

ASSESSING COGNITIVE PERFORMANCE FLUCTUATIONS USING PASSIVE CONTINUOUS WEARABLE DATA

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IGOR MATIAS M.Sc., PROF. MATTHIAS KLIEGEL Ph.D., PROF. KATARZYNA WAC Ph.D.



AIMS

Feasibility study on developing a **passive, ubiquitous assessment of cognitive performance fluctuations** over time

This research explores the potential of **consumer-grade portable and wearable devices** to measure behavioral changes linked to cognitive performance variations in cognitively healthy individuals.

This poster presents the initial step toward defining and evaluating digital biomarkers that characterize daily cognitive performance fluctuations, using only passively and ubiquitously collected TechROs data.

COHORT

Eighty-four cognitively healthy volunteers living in **Switzerland** and/or **France**. Twenty-one (25%) have/had cases of dementia in the family.

Age: between 46 and 78, mean of 57.917 (± 8.624) years.
Sex at birth: 49 (58%) Female, 35 (42%) Male, and 0 Intersex.
Self-identified race: 78 (93%) White, 2 (2%) Latino, 2 Asian, and 2 undisclosed.
Education years: between 6 and 40, mean of 17.840 (± 5.269).
Body mass index: between 18 and 41, mean of 24.668 (± 4.248).

METHODS

Data was collected **between 10 March and 31 August 2024**.

TechROs linked to PROs and PerfROs in 10 time windows:

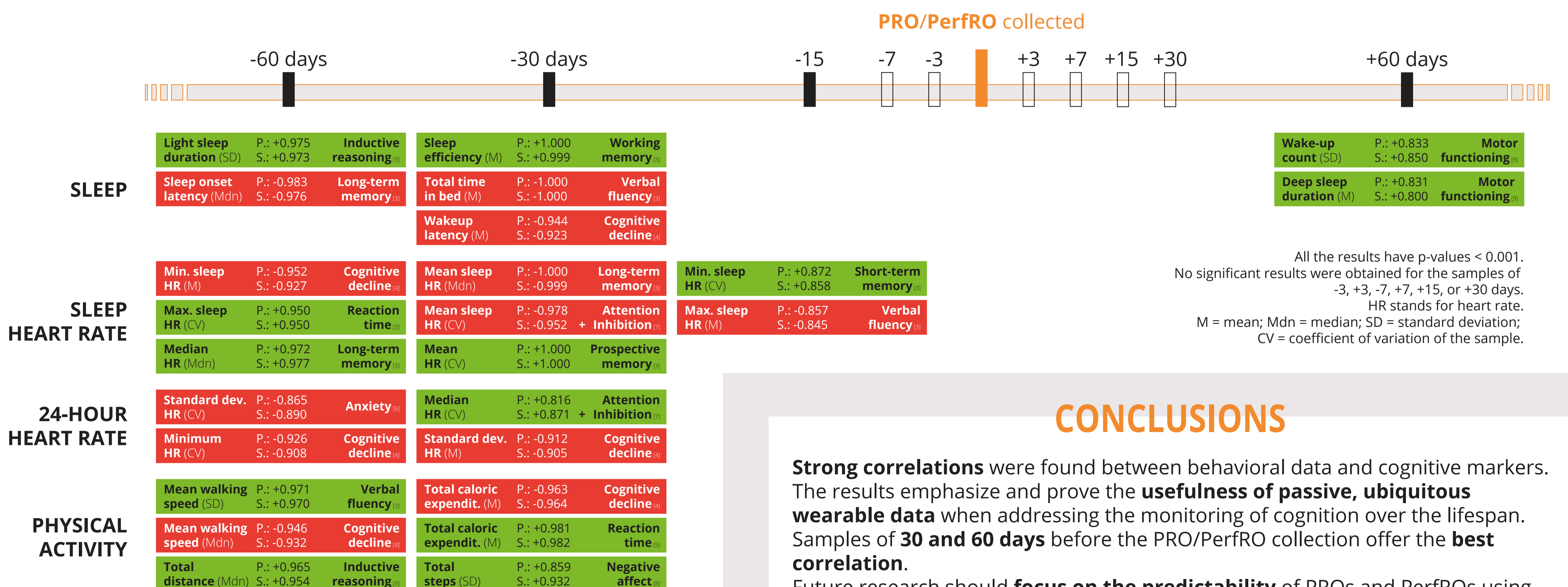
- 3 days before (1066 samples) and 3 days after (1307) the PRO/PerfRO assessment.
- 7 days before (865) and 7 days after (1163).
- 15 days before (668) and 15 days after (1001).
- 30 days before (585) and 30 days after (728).
- 60 days before (338) and 60 days after (481).

All samples were **free of missing data**. Calculated mean, median, standard deviation, and coefficient of variation for each sample.

Pearson and Spearman's partial correlations were computed, adjusting for potential **confounders** such as demographics, education, diet, lifestyle, medical history, longitudinal biometrics (e.g., midlife obesity), timezone changes, subjective age, and wearable usage time.

Only selected results with both Spearman and Pearson correlation coefficients simultaneously below -0.8 or above 0.8 are presented.

RESULTS



THE DATA POINTS

CHARACTERISTICS OF THE INDIVIDUAL

PRO Cognitive reserve*
PRO Demographics*
PRO Medical history*

BIOLOGICAL, PHYSIOLOGICAL VARIABLES

TechRO Heart rate levels while exercising*
TechRO Sleep fragmentation*
TechRO Sleep-wake cycle disturbances*
TechRO Sleeping and resting heart rate*

CHARACTERISTICS OF THE ENVIRONMENT

TechRO Season*
TechRO Weather*
TechRO Air quality*
TechRO Relative location*

FUNCTIONAL STATUS

TechRO Diurnal napping*
TechRO Nocturnal sleep duration*
TechRO Physical activity levels*
TechRO Gait speed, variability*
TechRO Step length, width, height, time*
TechRO Swing properties*
PRO Affect**
PerfRO Attention control**
PerfRO Activity shifting**
PerfRO Motor actions**
PerfRO Processing speed**
PerfRO and PRO Memory**

SYMPTOM STATUS

PRO Depression**
PRO Dysphoria**
PRO Neuroticism**
PRO Anxiety**
PRO Stress**

PerfRO Performance-reported outcome
PRO Patient-reported outcome
TechRO Technology-reported outcome

* Data for model creation
** Data for validation

Outcomes being collected, following the Wilson and Cleary [1] model

DATA COLLECTION TOOLS

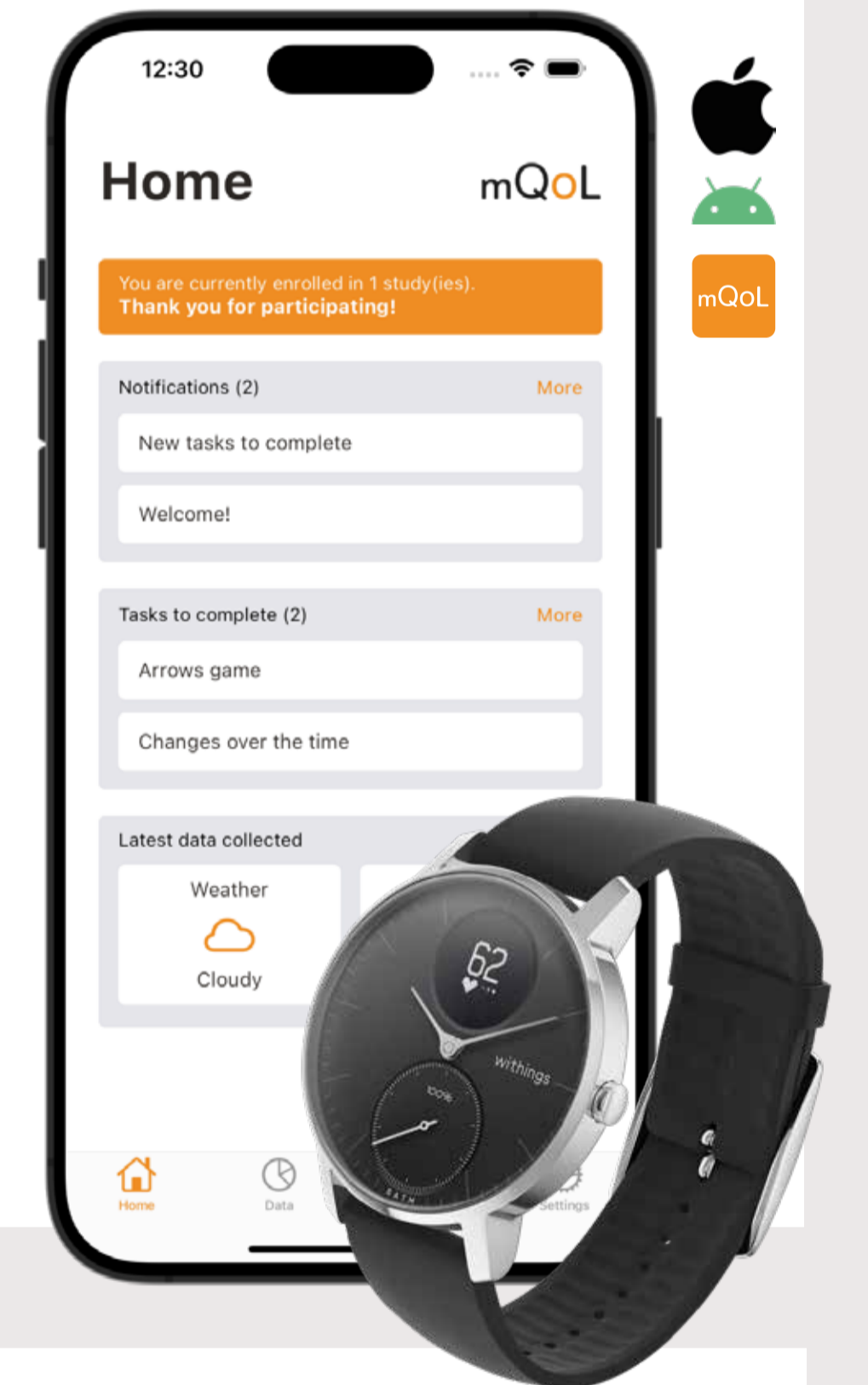
Observational study of 2 years in English, French, and Portuguese.

Collection of **active and passive data** between March 2024 and April 2026.

Using a **mobile application** (the mQoL Lab [2]) and a **clinically tested smartwatch** (Withings Steel HR).

PROs and PerfROs are collected every three months using the mQoL app.

TechROs continuously using the app and the smartwatch.



CONCLUSIONS

Strong correlations were found between behavioral data and cognitive markers. The results emphasize and prove the **usefulness of passive, ubiquitous wearable data** when addressing the monitoring of cognition over the lifespan. Samples of **30 and 60 days** before the PRO/PerfRO collection offer the **best correlation**. Future research should **focus on the predictability** of PROs and PerfROs using the here-determined sample sizes and exploring intermediate lengths.

More info and other publications at [PROVIDEMUS.UNIGE.CH](https://providemus.unige.ch).



Igor.Matias@unige.ch
IgorMatias.com



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