Digital Biomarkers for Neurodegenerative Diseases through Smartphone-Based Remote Patient Monitoring

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Why is it so difficult to track multiple sclerosis disease progression?

Neurodegenerative diseases, such as multiple sclerosis (MS), follow subtle and unpredictable disease courses. It is therefore notoriously difficult to quantify effective therapeutic interventions and disease management techniques. Patients might typically only visit a clinician 3 times a year, meaning that many disease-related changes can be missed.
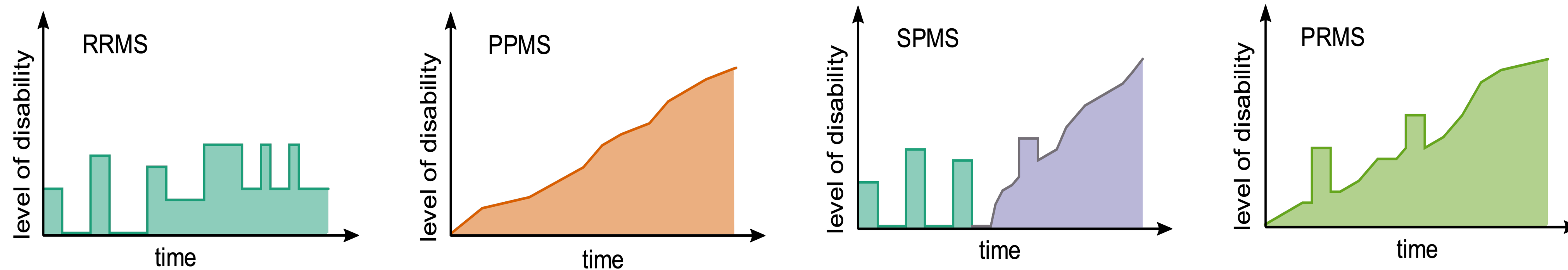
*Disease progression is variable for different MS patients, and over time*

Can smartphones remotely monitor patients at-home?

For the first time, we have developed smartphone sensor-based measurements, recorded during daily walking or touch-screen drawing assessments, which can estimate disease symptoms when patients are at-home.
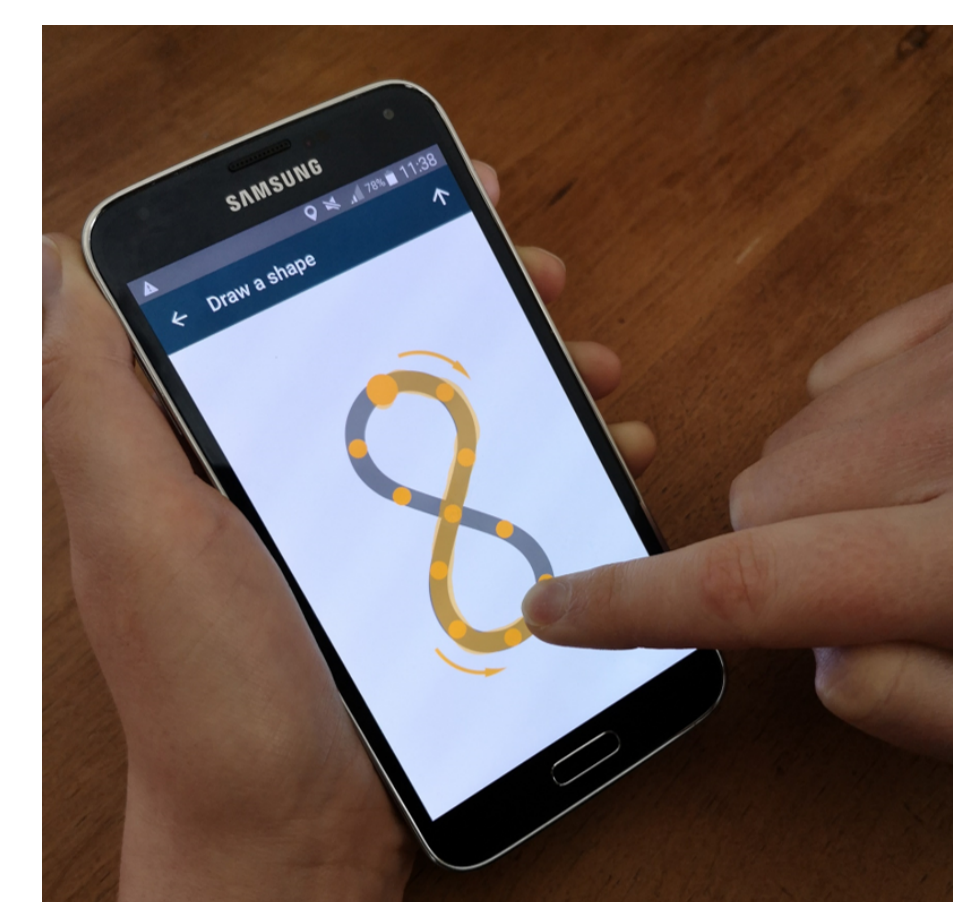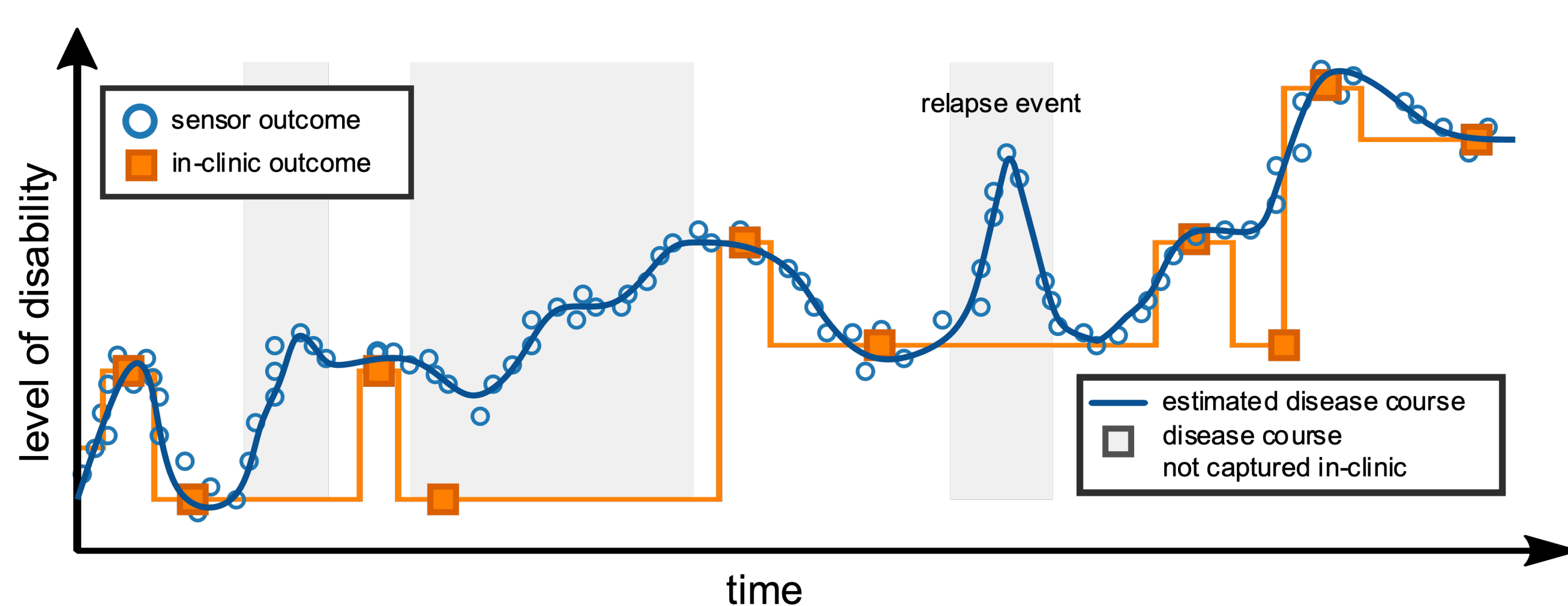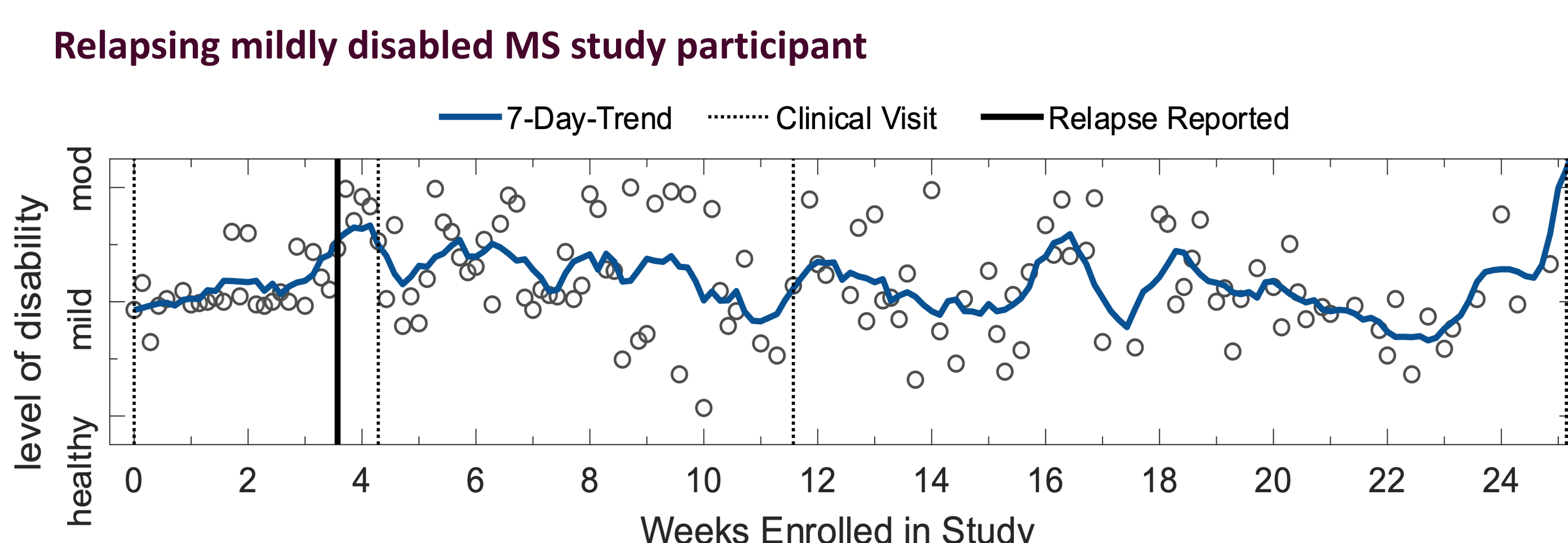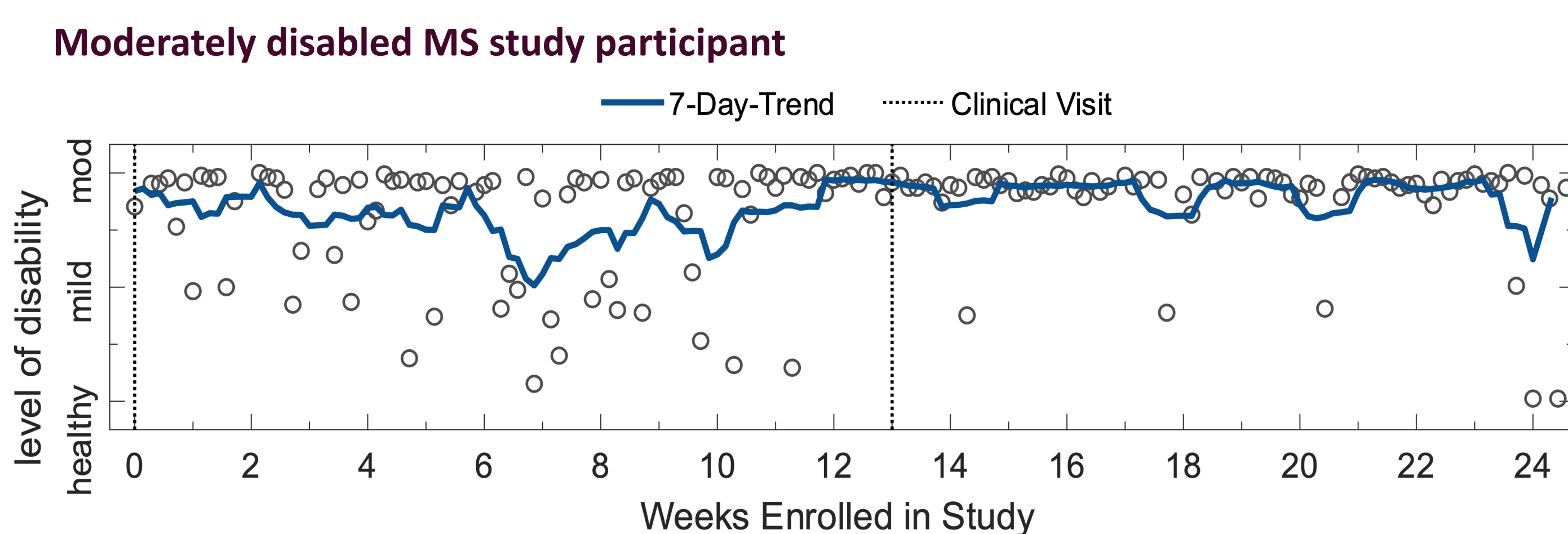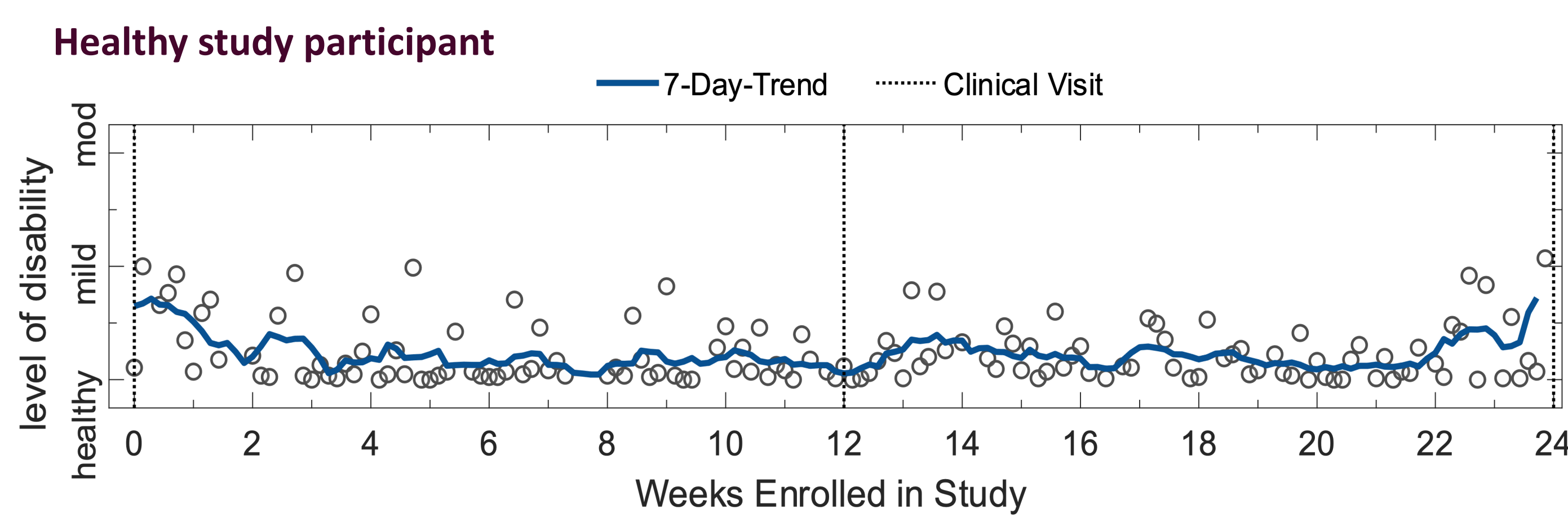

Smartphones can track patient symptoms between clinical visits

Could AI algorithms learn digital patterns of disease: *digital biomarkers?*
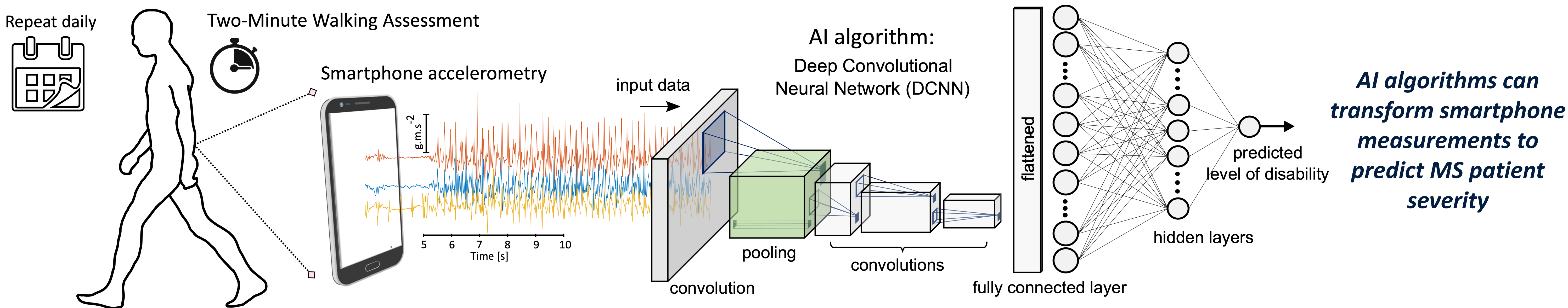
AI algorithms can transform smartphone measurements to predict MS patient severity

Smartphone measurements can accurately predict daily MS symptom severity over 6 months

Healthy study participant

Moderately disabled MS study participant

Relapsing mildly disabled MS study participant

Smartphone measurements predict level of MS disability over time

- State-of-the-art AI algorithms, such as Deep Convolutional Neural Networks, allow us to estimate a person's daily disease severity over time from smartphone sensor data collected at-home;
- Severity predictions accurately estimated participant's true level of disability over a 6 month period;
- Smartphones detected periods of symptom relapse occurring at-home, that would have previously been gone unseen by clinicians.

Take-home message: *The clinical utility of digital biomarkers*

Digital biomarkers could greatly augment routine healthcare assessments for people with neurodegenerative diseases; to help remotely monitor and identify signs of degeneration before they occur, to learn how different patients respond to various treatments and to provide rapid, real-time care.

References

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