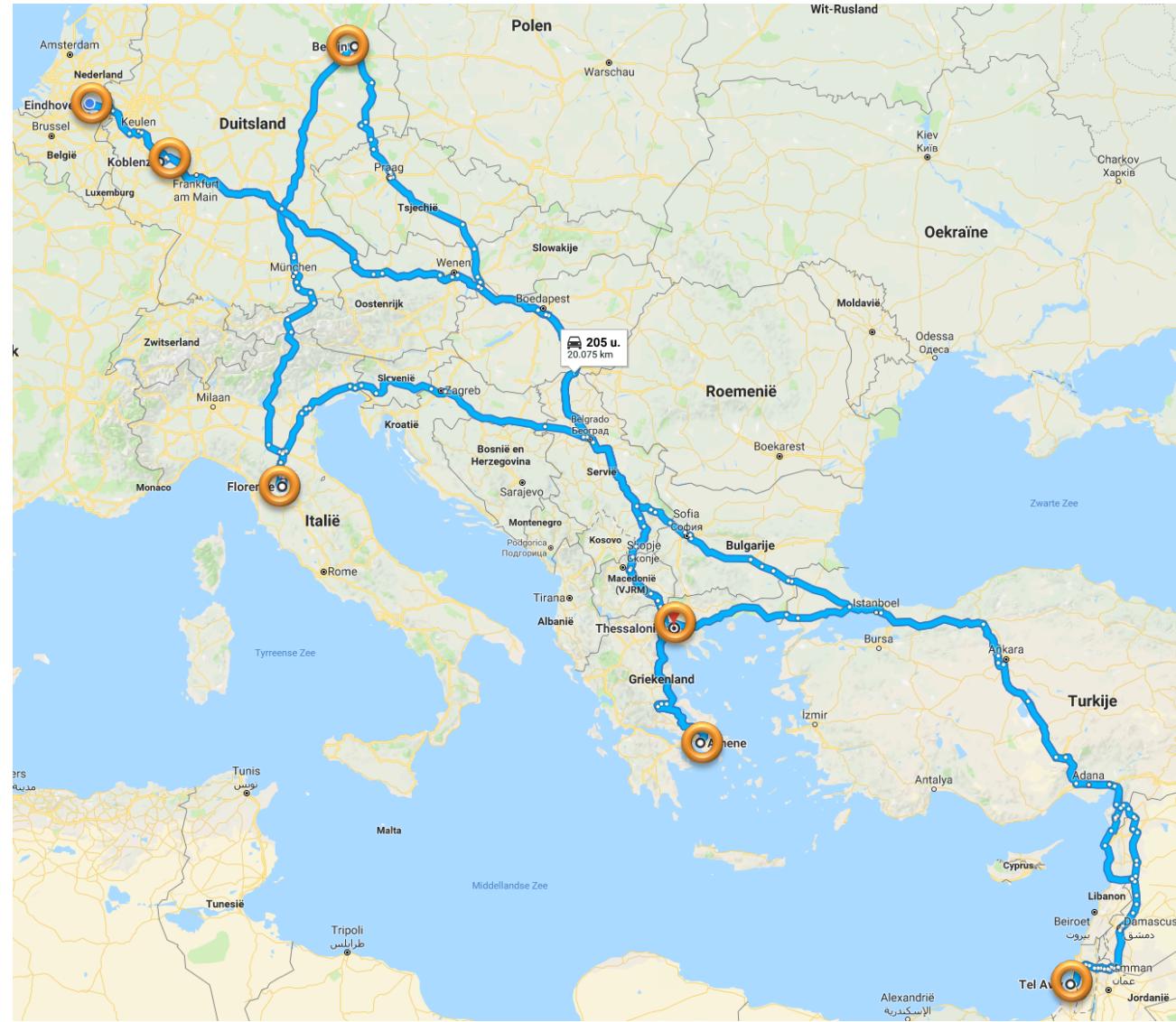
Eye-tracking &  
Integration



EEG Analysis &  
interaction  
paradigms



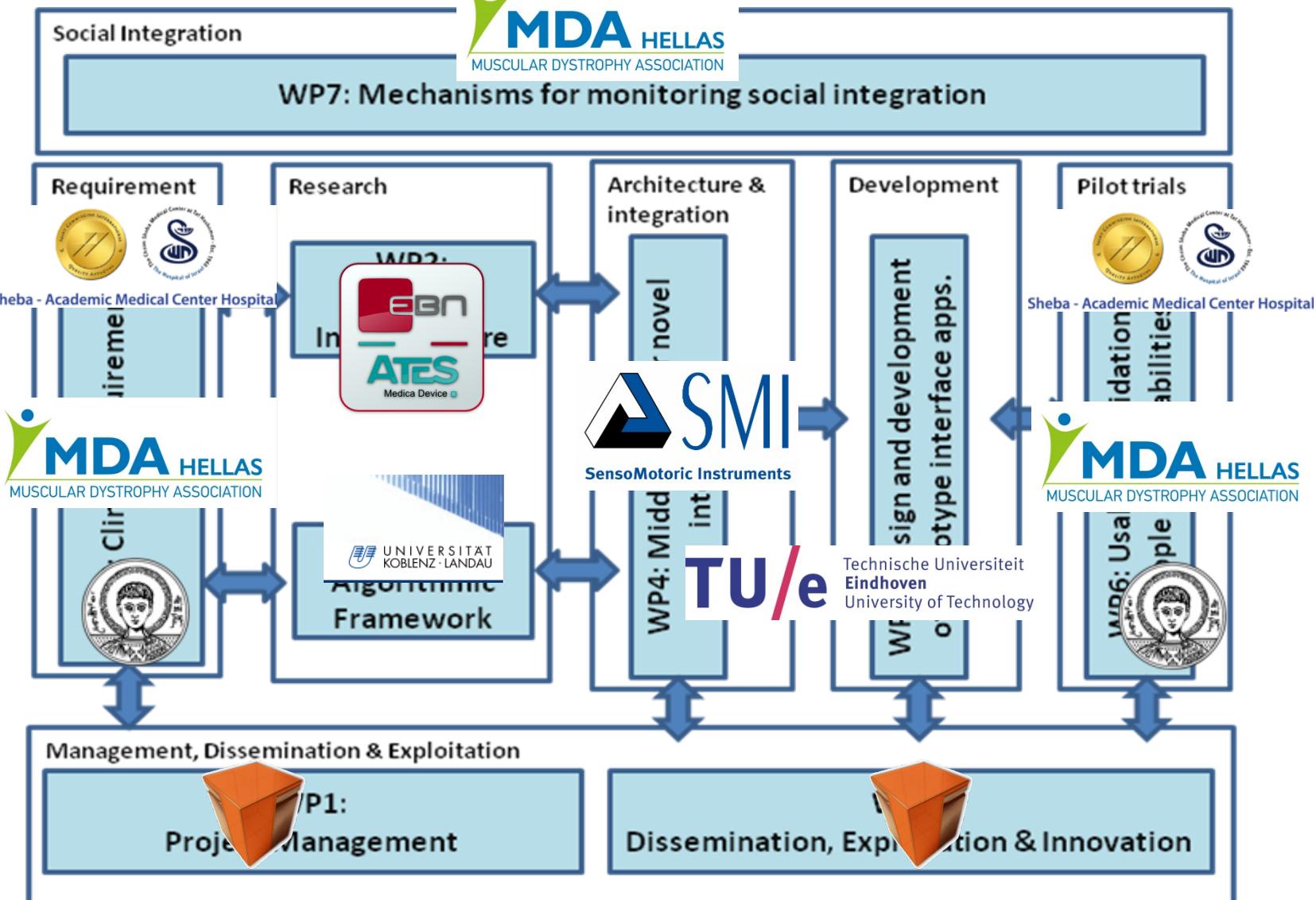
# Van Eindhoven tot Tel Aviv





- MAMEM bouwen
  - Technisch
  - Gebruikers in beeld brengen
  - Stimuleren tot gebruik
- Veldtest 1: Gebruikers in het lab
- MAMEM aanpassen
  - Sociale inclusie
  - Stimuleren tot sociale inclusie
- Veldtest 2: Bij gebruikers thuis

- MAMEM bouwen
  - Technisch
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# GazeTheWeb browser



# Devices for signal capturing & recording

## Eye-tracking

- Heavy-weight (SMI REDn Scientific)

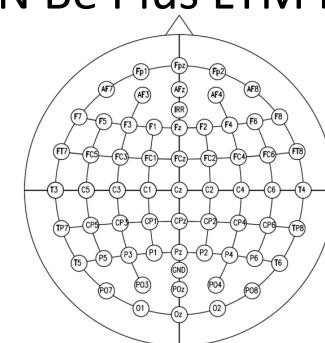


- Light-weight (MyGaze Assistive-2 eye tracker)



## EEG recording

- Heavy-weight (EBN Be Plus LTM EEG amplifier)



- Light-weight (EOC EEG headset)



## Galvanic Skin Response

## Heart Rate

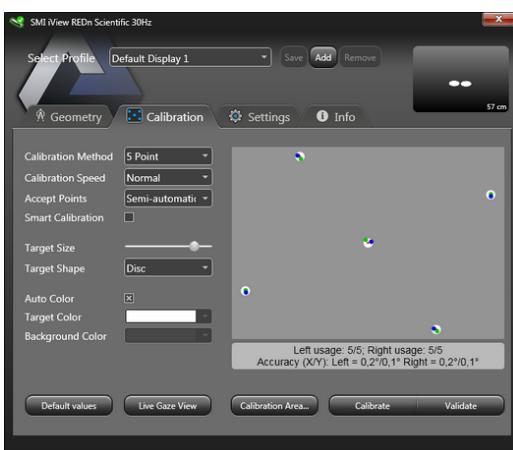
## Shimmer3 GSR+



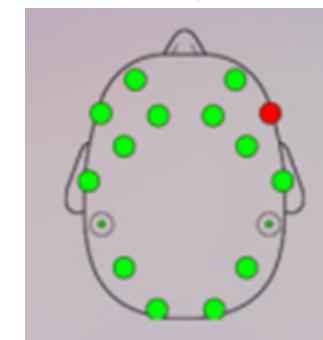
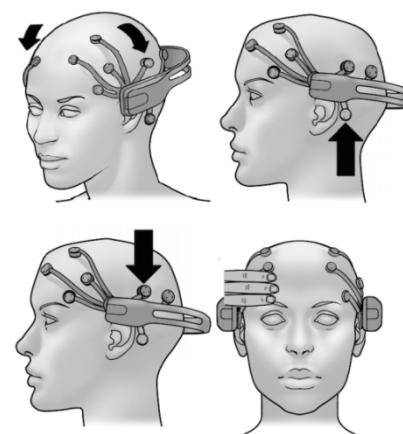
# Software for connecting to Middleware

- C/C++ interfaces for LabSteamingLayer built upon the SDKs of each device

Eye tracker setup/calibration



Headset setup +  
Ohm meter check

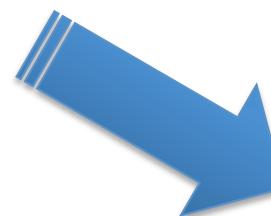
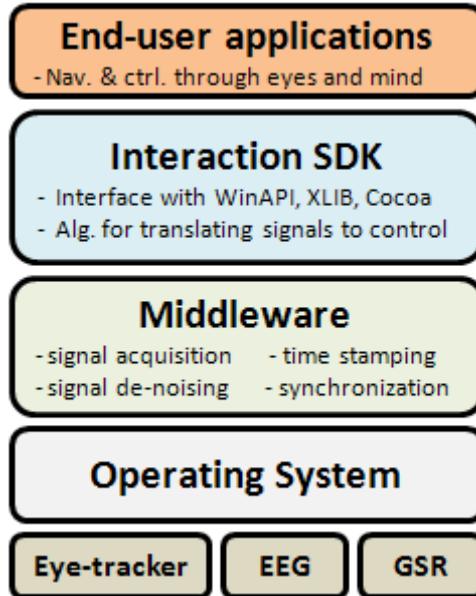


GSR sensor setup  
(no calibration required)

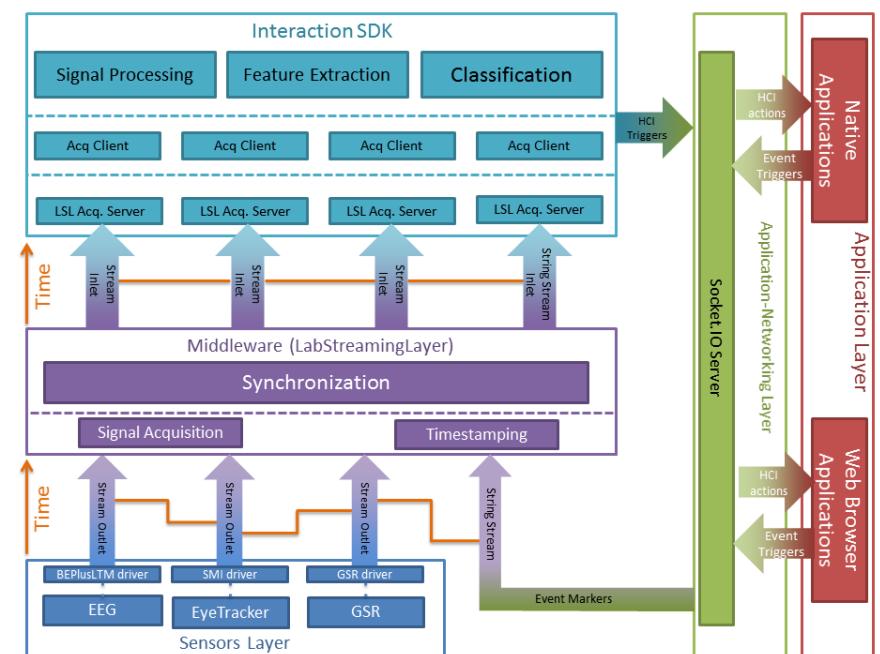


WP2

# System architecture & implementation

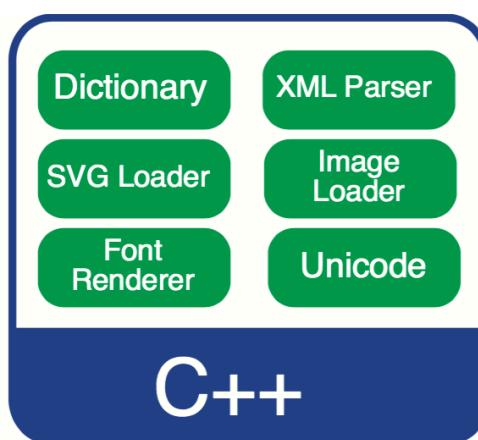


- Abstract description
- Requirement for flexibility & extensibility
- Serve as a middleware for novel multi-modal interfaces



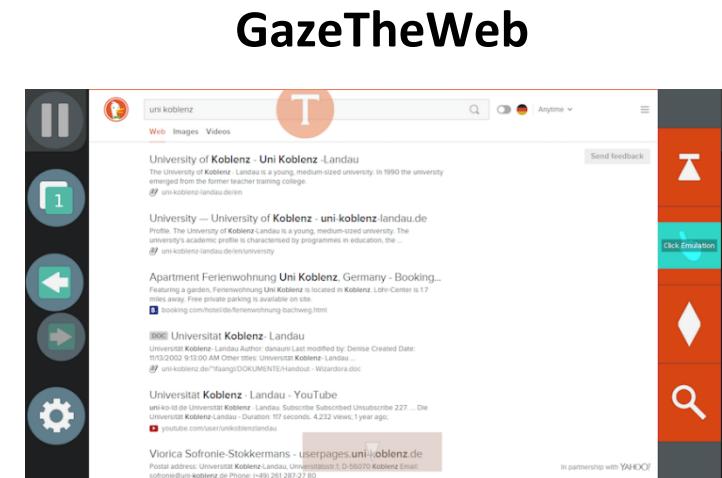
- Four architectural layers
- Modules in each layer
- Input/output interfaces for each module
- Relying on existing frameworks

# Translate eye-gaze signals into controls



- Adoptable layout defined by XML files
- Visual elements for gaze-based interaction
- Ready-made interaction components that can be easily re-used

- Browser-based framework offering all typical operations through eyes
- Relies on the eyeGUI library
- Serve as container for many different applications



# Translate EEG signals into controls

WP3

## SSVEPs

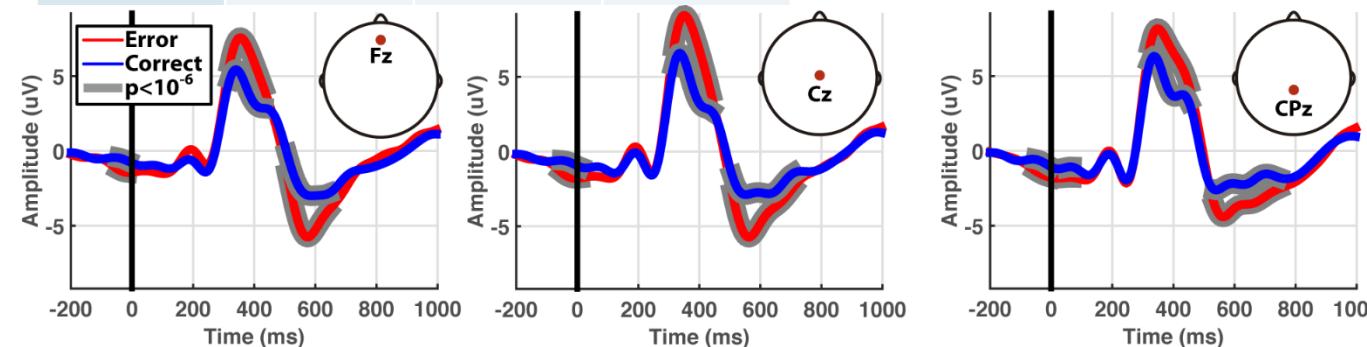
Subject ID	Optimal	Default
S001	<b>99.99</b>	98.55
S002	<b>99.13</b>	87.82
S003	<b>47.82</b>	34.78
S004	<b>97.82</b>	77.17
S005	26.08	30.43
S006	83.47	86.08
S007	<b>98.26</b>	60
S008	<b>42.02</b>	31.88
S009	<b>99.99</b>	<b>99.99</b>
S010	<b>96.52</b>	92.17
S011	<b>98.26</b>	98.26
Mean Acc.	<b>80.85</b>	<b>72.47</b>

## SMRs

Features	Classifier	Time (s)	Accuracy (%)
PWelch	Linear SVM	5.98	86.43
	RBF SVM	5.95	87.14
	MLR	6.05	87.86
	LDA	5.78	70.71
PYAR	Linear SVM	5.72	87.14
	RBF SVM	5.78	87.86
	<b>MLR</b>	<b>5.6</b>	<b>88.57</b>
	LDA	5.65	79.29
DWT	Linear SVM	5.86	89.29
	<b>RBF SVM</b>	<b>5.86</b>	<b>90.71</b>
	MLR	5.66	88.57
	LDA	5.66	87.86
CSP	Linear SVM	6.99	83.57
	RBF SVM	7.09	83.57
	MLR	5.69	85

- Reliable setup of EEG sensor infrastructure
- In-house experimental protocols
- Replicate SoTA results
- Focus in on-line and low-cost BCIs

## ErrPs



# How to combine ET & EEG

WP3

- Cope with the Midas Touch problem in eye-tracking interfaces using the Sensor-Motoric-Rhythms (EEG)
- Facilitate error-correction in eye-tracking interfaces by performing undo using Error-related potentials (EEG)

- MAMEM bouwen
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# Wie zijn de gebruikers?

- Literatuur, focus groups en vragenlijsten
- Qualitatieve and statistische analyses
- Users behoeftes en gewoontes
- Requirements op 5 dimensies

WP6

Relevant Dimension	Description	Example of req.
Personalization/adaptation	personal variables, e.g., age, individual work spaces	Compatible with different age or cognitive profiles
Performance	Unified required actions from the system	Enable using a computer in a variety of different body positions
Emotions/Motivation	Persuasive design (see WP5)	Training phase should provide 'fun' for the user
Interoperability	interfaces with other software and hardware	Should work with Microsoft windows
Usability	ease of operation and user experience	To distinguish between an intentional and unintentional movement
Physiology	Specific to eye movements and brain waves (i.e., re clinical cohorts)	Tremor generated artefacts (4-6 Hz) and dyskinesia generated artefacts in PD patients should be taken into account

# Task 1: User Profiles & Personas

- Spinal cord injury disorder
- Neuromuscular disorders
- Parkinson's Disorder



# Model users using Personas

## Persona 1: Arie



Demographic	
Name	Arie Cohen
Gender	Male
Age	46
Country of Origin	Israel
Marital status	Married
Children	One
Occupation	Unemployed
Educational level	14 years
Main hobby	Reading

Medical information	
Medical condition	Spinal cord injury
Level of injury	Complete injury in the c4 vertebra and loss of mobility from the neck down
Secondary conditions	Respiratory and breathing issues

Computer use information	
Computer skills	Intermediate
Computer use frequency	Medium
Assistive device use	Typing stick
Frequent computer activities	Recreation, communication
Main computer difficulties	Using two keys at the same time, zooming

Goals and attitudes	
Technology attitude	Technophobe
Main computer contribution potential	Employment
	employment potential, communication

- Based on requirements
- User needs and computer habits
- Medical condition and psychological status
- Make user profiles
- Build personas for each cohort
  - Demographic
  - Medical info
  - Computer user info
  - Goals & attitudes

# Usage scenarios

Training tasks	Suggested task using MAMEM platform	
Cursor – basic	Select: Click the left button Click the right button Activate: Double click the left button Move the cursor around the edges of the screen Zoom in / out Copy and move Scroll bar- scroll down and up, change pages	<ul style="list-style-type: none"> <li>Basic tasks</li> <li>Intended for training and familiarizing with the system</li> </ul>
Windows' operations	Menu – select “c” Switching windows Open an application Typing words	<b>Dictated task (communication)</b> <ul style="list-style-type: none"> <li>Writing an e-mail</li> <li>Photo editing</li> <li>Sharing information</li> </ul> <b>Suggested task using MAMEM platform</b> <ul style="list-style-type: none"> <li>Open an email client software, write and send an email</li> <li>Open an image editing software, resize or re-colour picture, save it</li> <li>Post text and pictures in a social network, e.g. Facebook</li> </ul>
Keyboard operations	Using frequent keyboard action)	<ul style="list-style-type: none"> <li>Searching the internet</li> <li>Instant messaging</li> <li>Watching a movie online</li> <li>Managing music library</li> <li>Writing /editing text</li> </ul> <b>Suggested task using MAMEM platform</b> <ul style="list-style-type: none"> <li>Use a search engine to find specific information including navigating to the pages and scrolling (e.g. getting to the bottom of the information on a long page)</li> <li>Use an Instant messaging app, e.g. The Facebook's Instant messaging app</li> <li>Search for a video on YouTube, and watch it (e.g. ability to start and pause the video)</li> <li>Arrange several music files into a playlist</li> <li>Write a few sentences in word /create one slide in PowerPoint</li> </ul>

- MAMEM bouwen
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# Stimuleren

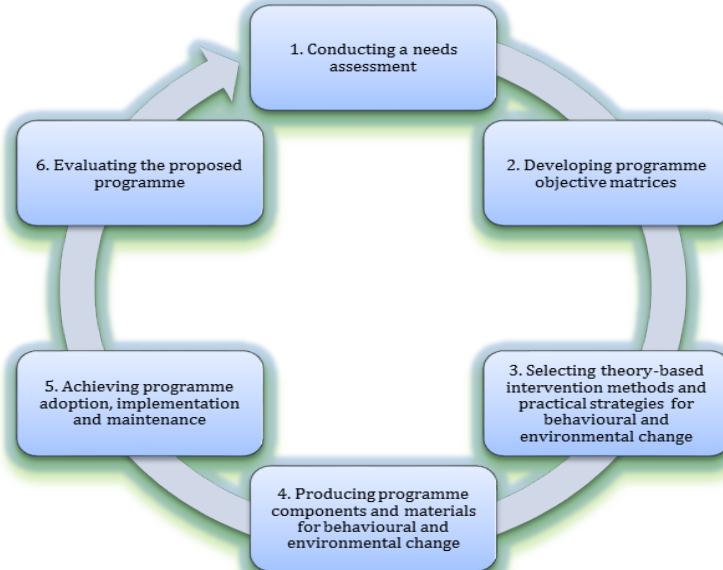
1. User acceptance and training engagement

2. Keep using to increase social participation

## How to influence the acceptance and use of MAMEM technology for the different target groups?



# Persuasive Design



- Intervention Mapping Framework
- Six stages
- Determines the interventions

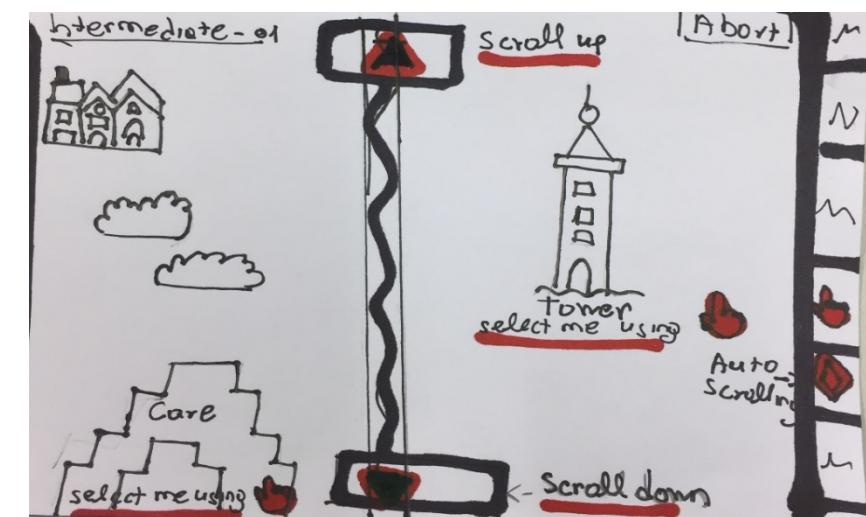
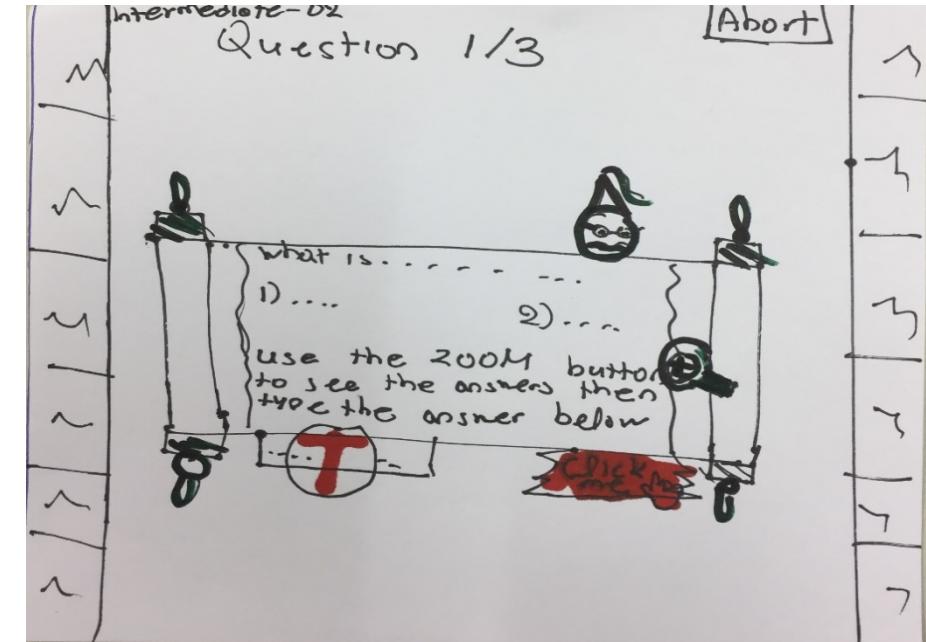
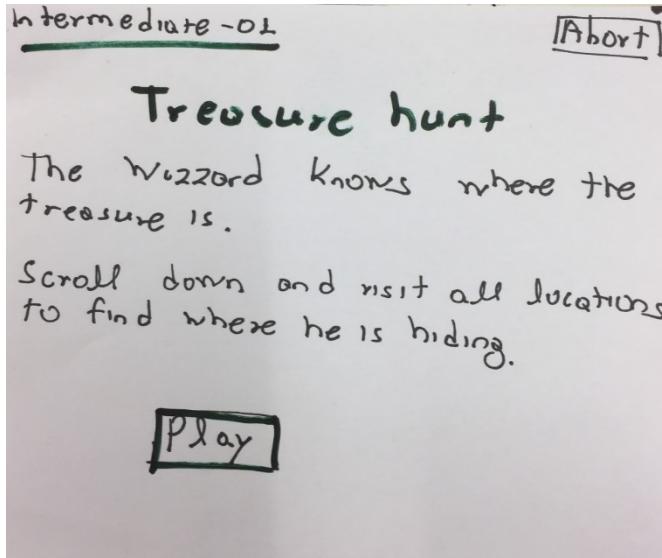
- Change objective
- Determinant
- Persuasive strategy

Change objective	Determinant	Persuasive strategies (examples)
Choose realistic goals and appropriate tasks	Effort expectancy:  <b>Belief that goals you choose are do-able, appropriate and selected for you.</b>	<b>Suggestion:</b> let the system make suggestions and let users make choice guided by what the system provides as good option  <b>Tailoring:</b> make sure that offered options are relevant to the user profile

# Games om te leren

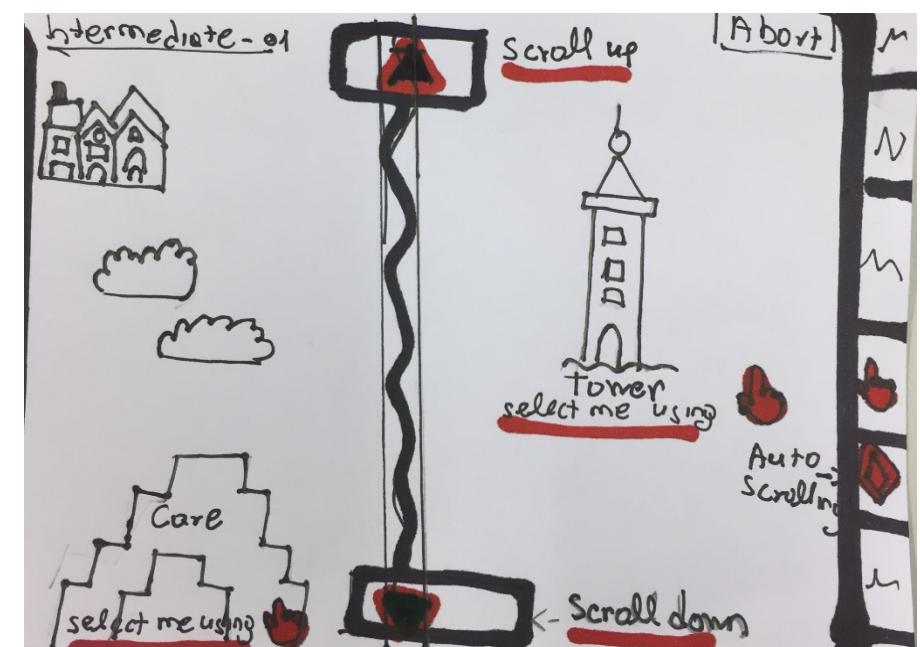
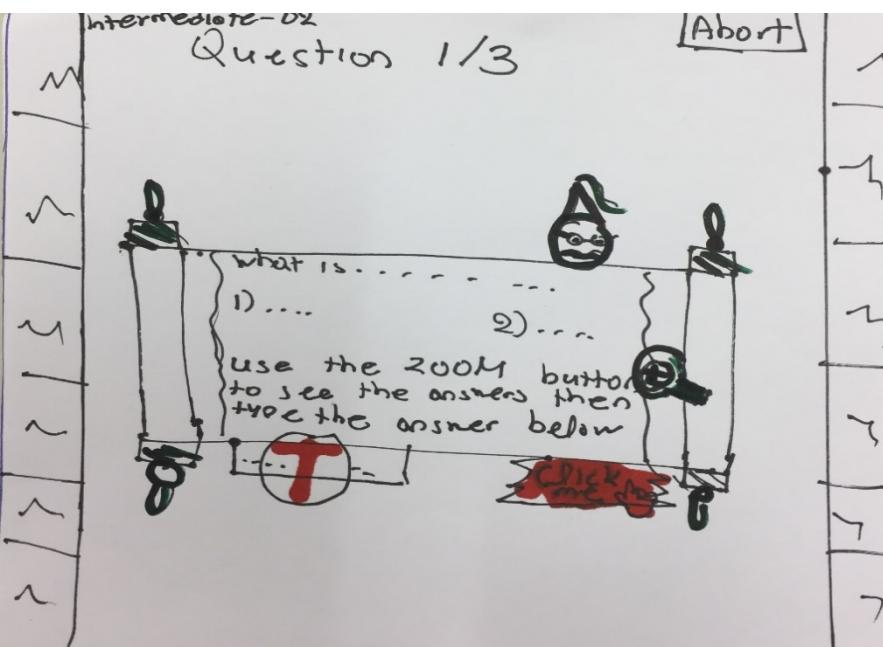


# Games bedenken



# b) Action card updates

- Remove any task explanations;
- Provide instructions in a meaningful way



# Zoek de tovenaar

The screenshot shows a mobile game interface. At the top, there is a navigation bar with a play/pause button, a progress bar labeled "INTERMEDIATE - 01 Find the wizard" (00:00:00), and a scroll up arrow. On the right, there is a question mark icon and a scroll down arrow. The main title "Find the wizard" is displayed in green, with the subtitle "He is hiding somewhere along the river" below it. A text box contains instructions: "Scroll through the level to find the wizard using the scroll overlays or the auto scrolling, and use the click emulation button to select the place where he is hiding!". Below this is a large green "Start" button. To the right of the start button is a yellow smiley face icon with the text "Click emulation" and a green arrow pointing right. Below the start button is a green downward arrow labeled "Scroll down". To the right of the scroll down arrow is a green arrow pointing right labeled "Auto scrolling". On the far left and right sides of the screen are vertical stacks of circular icons representing different controls or functions.

INTERMEDIATE - 01 Find the wizard  
00:00:00

mastasios Papazoglou - Chalkias  
Scroll up

Find the wizard

He is hiding somewhere along the river

Start

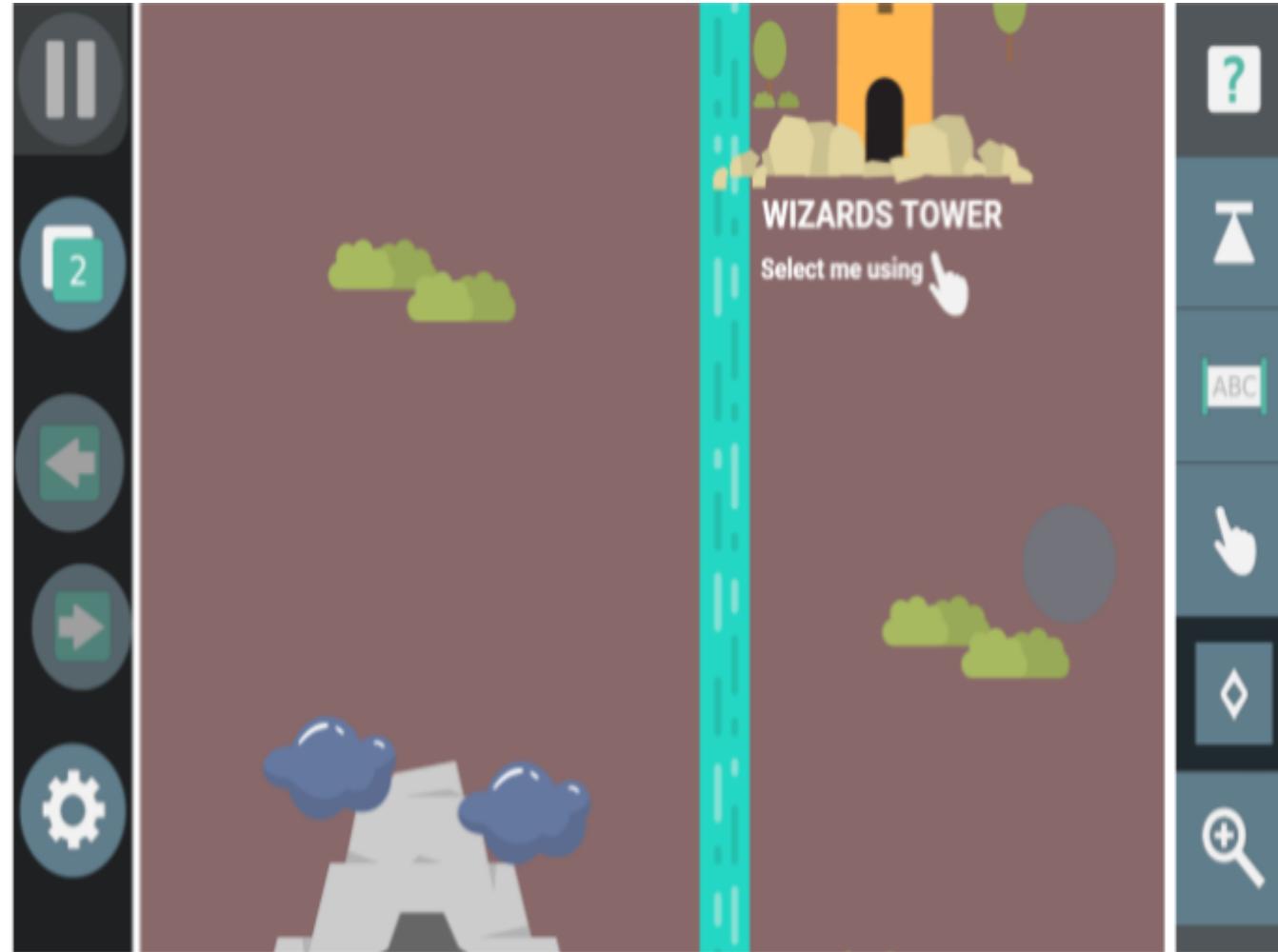
Scroll down

Click emulation

Auto scrolling

## B.3 Level intro & tutorial

# Zoek de tovenaar



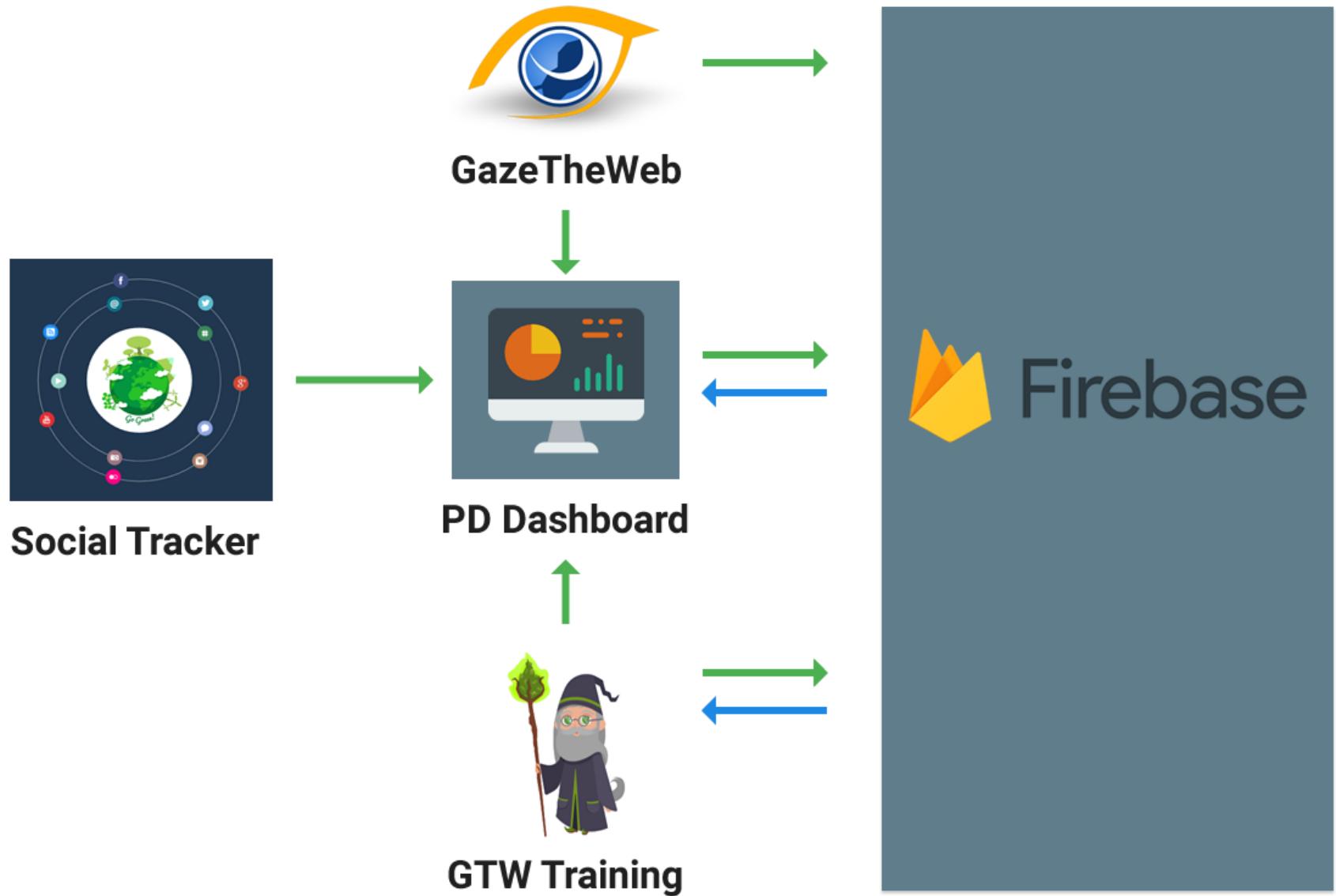
# Nog meer beïnvloeding: Scores

The screenshot shows a game summary screen titled "INTERMEDIATE - 01 Find the wizard". The top bar displays the title and a timer at 00:20. A message box says "S, you scored really great! You finished the level very effectively, gaining you the trophy!" with a smiling emoji. On the left, a vertical sidebar has icons for pause, first place, back, forward, and settings. The main area shows a "SCORE" section with a new score of 89428 and a best score of 93549. A "TIME" section shows a new time of 00:20 and a best time of 00:12. A "REWARDS" section shows a trophy icon for "The Flash!" with the note "Lightning strikes only once in the same place." Below these are "RANKINGS - TOP 5" tables for Score and Time. At the bottom are buttons for "Overview", "Replay", and "Next". To the right, a vertical sidebar has icons for question mark, funnel, ABC, hand, diamond, and magnifying glass.

#	Name	Score	Time	Rewards
1	1234567	98793	00:02	
2	113	95169	00:08	
3	1	94742	00:10	
4	test	94721	00:09	
5	72	94107	00:11	

#	Name	Score	Time	Rewards
1	1234567	98793	00:02	
2	113	95169	00:08	
3	1	94742	00:10	
4	test	94721	00:09	
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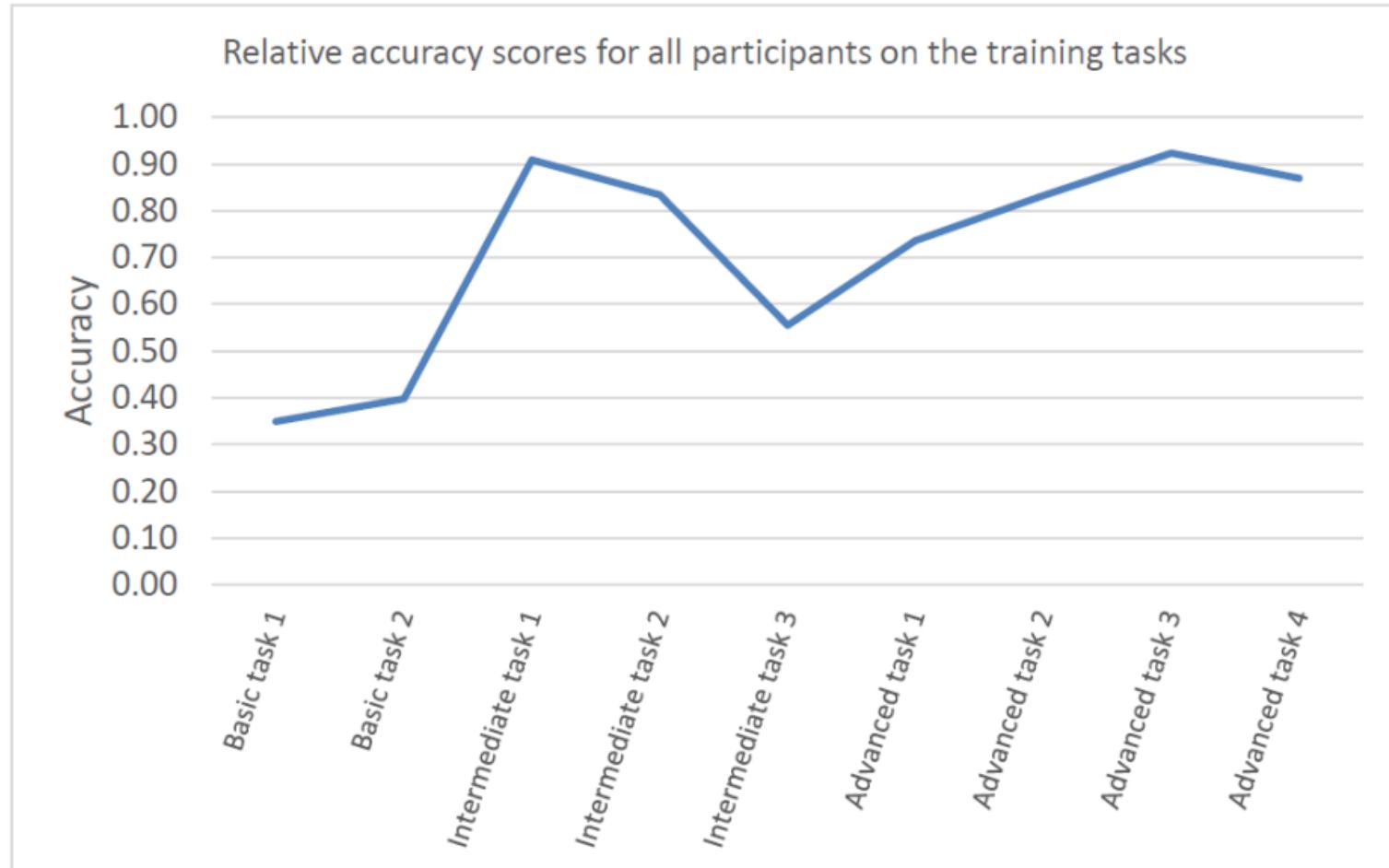
# Platform Communication



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- **Veldtest 1: Gebruikers in het lab**
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  - Sociale inclusie
  - Stimuleren tot sociale inclusie
- Veldtest 2: Bij gebruikers thuis

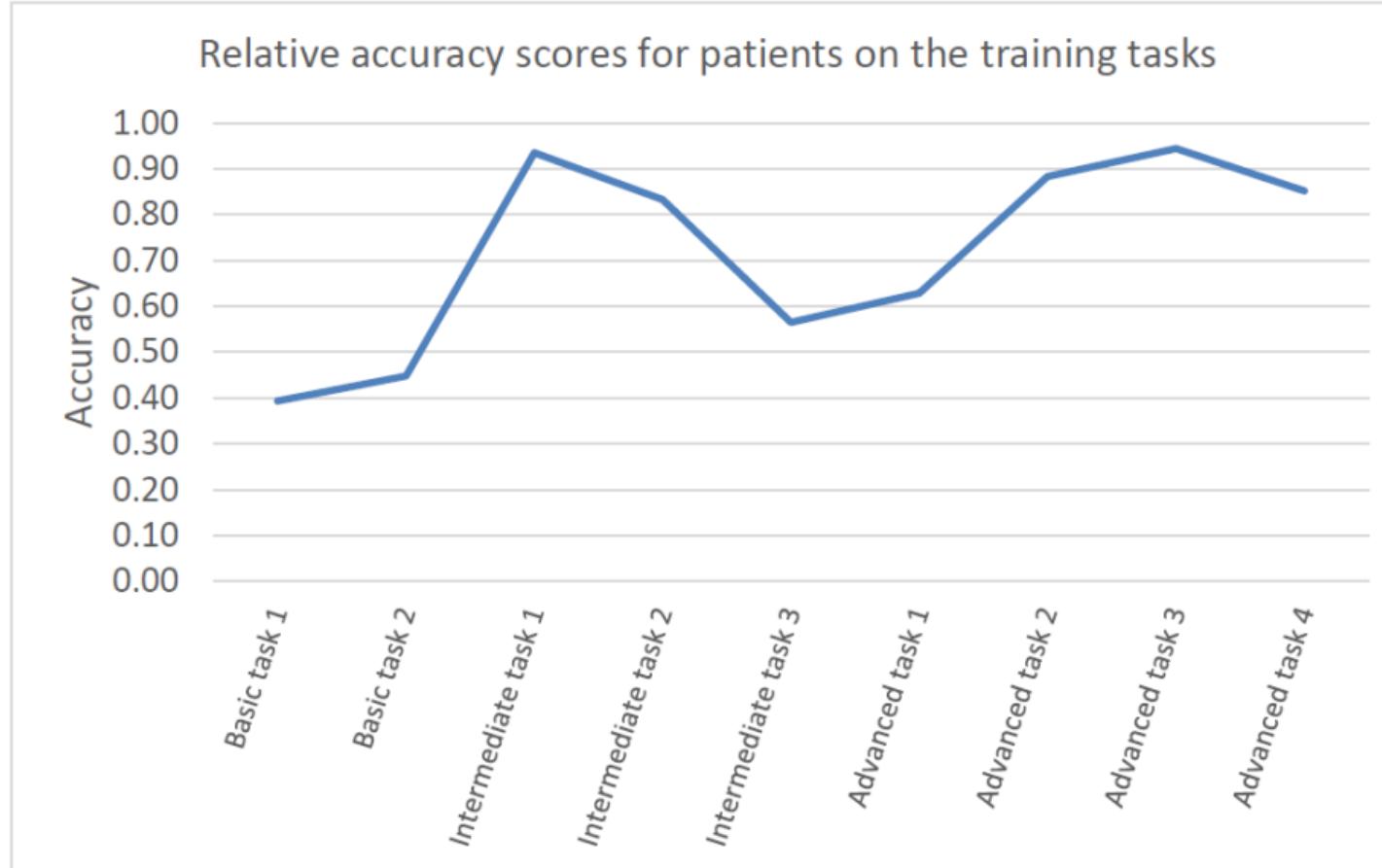
# Alle deelnemers werden beter

Figure 8. Training tasks learning curve for all participants



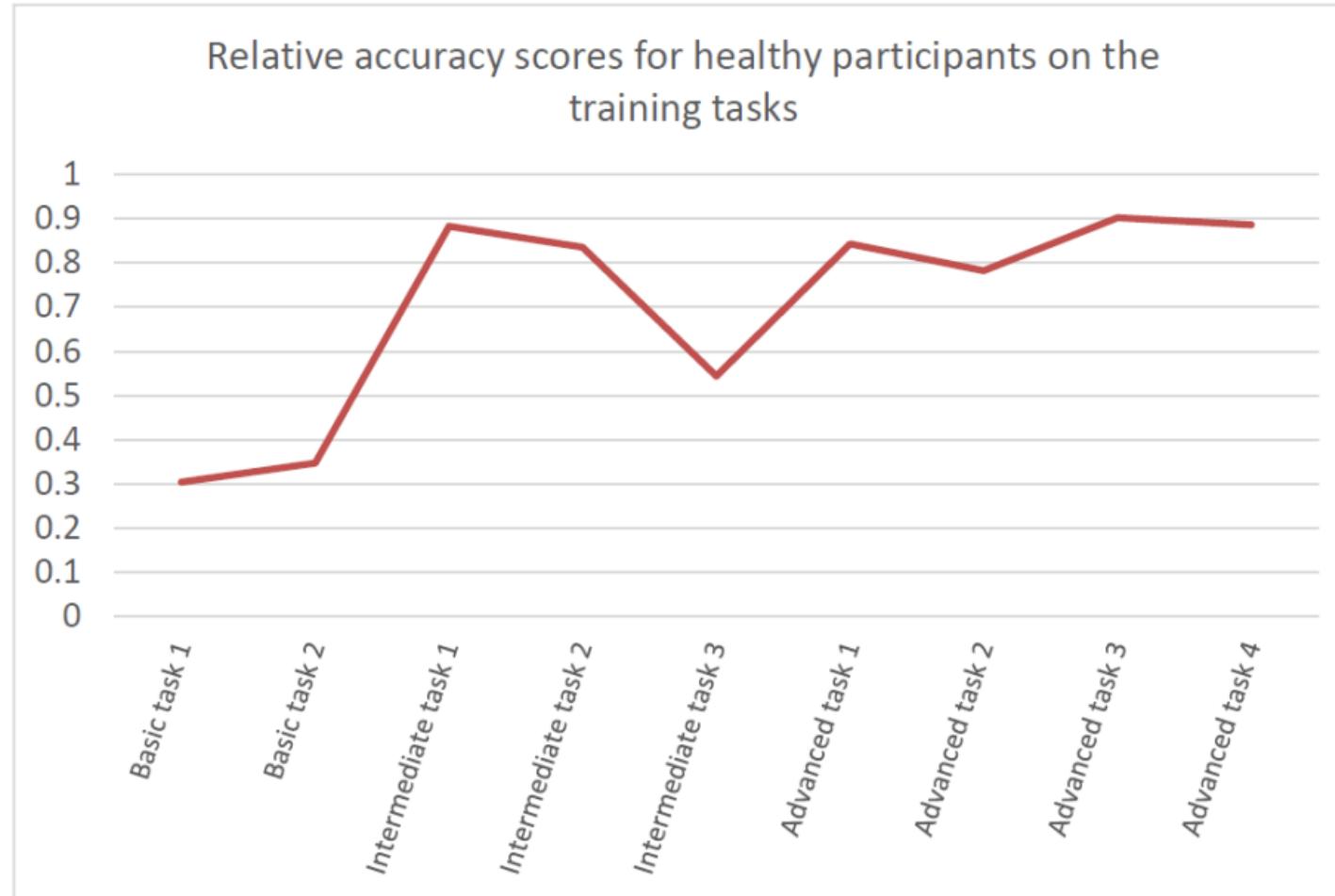
# SCI, PD, NMD werden beter

Figure 9. Training tasks learning curve for the disabled participants



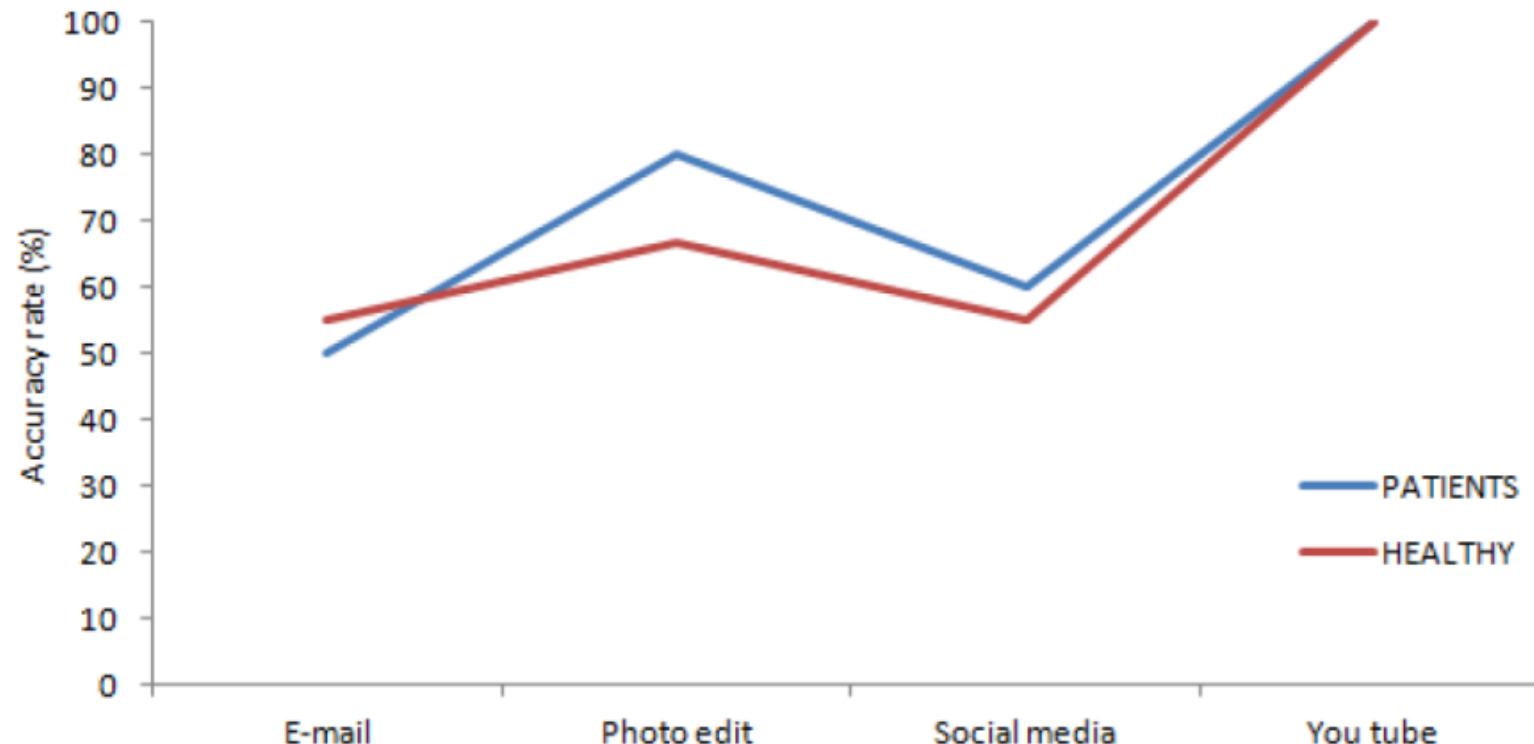
# Able-bodied warden better

Figure 10. Training tasks learning curve for the able-bodied participants



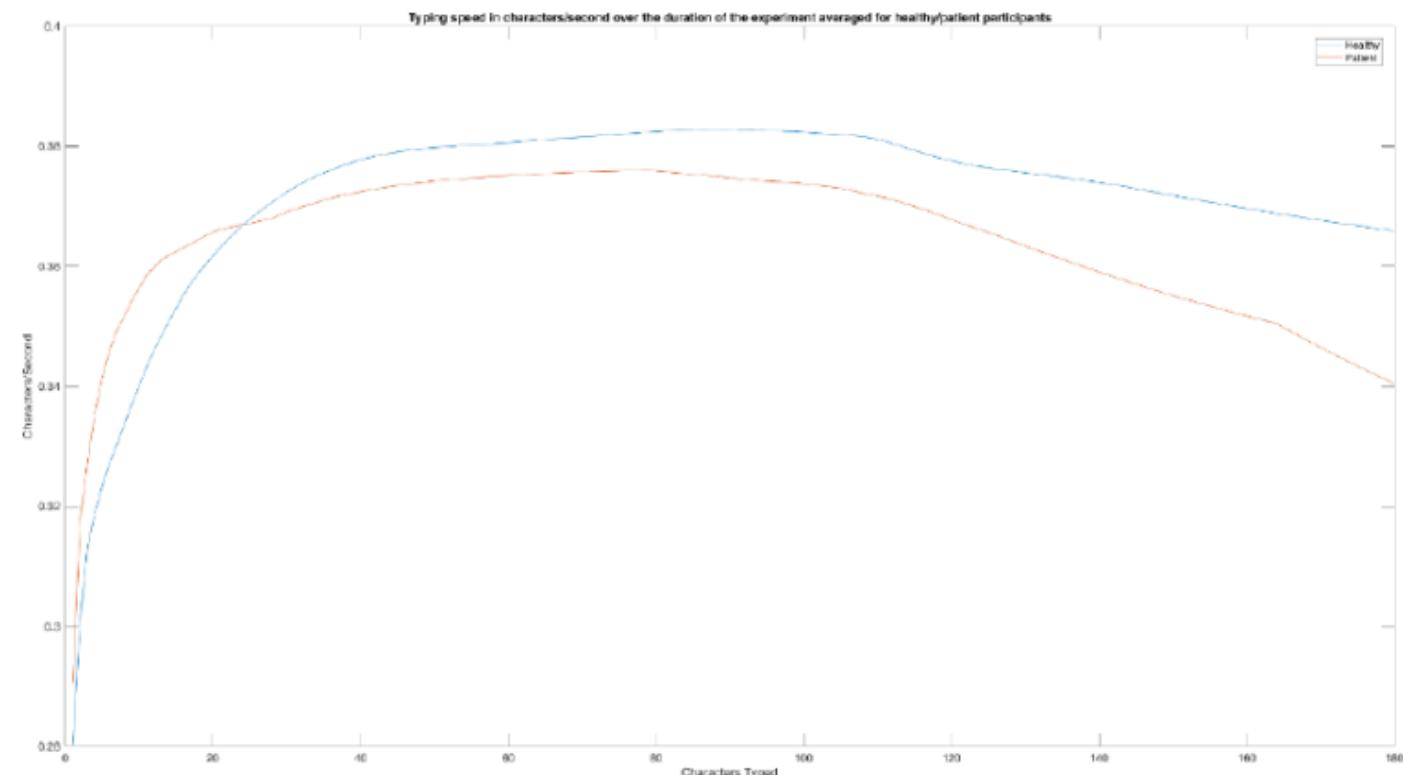
# In de games, maar ook in 4 web-taken

Figure 11. Dictated tasks learning curve for able-bodied (blue) and disabled (red) participants



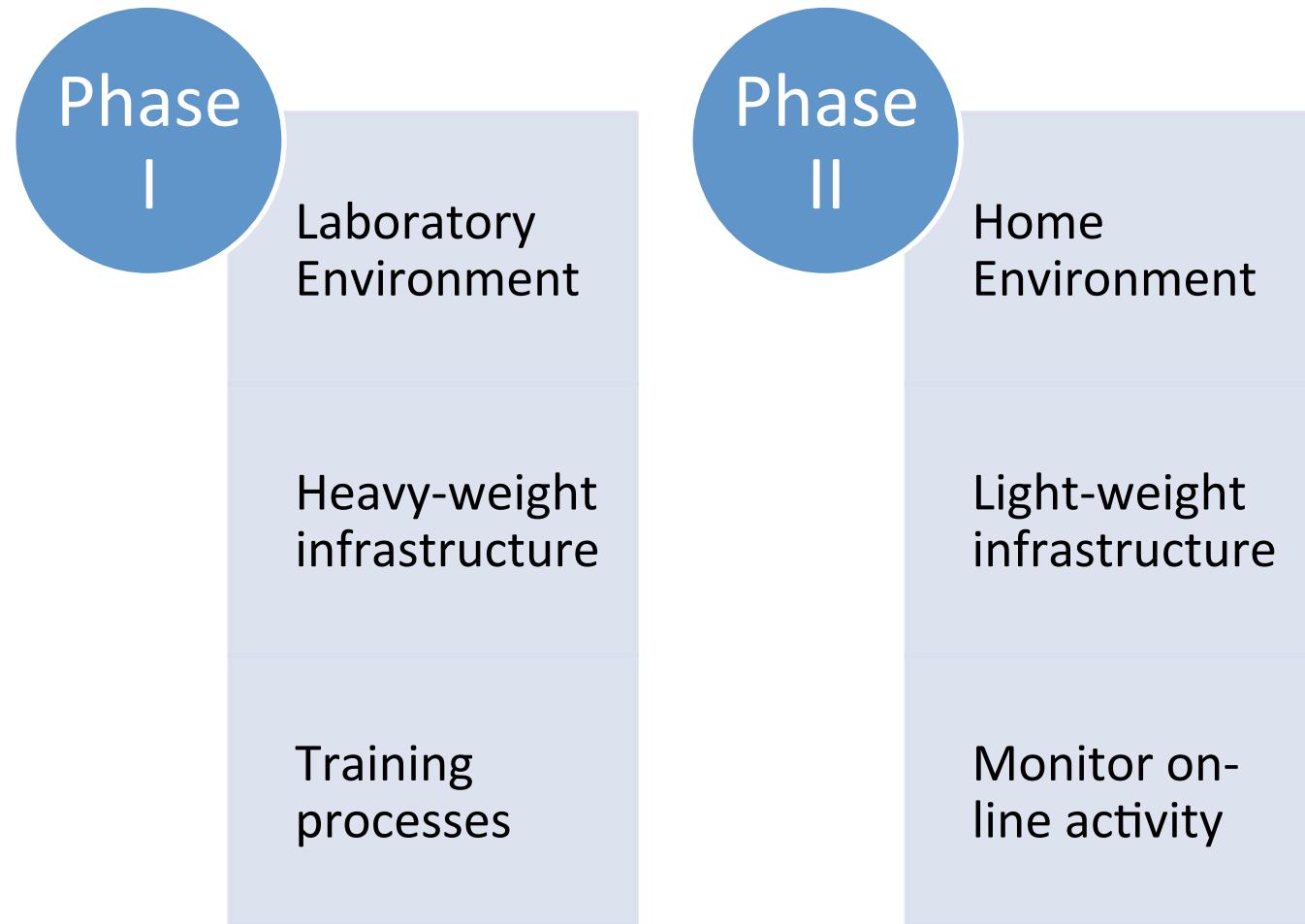
# Steeds sneller typen

Figure 13. Typing speed learning curves for able-bodied (blue) and disabled (orange) participants



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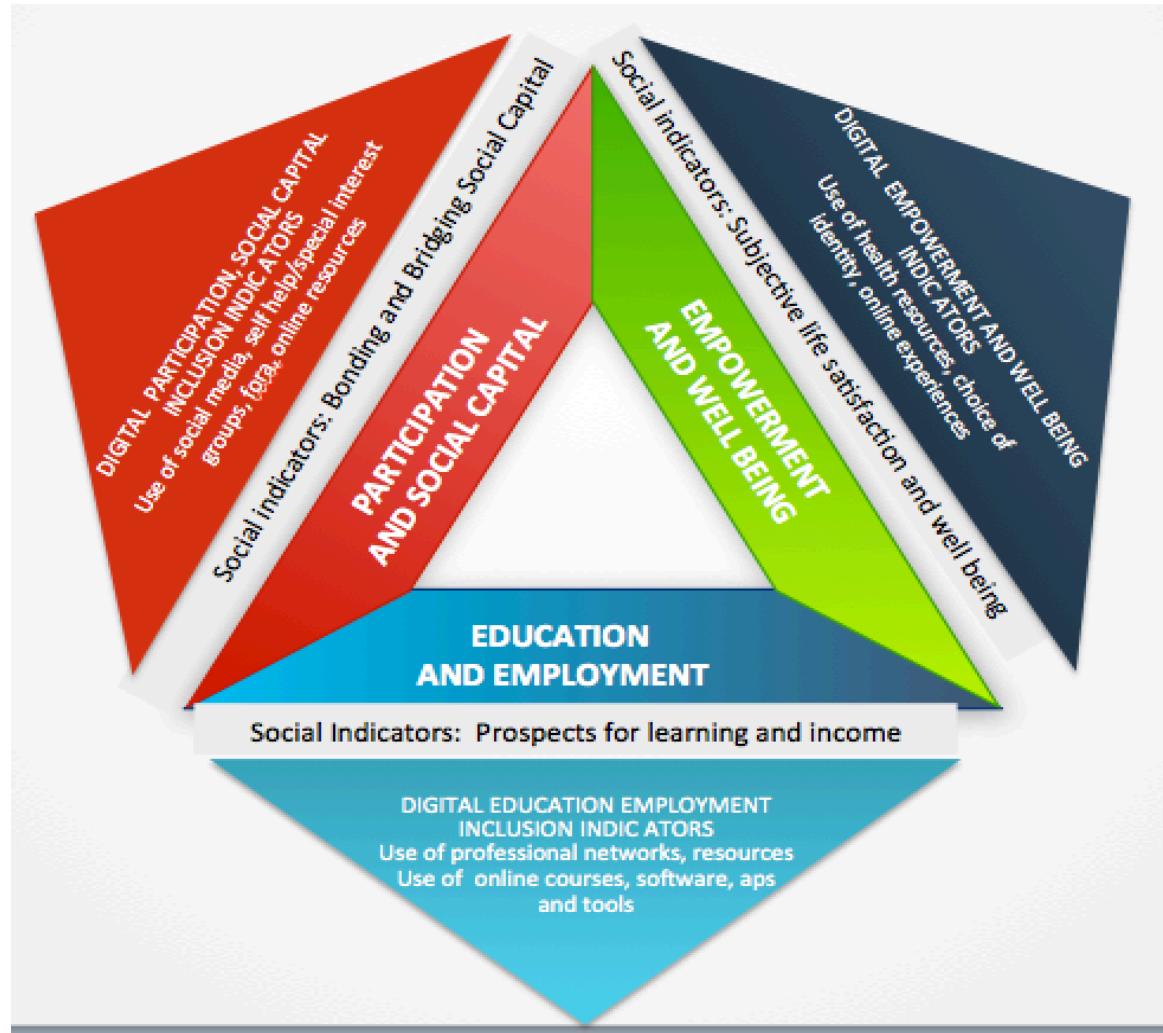
# Usage in non-controlled environments



WP6

- MAMEM bouwen
  - Technisch
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  - Stimuleren tot gebruik
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  - **Sociale inclusie**
  - Stimuleren tot sociale inclusie
- Veldtest 2: Bij gebruikers thuis

# Sociale inclusie



- Methodology synthesizing digital indicators with social inclusion areas
- Participation and social capital
- Empowerment and well being
- Education and employment

WP7

# Tools for quantifying social integration

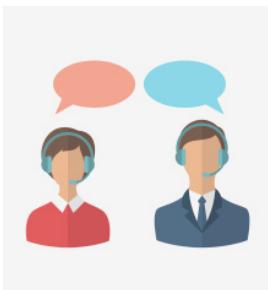
WP7



Computer monitored activity pre and post MAMEM use



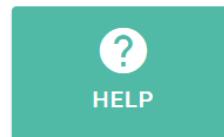
Questionnaire filled in by sample with disability  
Questionnaire filled in by respective care takers  
Questionnaire benchmarked against healthy sample



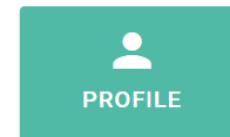
Audio diaries to capture usage momentum and insights about MAMEM optimization

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- MAMEM aanpassen
  - Sociale inclusie
  - **Stimuleren tot sociale inclusie**
- Veldtest 2: Bij gebruikers thuis

# MAMEM Dashboard / Homepage



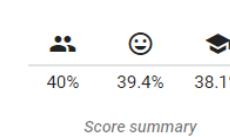
Contact us if you need help



Edit your information



Replay the training app to score better



sushi  
Total score  
**39.2%**

## DETAILS

See how you can improve

**How to get better**

**Participation & Social**

E-mail	42.4%
Social media	39.4%
Fora	38.1%
YouTube	43.4%
News	38.1%

**Empowerment & Wellbeing**

YouTube	43.4%
Entertainment	38.1%
News	38.1%
Health	38.1%

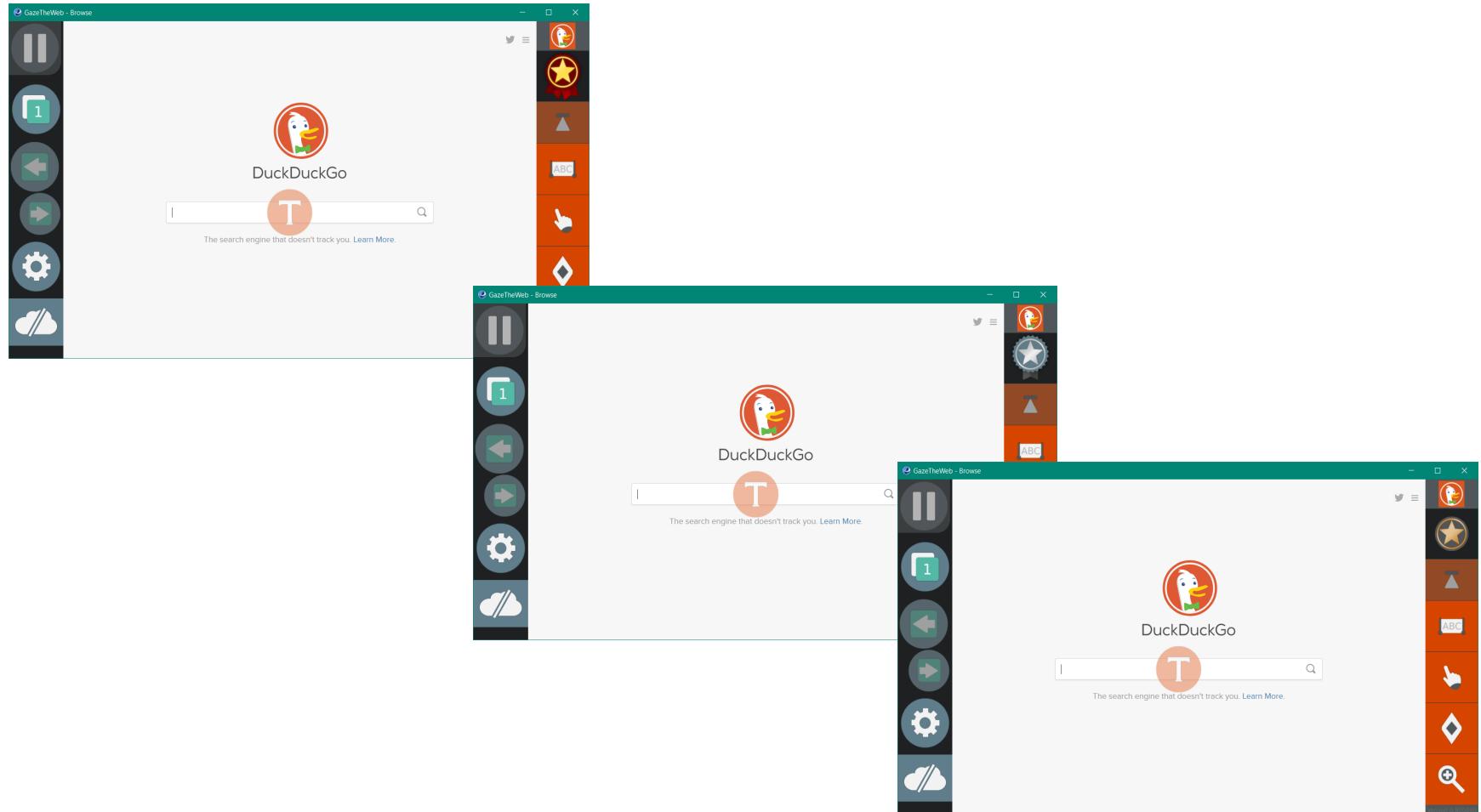
**Education & Employment**

E-learning	38.1%
Pro networks	38.1%
Job search	38.1%

## GRAPHS

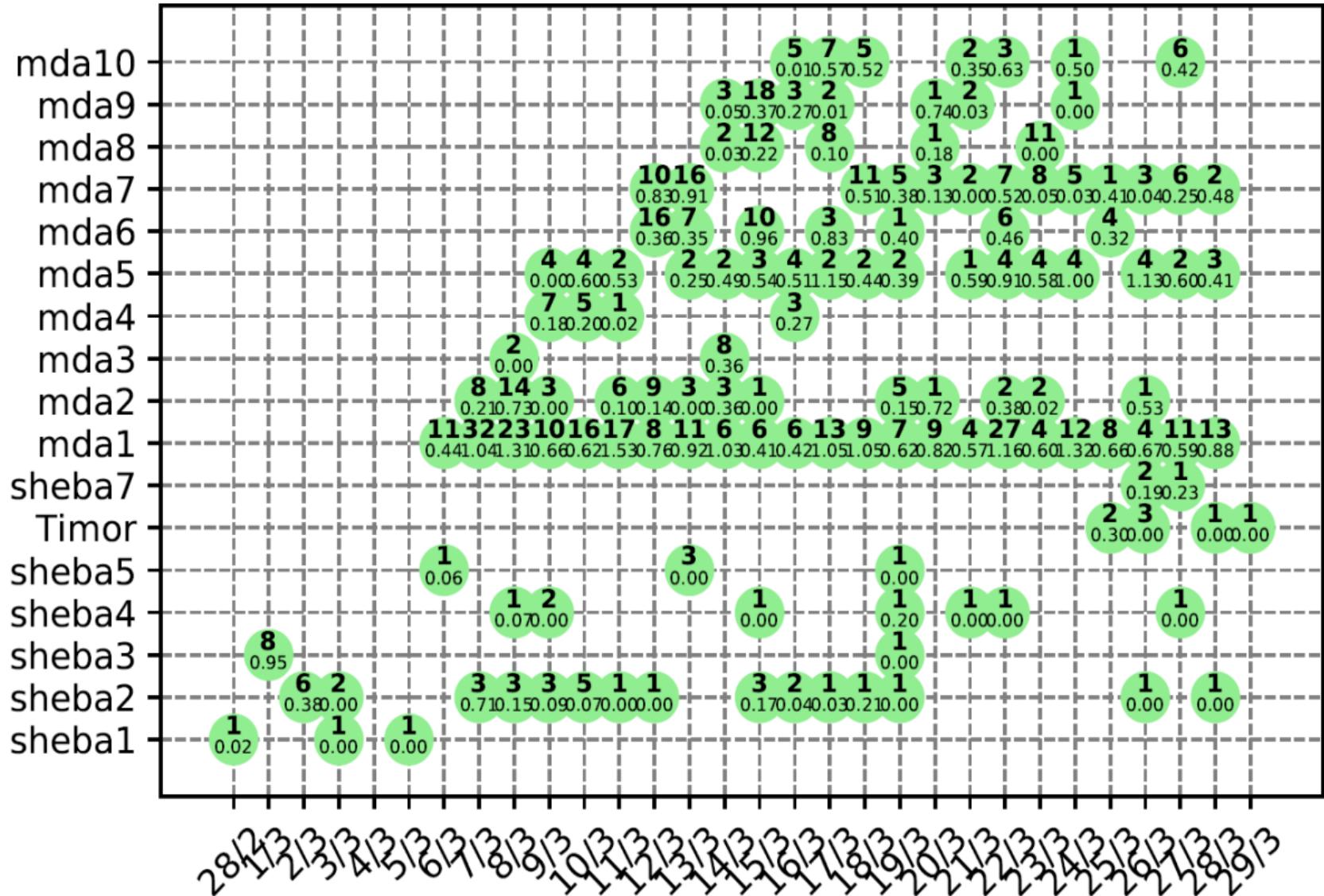
See how well you perform over time

# Stimuleren in GazeTheWeb

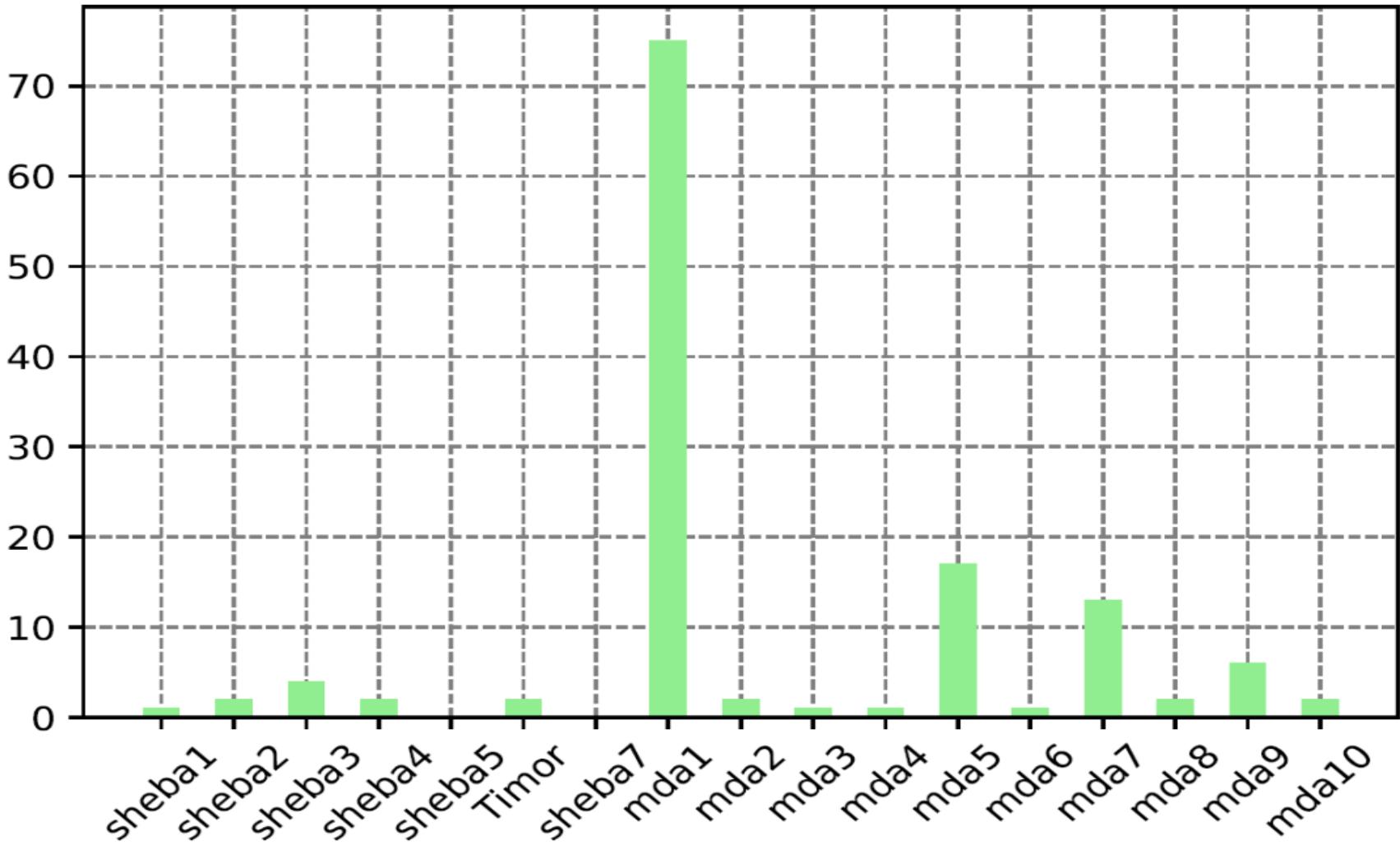


- MAMEM bouwen
  - Technisch
  - Gebruikers in beeld brengen
  - Stimuleren tot gebruik
- Veldtest 1: Gebruikers in het lab
- MAMEM aanpassen
  - Sociale inclusie
  - Stimuleren tot sociale inclusie
- **Veldtest 2: Bij gebruikers thuis**

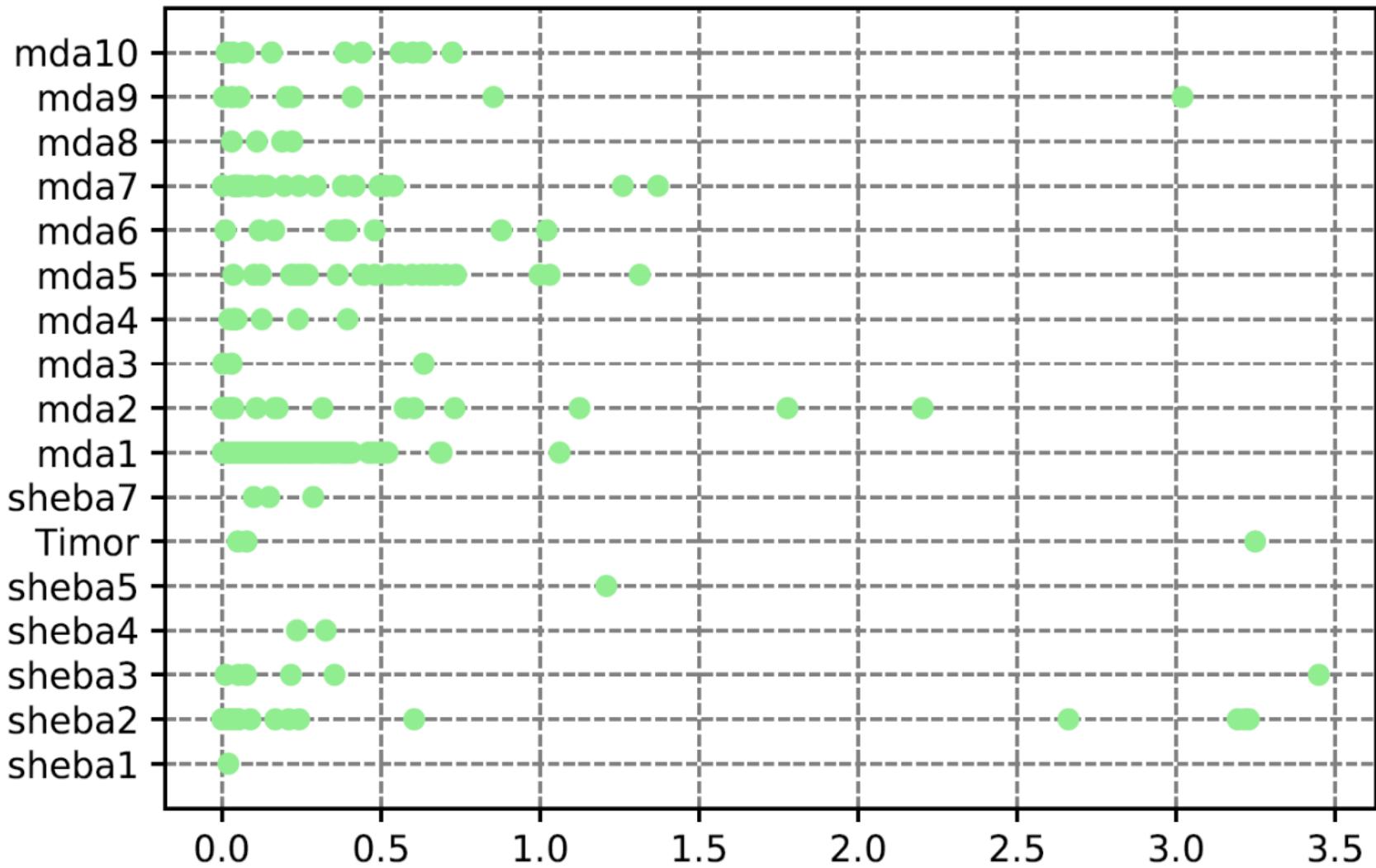
## Daily Usage - Start Count (bold) and Active Hours (in Web)



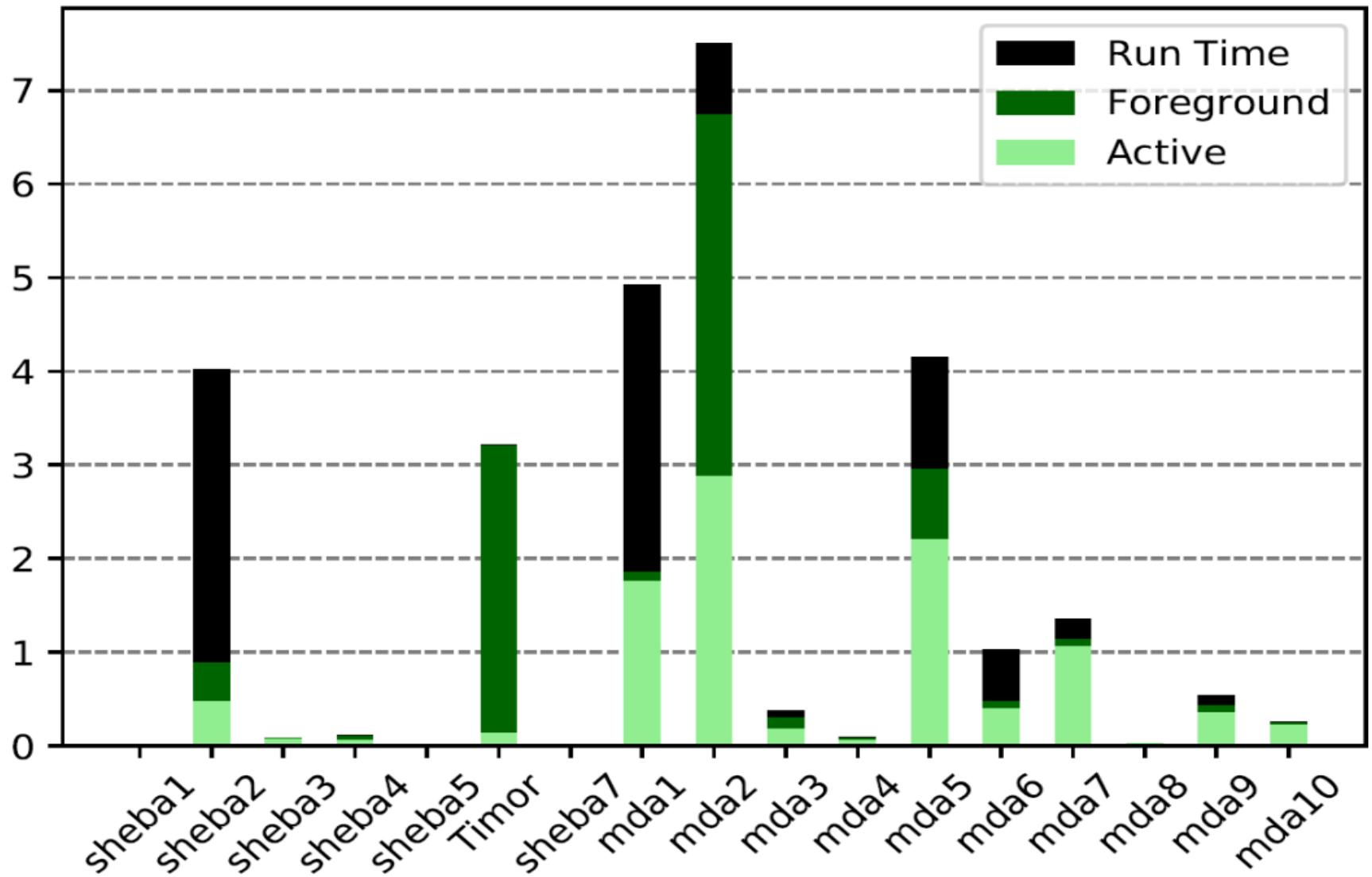
## Global Metrics: Bookmark Usage Count

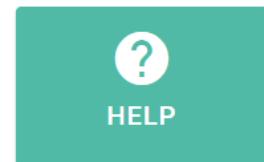


## Run Times After Start in Hours



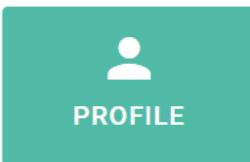
## YouTube Hours





?

HELP



PROFILE

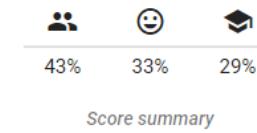


TRAINING

Contact us if you need help

Edit your information

Replay the training software to score better

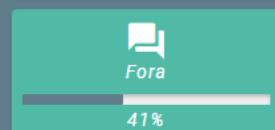
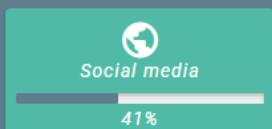


## DETAILS

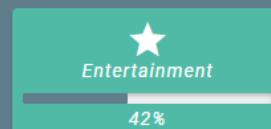
See how you can improve

### How to get better

#### Participation & Social



#### Empowerment & Wellbeing



#### Education & Employment



## GRAPHS

See how well you perform over time



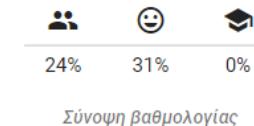
Επικοινωνήστε μαζί μας



Επεξεργασία προσωπικών στοιχείων



Δοκιμάστε να πετύχετε καλύτερη βαθμολογία



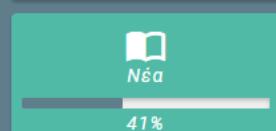
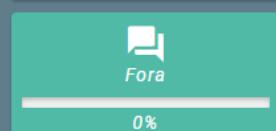
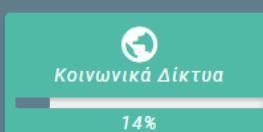
mdu2  
Συνολική βαθμολογία  
18%

## ΛΕΠΤΟΜΕΡΕΙΕΣ

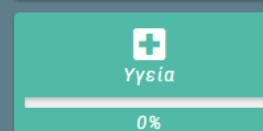
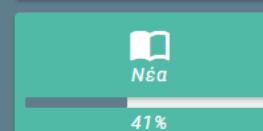
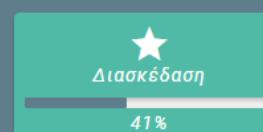
Δείτε πως μπορείτε να βελτιωθείτε

### Πως να βελτιωθείτε

#### 👤 Συμμετοχή & Κοινωνικότητα



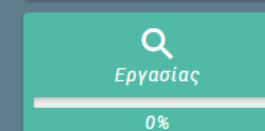
#### 😊 Ενδυνάμωση & Ευεξία

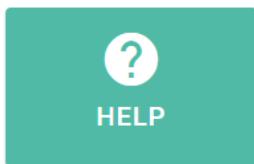


## ΓΡΑΦΗΜΑΤΑ

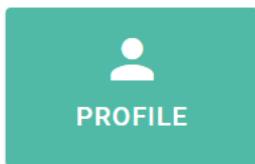
Δείτε τη βελτίωση σας με την πάροδο του χρόνου

#### 🎓 Εκπαίδευση & Εργασία





HELP



PROFILE



TRAINING

Contact us if you need help

Edit your information

Replay the training software to score better

Basic 1 ● 1

Int 3 ● ●

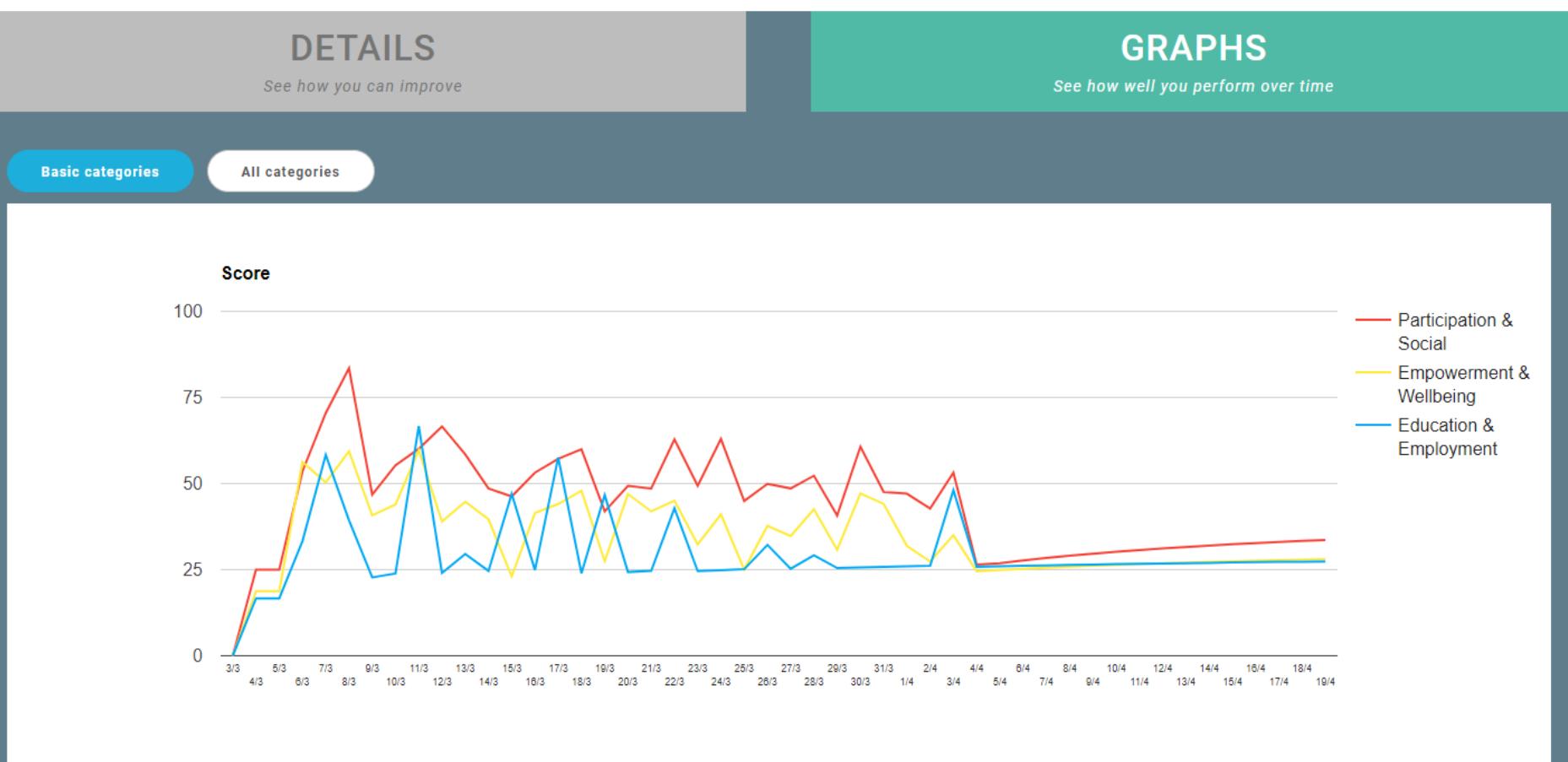
Adv 4 ● ● ●

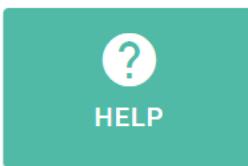


43% 33% 29%

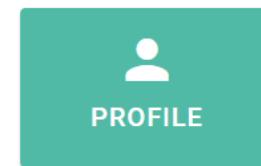
Score summary

mdu1  
Total score  
35%





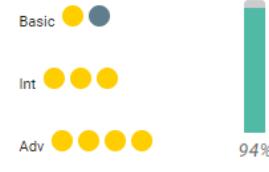
Contact us if you need help



Edit your information



Replay the training software to score better



Training summary



Score summary

mida  
Total score  
35%

## DETAILS

See how you can improve

## GRAPHS

See how well you perform over time

Basic categories

All categories

Score

100

75

50

25

0

3/3 4/3 5/3 6/3 7/3 8/3 9/3 10/3 11/3 12/3 13/3 14/3 15/3 16/3 17/3 18/3 19/3 20/3 21/3 22/3 23/3 24/3 25/3 26/3 27/3 28/3 29/3 30/3 1/4 2/4 3/4 4/4 5/4 6/4 7/4 8/4 9/4 10/4 11/4 12/4 13/4 14/4 15/4 16/4 17/4 18/4

- email
- facebook
- twitter
- instagram
- forum
- youtube
- news
- entertainment
- health
- elearning
- linkedin
- job



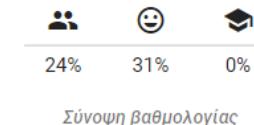
Επικοινωνήστε μαζί μας



Επεξεργασία προσωπικών στοιχείων



Δοκιμάστε να πετύχετε καλύτερη βαθμολογία



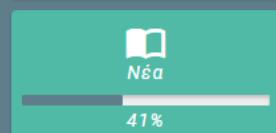
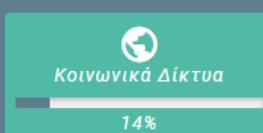
mdu2  
Συνολική βαθμολογία  
18%

## ΛΕΠΤΟΜΕΡΕΙΕΣ

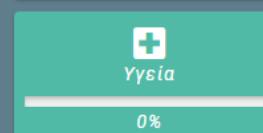
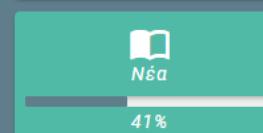
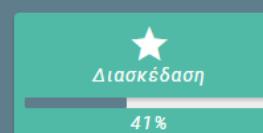
Δείτε πως μπορείτε να βελτιωθείτε

### Πως να βελτιωθείτε

#### 👤 Συμμετοχή & Κοινωνικότητα



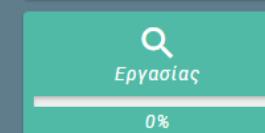
#### 😊 Ενδυνάμωση & Ευεξία



## ΓΡΑΦΗΜΑΤΑ

Δείτε τη βελτίωση σας με την πάροδο του χρόνου

#### 🎓 Εκπαίδευση & Εργασία





Επικοινωνήστε μαζί μας

Επεξεργασία προσωπικών στοιχείων

Δοκιμάστε να πετύχετε καλύτερη βαθμολογία



mda2  
Συνολική βαθμολογία  
18%

## ΛΕΠΤΟΜΕΡΕΙΕΣ

Δείτε πως μπορείτε να βελτιωθείτε

Βασικές κατηγορίες

Όλες οι κατηγορίες

## ΓΡΑΦΗΜΑΤΑ

Δείτε τη βελτίωση σας με την πάροδο του χρόνου

### Βαθμολογία



- Συμμετοχή & Κοινωνικότητα
- Ενδυνάμωση & Ευεξία
- Εκπαίδευση & Εργασία



## ΒΟΗΘΕΙΑ



## ΣΤΟΙΧΕΙΑ



## ΕΚΠΑΙΔΕΥΣΗ

Επικοινωνήστε μαζί μας

Επεξεργασία προσωπικών στοιχείων

Δοκιμάστε να πετύχετε καλύτερη βαθμολογία

Βασικές

Ενδιαφέρονται

Προσωπικός

Σύνοψη εκπαίδευσης



24%



31%



0%

Συνολική βαθμολογία

18%

## ΛΕΠΤΟΜΕΡΕΙΕΣ

Δείτε πώς μπορείτε να βελτιωθείτε

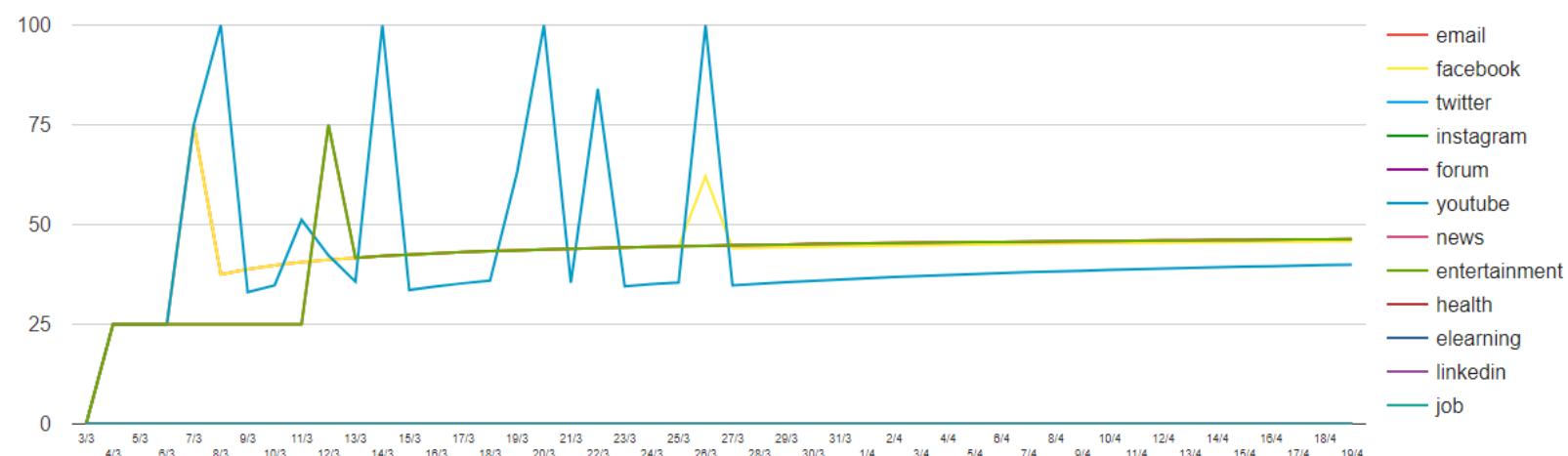
## ΓΡΑΦΗΜΑΤΑ

Δείτε τη βελτίωση σας με την πάροδο του χρόνου

Βασικές κατηγορίες

Όλες οι κατηγορίες

## Βαθμολογία





Επικοινωνήστε μαζί μας



Επεξεργασία προσωπικών στοιχείων



Δοκιμάστε να πετύχετε καλύτερη βαθμολογία



mda10  
Συνολική βαθμολογία  
**28%**

## ΛΕΠΤΟΜΕΡΕΙΕΣ

Δείτε πως μπορείτε να βελτιωθείτε

## ΓΡΑΦΗΜΑΤΑ

Δείτε τη βελτίωση σας με την πάροδο του χρόνου

### Πως να βελτιωθείτε

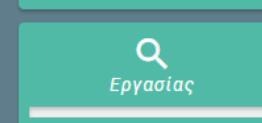
#### 👤 Συμμετοχή & Κοινωνικότητα



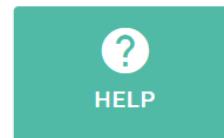
#### 😊 Ενδυνάμωση & Ευεξία



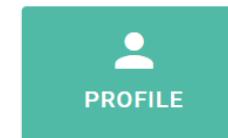
#### 🎓 Εκπαίδευση & Εργασία



# MAMEM Dashboard / Homepage



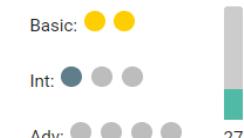
Contact us if you need help



Edit your information



Replay the training app to score better



sushi  
Total score  
**39.2%**

Score summary

Training summary

## DETAILS

See how you can improve

**How to get better**

Participation & Social	
E-mail	42.4%
Social media	39.4%
Fora	38.1%
YouTube	43.4%
News	38.1%

Empowerment & Wellbeing	
YouTube	43.4%
Entertainment	38.1%
News	38.1%
Health	38.1%

Education & Employment	
E-learning	38.1%
Pro networks	38.1%
Job search	38.1%

## GRAPHS

See how well you perform over time

- MAMEM bouwen
  - Technisch
  - Gebruikers in beeld brengen
  - Stimuleren tot gebruik
- Veldtest 1: Gebruikers in het lab
- MAMEM aanpassen
  - Sociale inclusie
  - Stimuleren tot sociale inclusie
- Veldtest 2: Bij gebruikers thuis



Je computer besturen met je  
ogen en je hersenen

Jaap Ham