Module 3

Introduction to Python & Parkinson's Disease Clinical Data

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THE MICHAEL J. FOX FOUNDATION FOR PARKINSON'S RESEARCH
Founding funders:
UKRI Medical Research Council
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What We'll Do Today

- **Why Python?**
- **Context:** Parkinson's disease

- **What you will learn:**
  - Run code in **Jupyter**
  - **Data types**, **operators**, **modules**
  - **Loops** & **conditionals**
  - **File handling**
  - **Pandas** & **NumPy** basics
  - Writing simple **functions**

- **Practice:** Mini coding exercises

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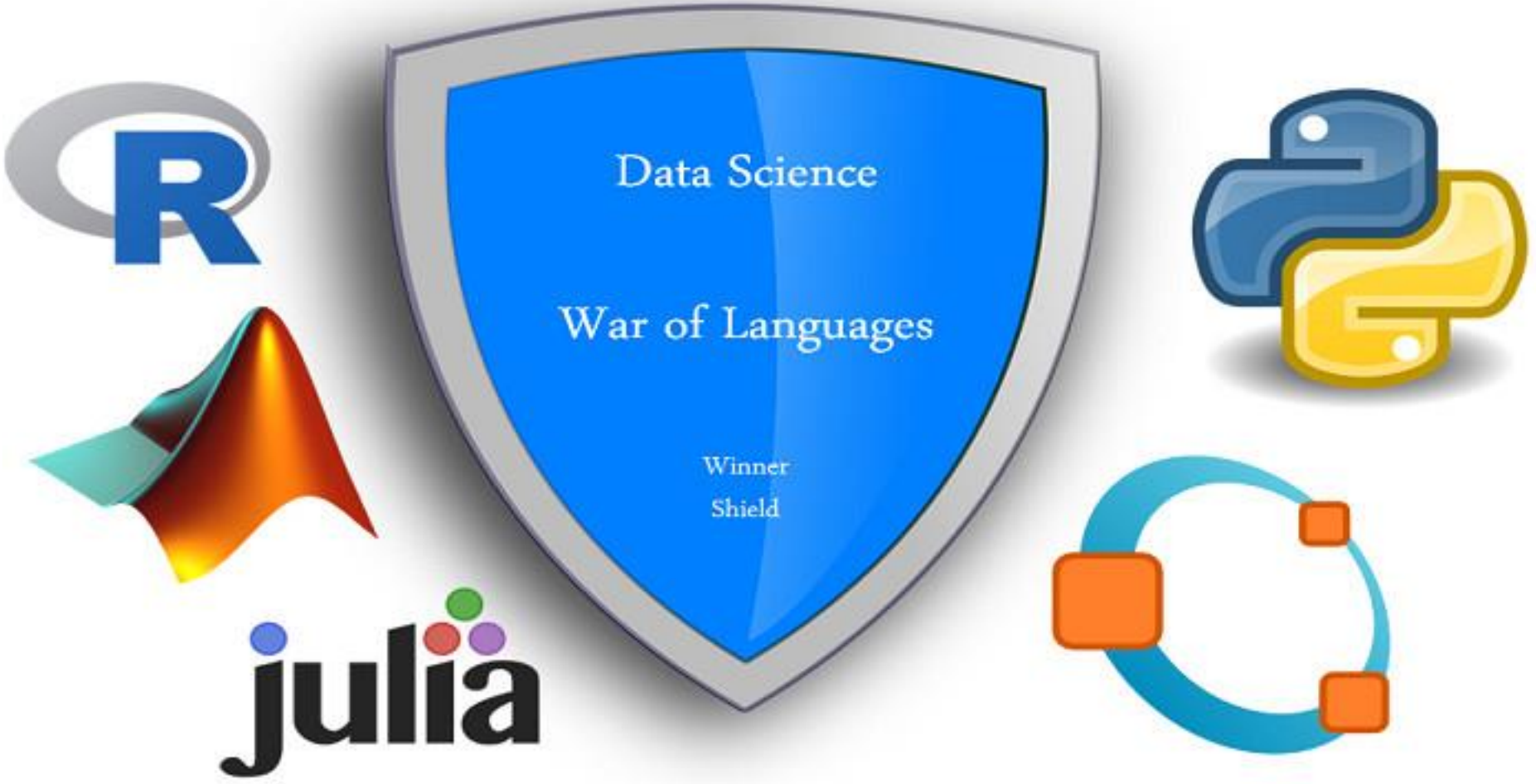
Dr Katarzyna Zoltowska

Cecilia Rodriguez

Python vs MATLAB vs R…

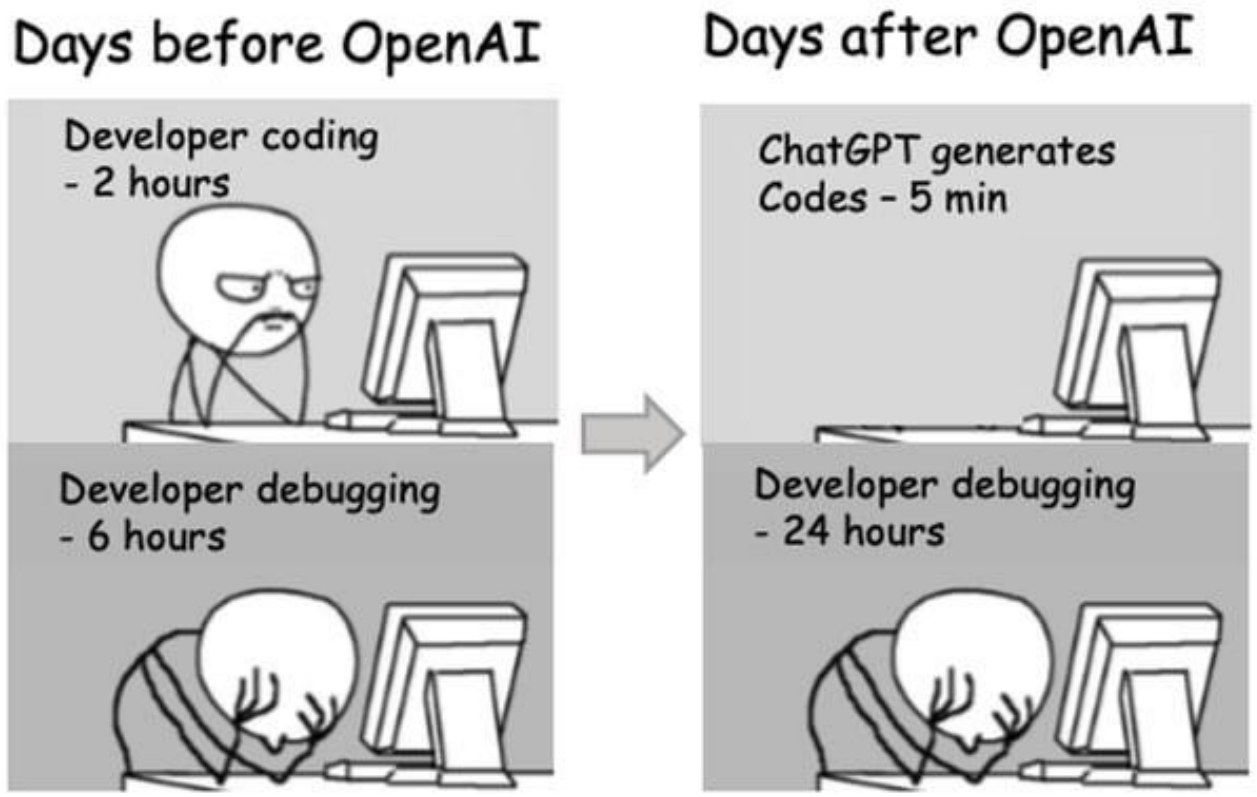


Programming Langauge	Standouts	Setbacks	Key Libraries	Execution Speed	Learning curve	Data Analytics Capabilities	Graphical Capabilities	Tools (IDEs, Plugins, etc)	Community Support	Integration with External apps	Job market	Score
R	Open source; Good for statistical analysis and data processing; Huge collection of algorithms available as packages; Visualization support;	Steep learning curve; obscure commands	gbm, RTextTools, dplyr, zoo, ggplot2, caret	3	1	5	4	4	4	3	4	28
Python	Open source; Easy to learn; All the benefits of general-purpose programming language; Big Data ready;	Speed of execution; needs to handle library dependancies if migrated from 2.x to 3.x	Scikit-learn, Pandas, matplotlib, NumPy, SciPy, theano, nltk	4	4	3	3	3	5	5	5	32
MATLAB	Good with mathematical processes, complex matrix operations; Broad range of machine learning, signal processing and image processing libraries as toolboxes;	Proprietary; Lack of good open source ecosystem; Difficulty when the data can't be represented in matrices	Statistics and Machine Learning; Image Processing; Signal Processing; Optimizatio n; Wavelet;	2	3	4	4	5	3	2	2	25
Octave	Open source; Good for numerical computations; Built with MATLAB compatibility; Known as Clone of Matlab; Good for building preliminary models;	Lack of interoperability with external data sources - csv, databases, etc	libsvm, shogun, liblinear, ltfat, vlfeat	2	2	3	2	2	3	2	1	17
Julia	Open source; Desinged to handle numerial and scientific computing; Good performance;Ability to call C, Python functions;	Relatively new programming language; doesn't have much to offer in the way of extensive libraries	MLBase, MLUtils, MLKernels, Clustering, MachineLear ning	5	3	4	2	2	2	3	1	22

Why a Learning Programmer Should Not Rely Too Much on ChatGPT

1. Loss of Problem-Solving Skills
2. Shallow Understanding
3. Risk of Bad Habits
4. Reduced Confidence
5. Missing the Broader Process
6. Curiosity Erosion
7. Ethical & Professional Risks

Use ChatGPT Wisely



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Code. Break it. Fix it. Repeat.

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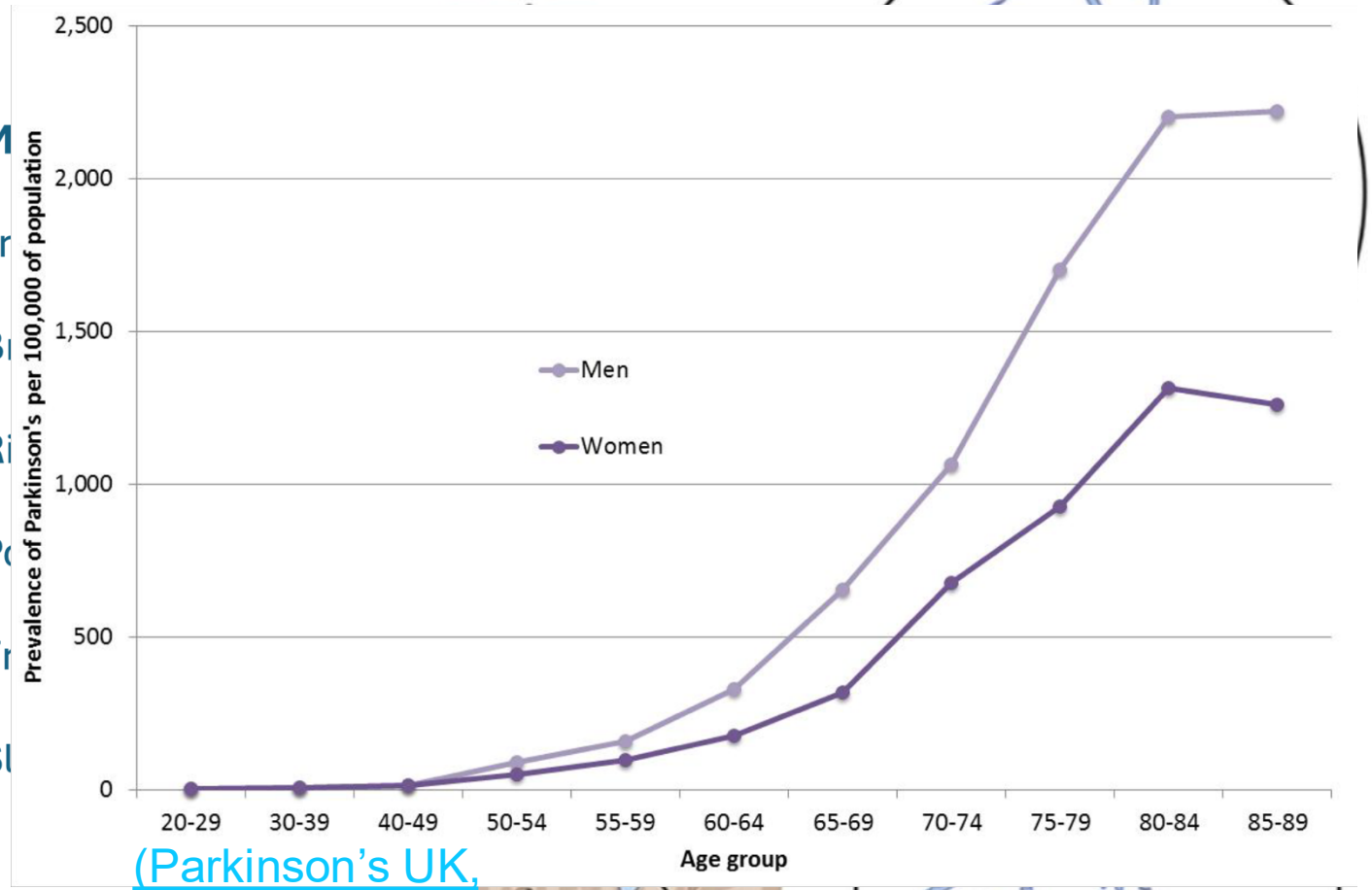
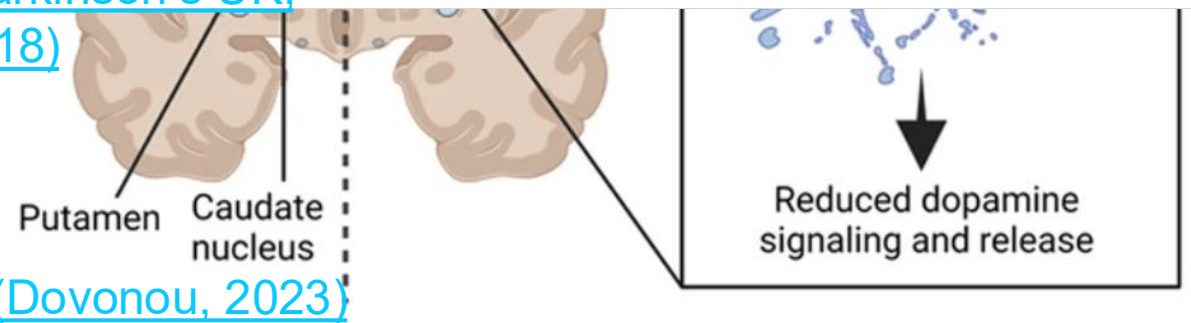
Quick intro to Parkinson's

- A **progressive neurological disorder**
- Caused by the **degeneration** of dopamine-producing neurons in the substantia nigra
- Characterized by hallmark **motor symptoms**
- **1 in every 37 (2.7%)** people diagnosed at some point in life
- **No cure**, only symptomatic treatment



(Parkinson's UK, 2018)



(Dovonou, 2023)

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No established disease-modifying treatments for Parkinson's disease

THE LANCET
Neurology

REVIEW · Volume 20, Issue 7, P559-572, July 2021

Progress towards therapies for disease modification in Parkinson's disease

Nirosen Vijiaratnam, FRACP [a,b] · Prof Tanya Simuni, MD [c] · Prof Oliver Bandmann, PhD [d] · Prof Huw R Morris, PhD [a,b] · Prof Thomas Foltynie, PhD [a,b]

Summary

The development of interventions to slow or halt the progression of Parkinson's disease remains a priority for patients and researchers alike. To date, no agents have been shown to have unequivocal evidence of disease-modifying effects in Parkinson's disease. The absence of disease-modifying treatments might relate not only to inadequate approaches for the selection of therapeutic candidates but also to insufficient attention to detail in clinical trial design. Better understanding of Parkinson's disease pathogenesis associated with advances in laboratory models, the use of objective biomarkers of disease progression and target engagement, and a focus on agents known to be safe for human use, alongside the use of precision medicine approaches, should together greatly increase the likelihood for successful identification of disease-modifying treatments for Parkinson's disease.

- Parkinson's is primarily managed with medication that **controls symptoms**
- Dopaminergic medication alleviates symptoms, but its effects diminish over time & cause side effects

No established treatments to **stop/slow/modify** the disease course !

Parkinson's Progression Markers Initiative

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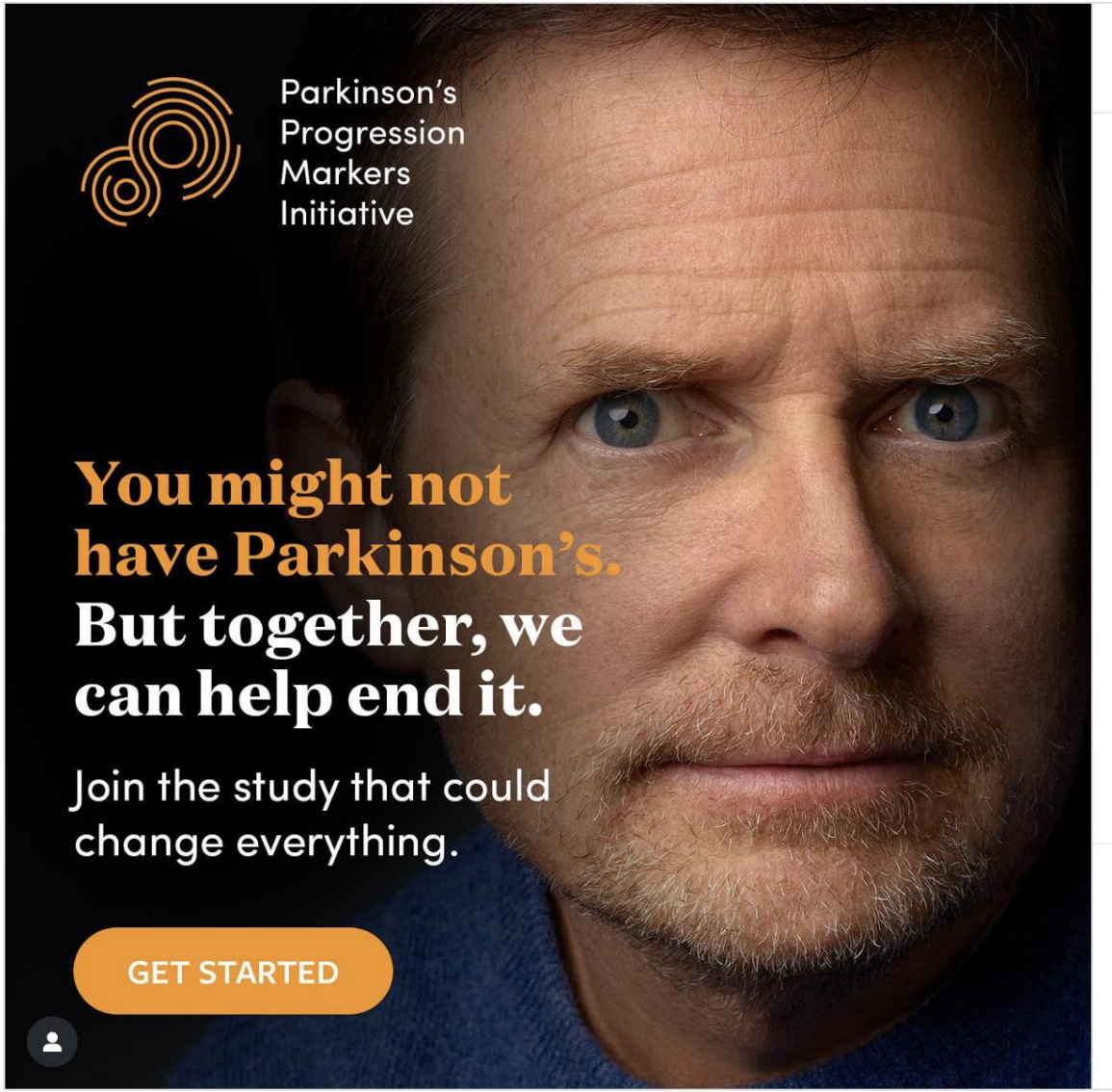

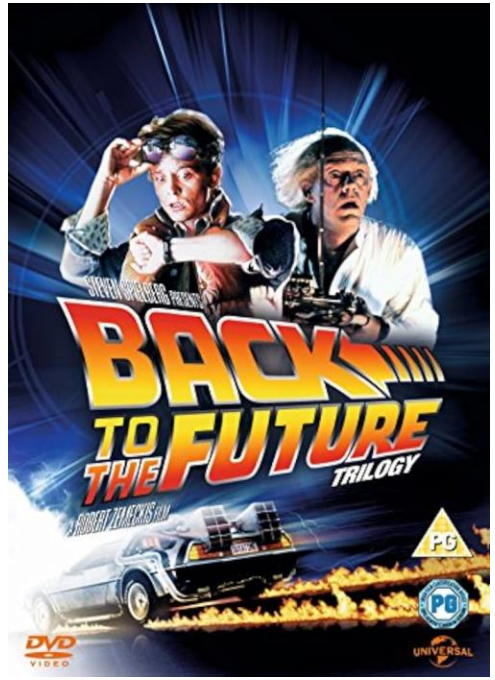

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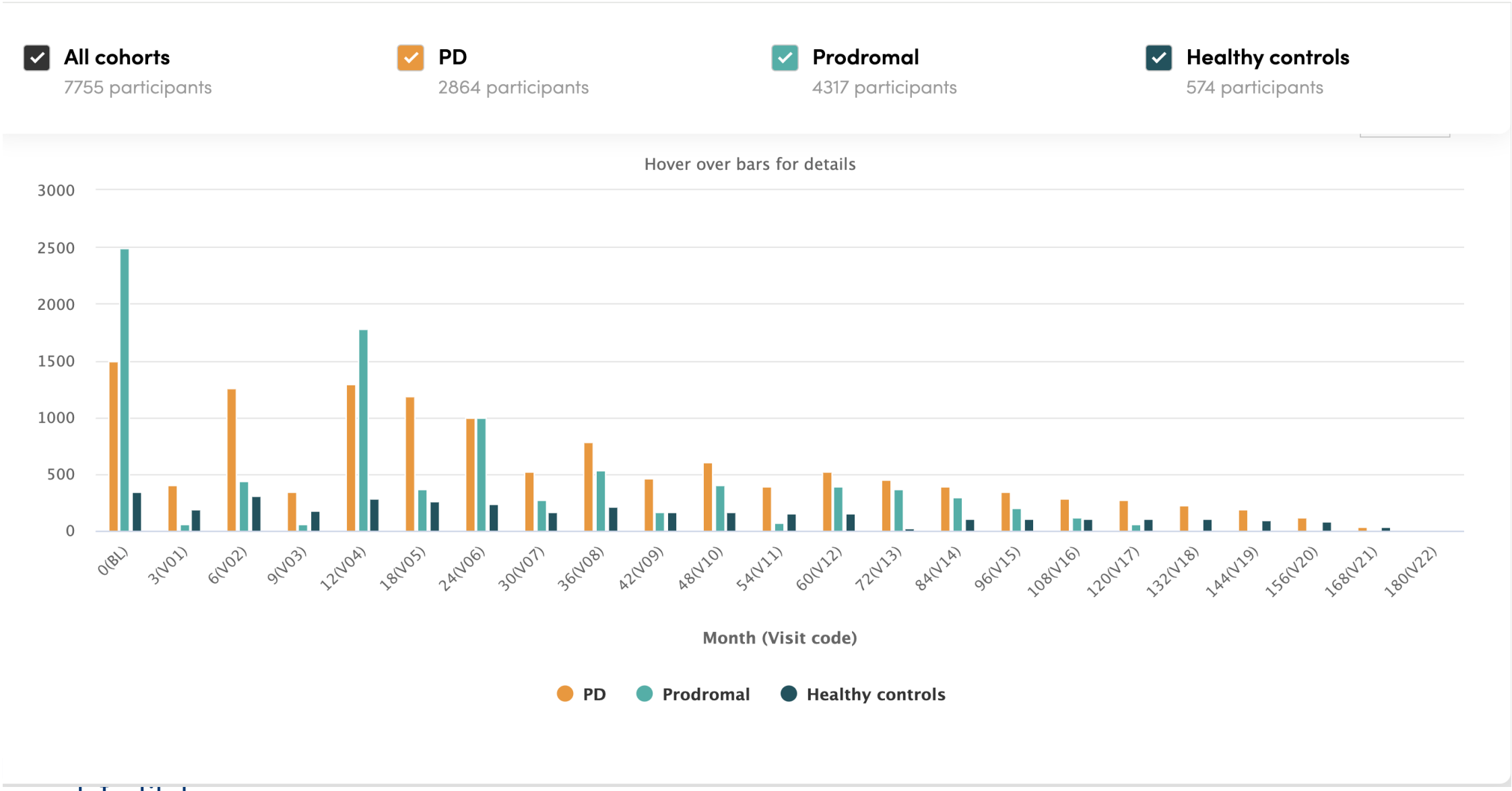
Parkinson's Progression Markers Initiative



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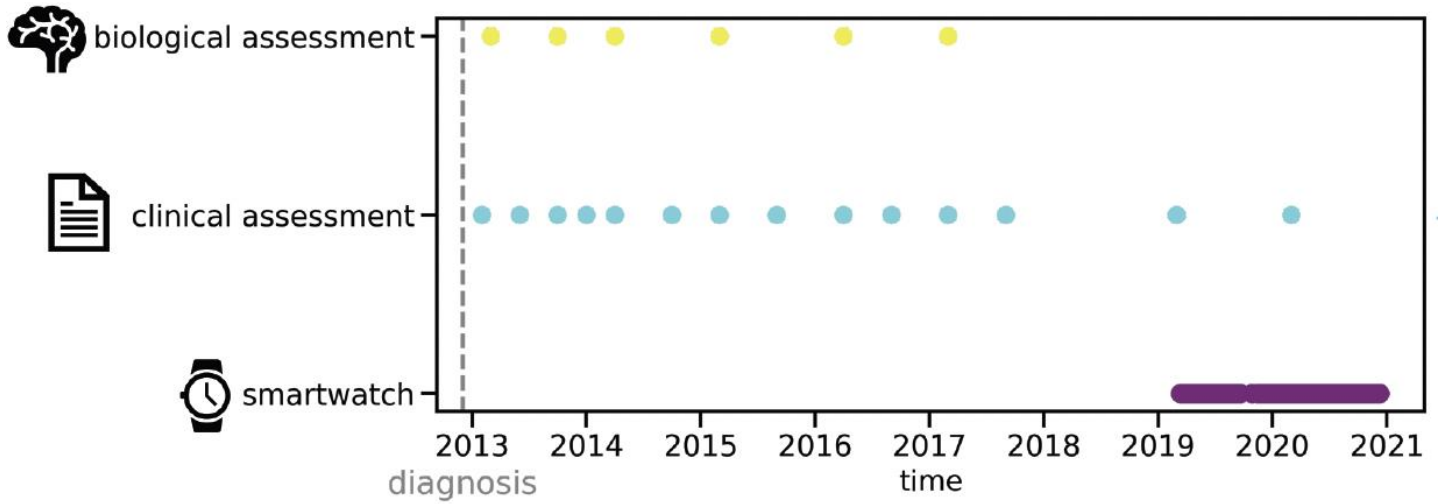
Data Modalities



Clinical Assessments:
Unified Parkinson's Disease Rating Scale, Montreal Cognitive Assessment, Drug Prescriptions (Workshop 2)

Biological Assessments:
Neuroimaging (Dopamine Transporter Scan), Cerebrospinal Fluid (Seed Amplification Assay), Blood

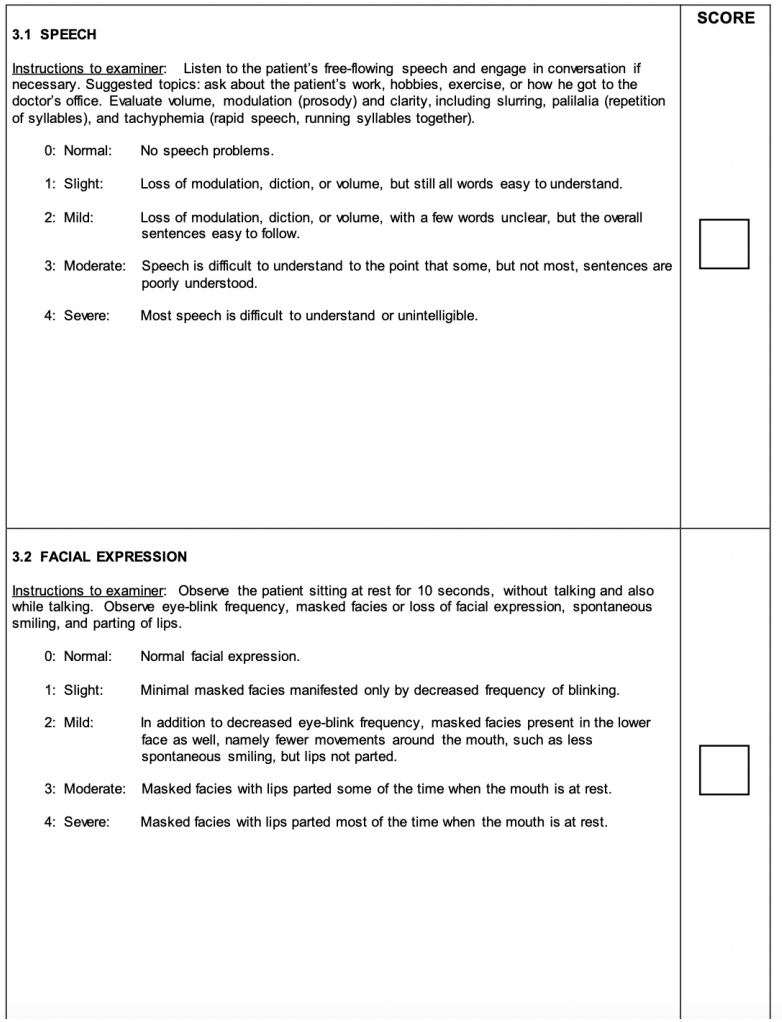
Digital Assessments:
Smartwatch (Workshop 3)

Unified Parkinson's Disease Rating Scale (UPDRS)

Part I: Non-Motor Aspects of Experiences of Daily Living – Questionnaire
Part II: Motor Aspects of Experiences of Daily Living - Questionnaire
Part III: Motor Examination – Clinician scored
Part IV: Motor Complications (dyskinesias and motor fluctuations) – Questionnaire

Each item has 0 - 4 ratings:
0: Normal
1: Slight
2: Mild
3: Moderate
4: Severe

18 items
Score range: 0–132
32 and below is mild
59 and above is severe



	SCORE
3.1 SPEECH Instructions to examiner: Listen to the patient's free-flowing speech and engage in conversation if necessary. Suggested topics: ask about the patient's work, hobbies, exercise, or how he got to the doctor's office. Evaluate volume, modulation (prosody) and clarity, including slurring, palilalia (repetition of syllables), and tachyphemia (rapid speech, running syllables together). 0: Normal: No speech problems. 1: Slight: Loss of modulation, diction, or volume, but still all words easy to understand. 2: Mild: Loss of modulation, diction, or volume, with a few words unclear, but the overall sentences easy to follow. 3: Moderate: Speech is difficult to understand to the point that some, but not most, sentences are poorly understood. 4: Severe: Most speech is difficult to understand or unintelligible.	☐
3.2 FACIAL EXPRESSION Instructions to examiner: Observe the patient sitting at rest for 10 seconds, without talking and also while talking. Observe eye-blink frequency, masked facies or loss of facial expression, spontaneous smiling, and parting of lips. 0: Normal: Normal facial expression. 1: Slight: Minimal masked facies manifested only by decreased frequency of blinking. 2: Mild: In addition to decreased eye-blink frequency, masked facies present in the lower face as well, namely fewer movements around the mouth, such as less spontaneous smiling, but lips not parted. 3: Moderate: Masked facies with lips parted some of the time when the mouth is at rest. 4: Severe: Masked facies with lips parted most of the time when the mouth is at rest.	☐

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Montreal Cognitive Assessment (MoCa)

Scoring the MoCA Test

The total score on the M
domain is broken downs

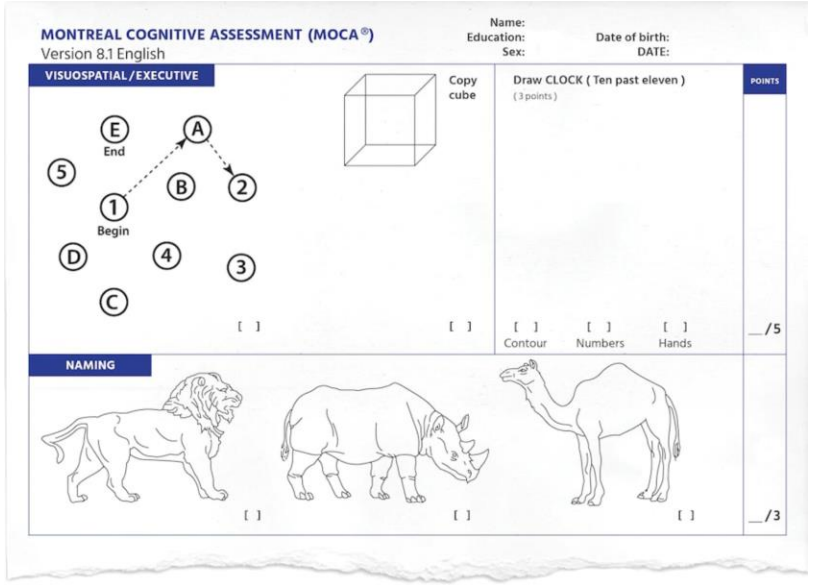
Domain
Executive/visuospatial function
Naming
Attention
Language
Abstraction
Recall
Orientation
TOTAL

Because a person's educ
tasks, **1 point** is added tc
formal education.

Interpreting the Results

After tallying the MoCA scores, the results can be interpreted as follows:

Interpretation	Score range
Normal cognition	26–30 points
Mild cognitive impairment	18–25 points
Moderate cognitive impairment	10–17 points
Severe cognitive impairment	Under 10 points



30/30

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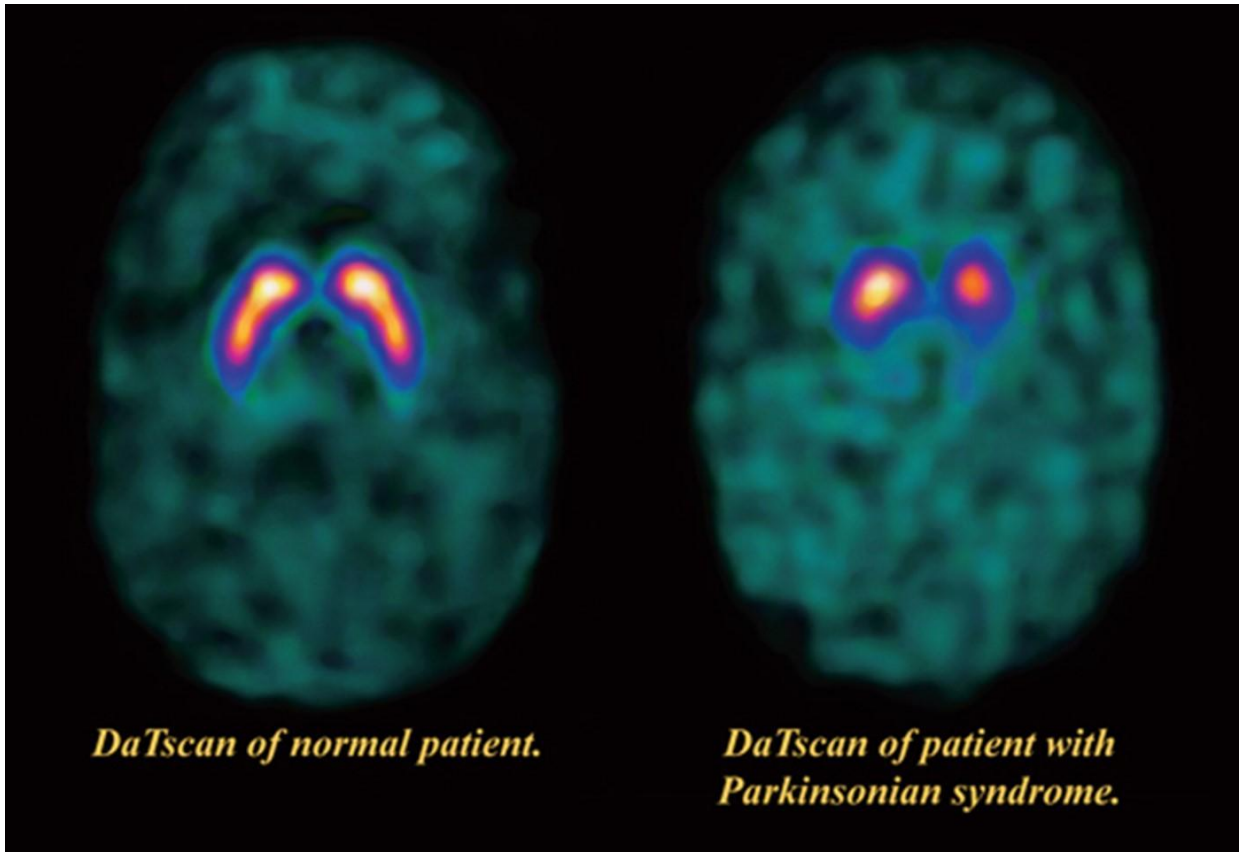
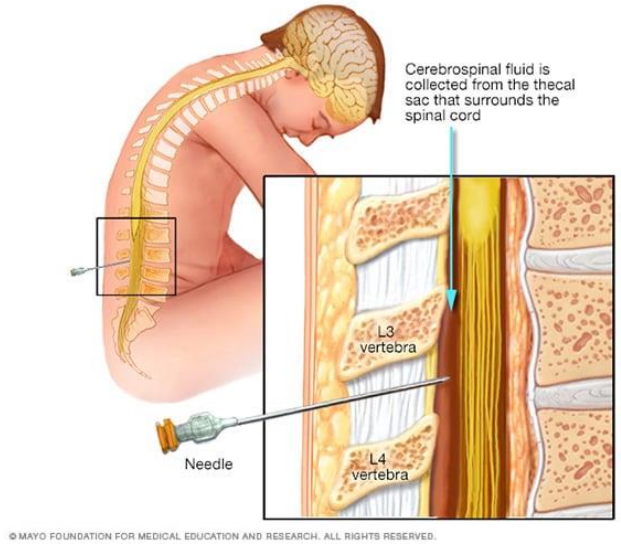
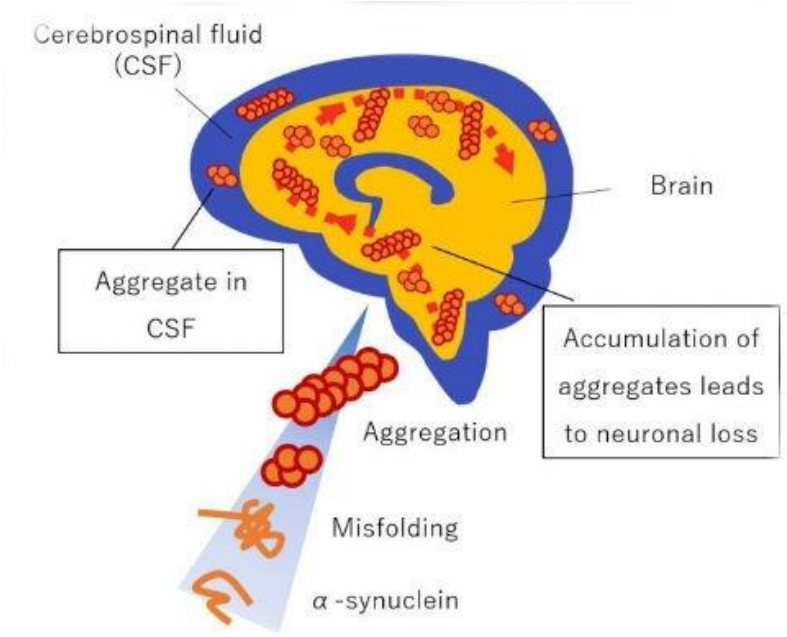
DaTscan

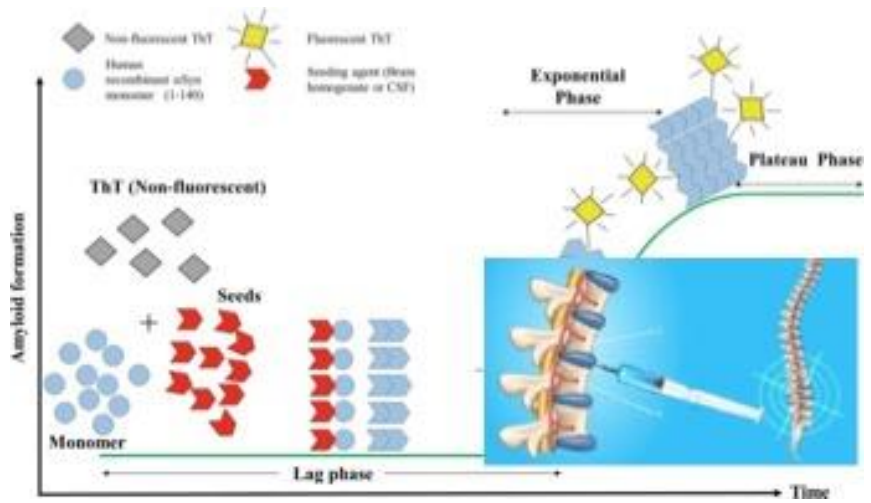


- **DATScan:** visualization of dopamine transporter (DaT) function in the striatum (caudate and putamen) using SPECT brain imaging => can detect **nigrostriatal neurodegeneration**

CSF test: α-Synuclein Seeding Assay Using RT-QuIC







- **Cerebro-spinal fluid assays:** the quantification of α-synuclein (αSyn) in cerebrospinal fluid (CSF) has been proposed as a diagnostic biomarker for Parkinson's disease. **Invasive:** requires a lumbar puncture to collect CSF

Let's Code

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Phillip Press	Viola Ceriani	Duru Okay	Yossra Serroukh	Harsimran Kaur	Jenna Lin	Muireann Hogan	Lucia Jing
Margarida Neves	Anya Kaur Haddon	Chloe Kam	Rebekah Bourne	Luca Pastorello	Mustafa Gunaydin	Edona Bajrami	Zishan Lin
Olivia Pownall	Anais Chia	Wenbo Liao	Hattie Oliver	Luoyuan Zhang	Laura Raklec	Francesca Murley-Holme	Stephanie Sun
Charlotte Yu	Shobana Chandrashekar	Yunyi Gao	Thishany Kuganeswaran	Ellie Carre	Hanna Altessaid	Ruben Thiagarajah-Fernar	Neera Gahir
Chun Hei Leung	Katie Hay	Anas Saleem	Hanyue Pang	Veronika Shevchenko	Aitsilja Dabasinskaite	Felix Varenne	Chuyi Zhang
Andrea Fan	Nina Jeffrey	Chi U Chau	Zeinab Ben Halim	Amina Bououdine	Ema Ferra	Ruofan CAO	Lili Yassin
Adelina Shahata	Asma Abdullahi	YINUO Wang	Isabella Coloru	Krystal Tan	Temi Lana	Xinrui Fan	Keya Tanwani
Tanaka Udugama Jal	Vea Bley	Mari Hronska	Lucas Yebra Garcia	Sarah Kurbanov			

https://github.com/Sandoretal/Module_3/tree/main/tutorial_1

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