



**ROBERT GORDON
UNIVERSITY ABERDEEN**

Parkinsonian Gait – where the
journey begins and where should
we take it.

Julie Jones

Who am I?



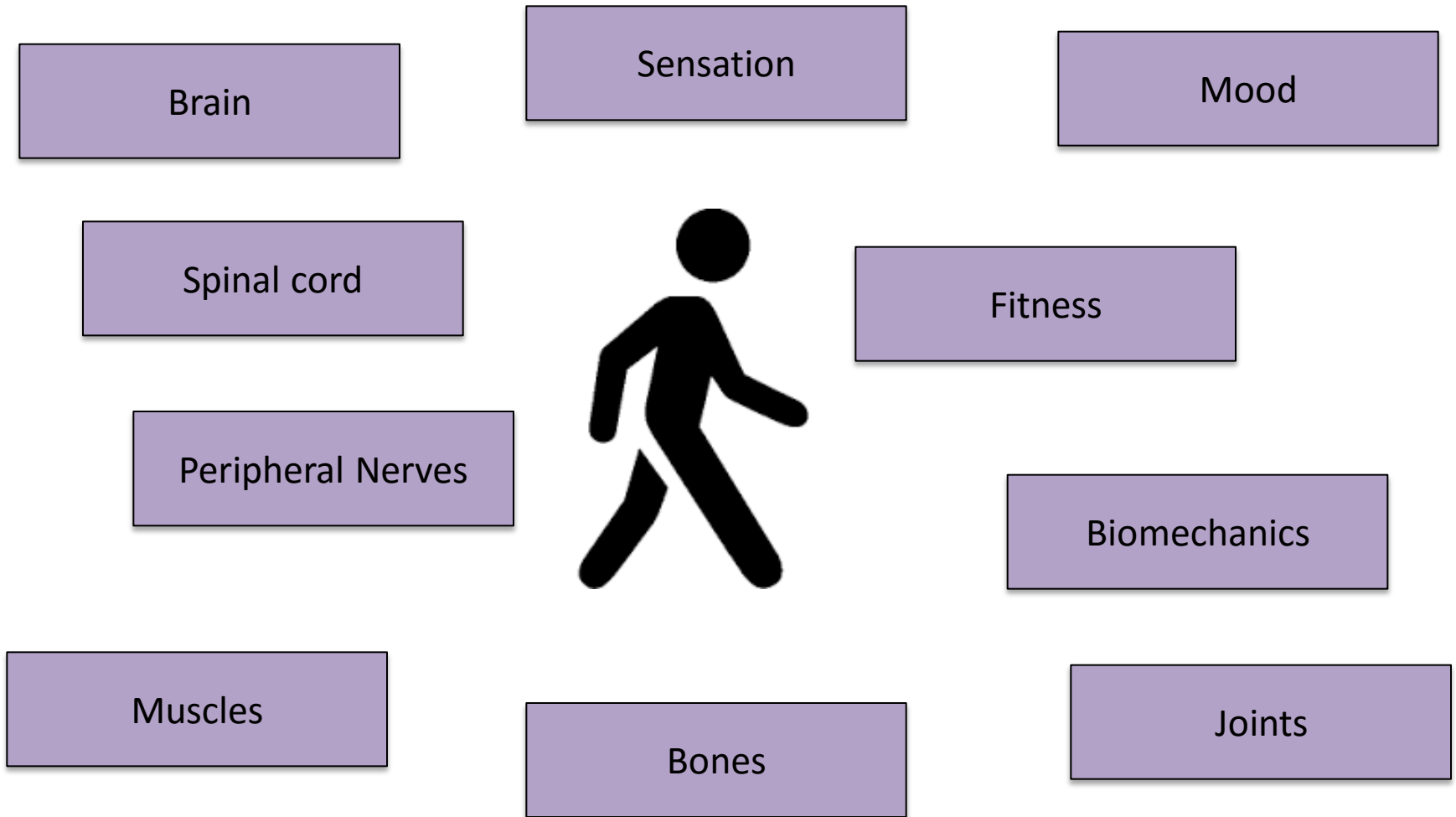
PARKINSON'S^{UK}
CHANGE ATTITUDES.
FIND A CURE.
JOIN US.



What I am aim to cover.

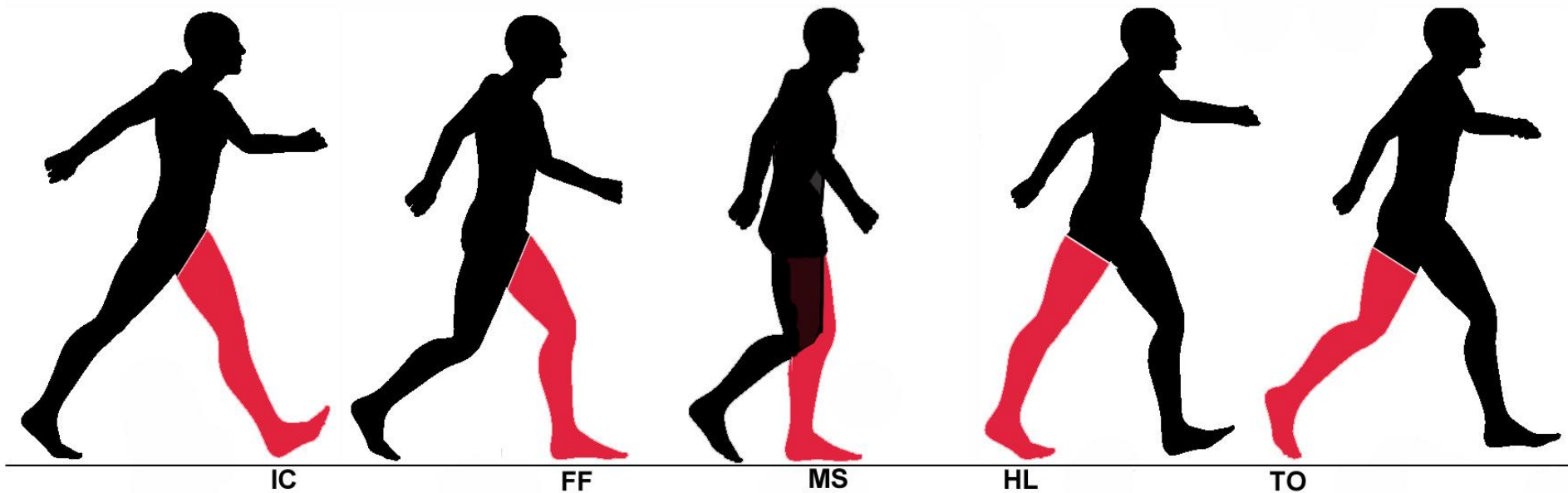
- Pathogenesis of PD gait.
- The role of Physiotherapy in the management of gait.
- Current research opinion of the management of gait.

Complicated process



The normal gait cycle

THE GAIT CYCLE

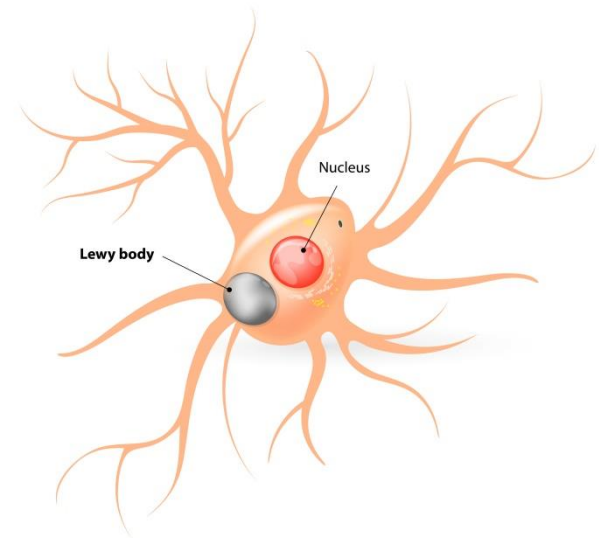
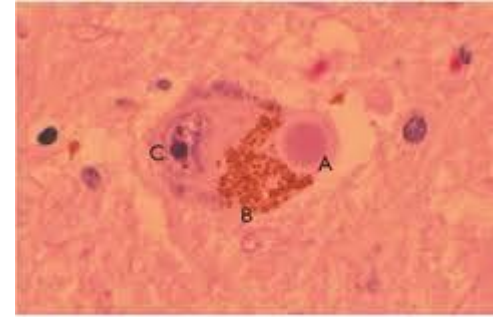
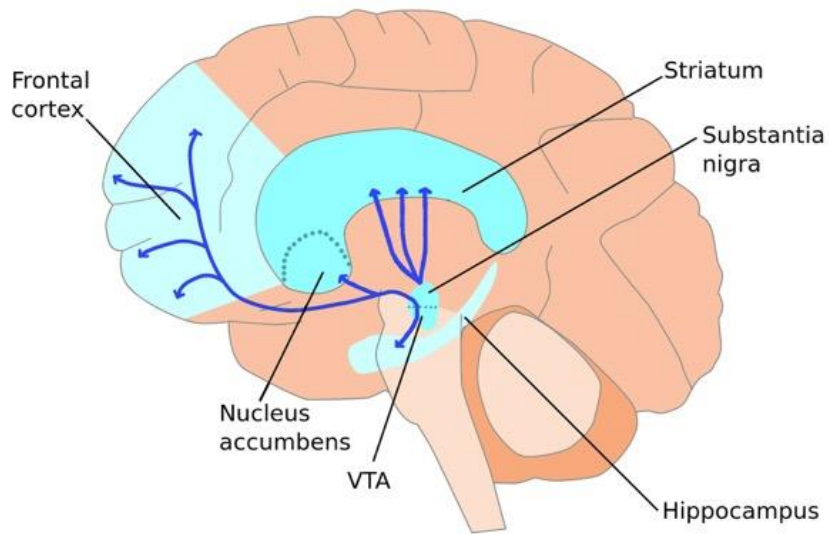




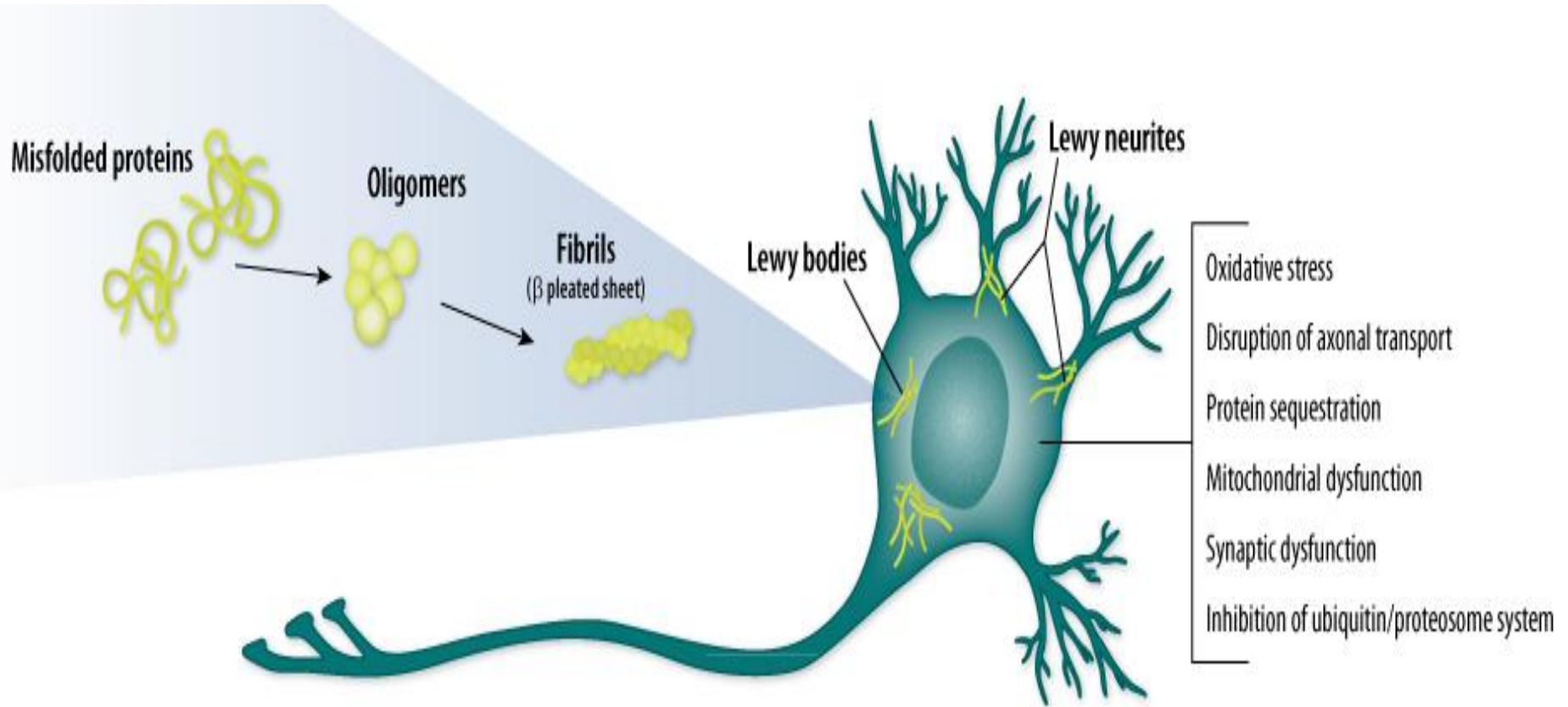
**ROBERT GORDON
UNIVERSITY ABERDEEN**

Pathogenesis of PD and the relationship to walking

Pathogenesis

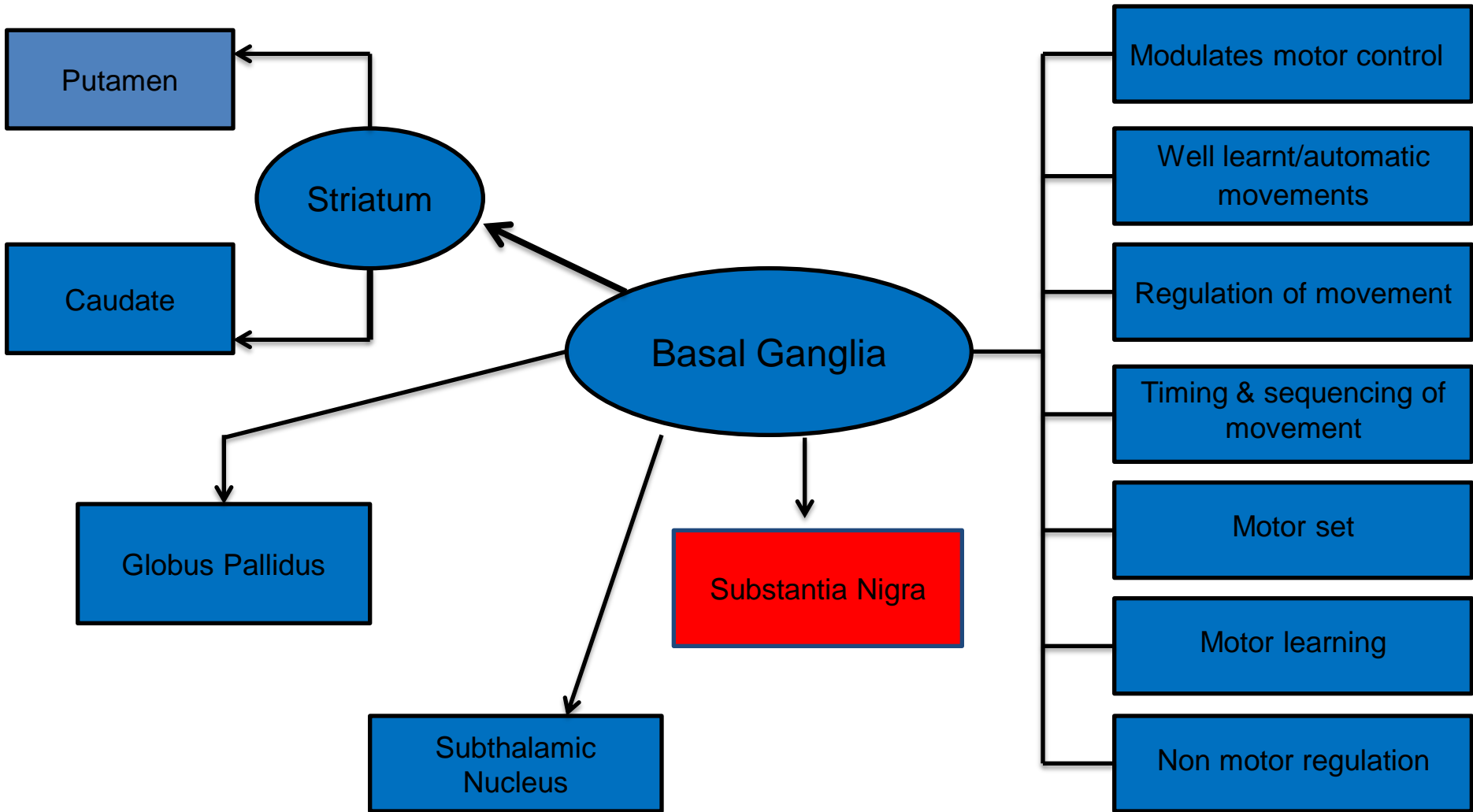


Lewy Bodies

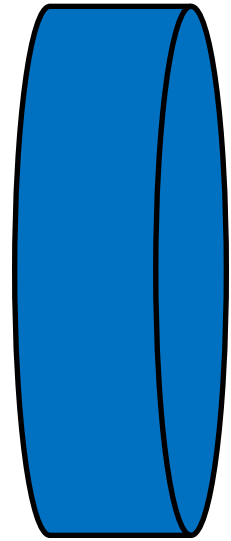
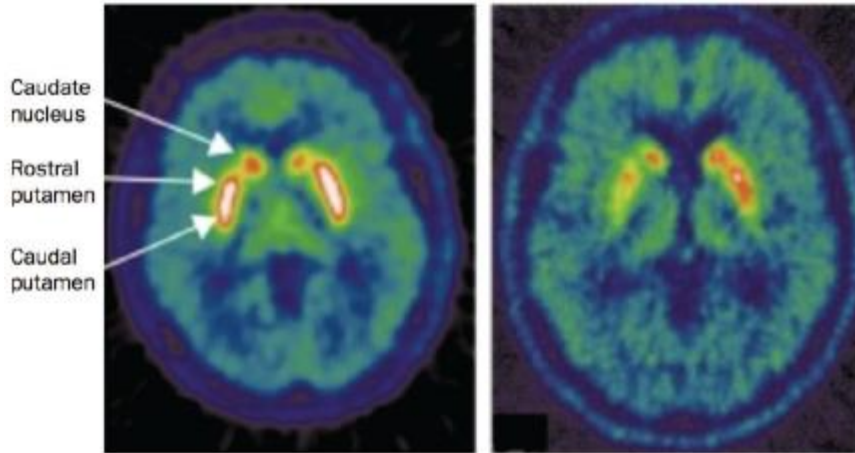
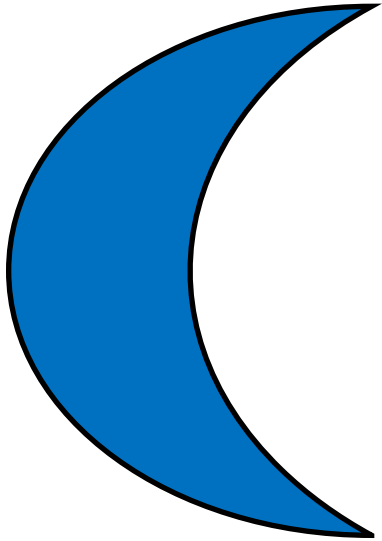


© R&D Systems, Inc.

The Basal Ganglia



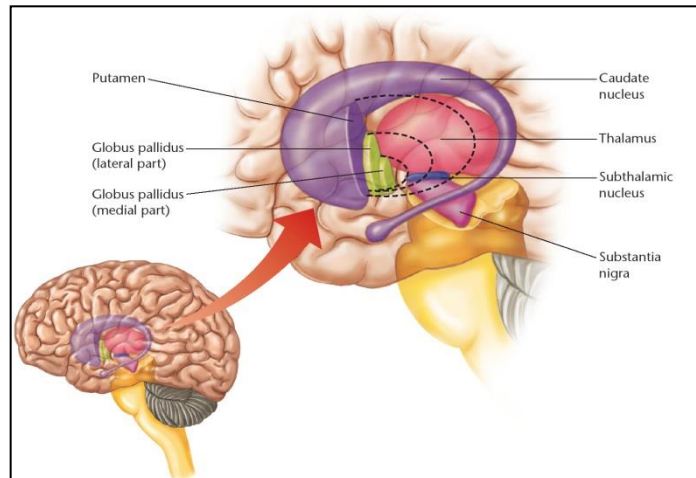
Caudate and Putamen



Speed & accuracy

Body & limb position/posture

Linked with sleep & social behaviour

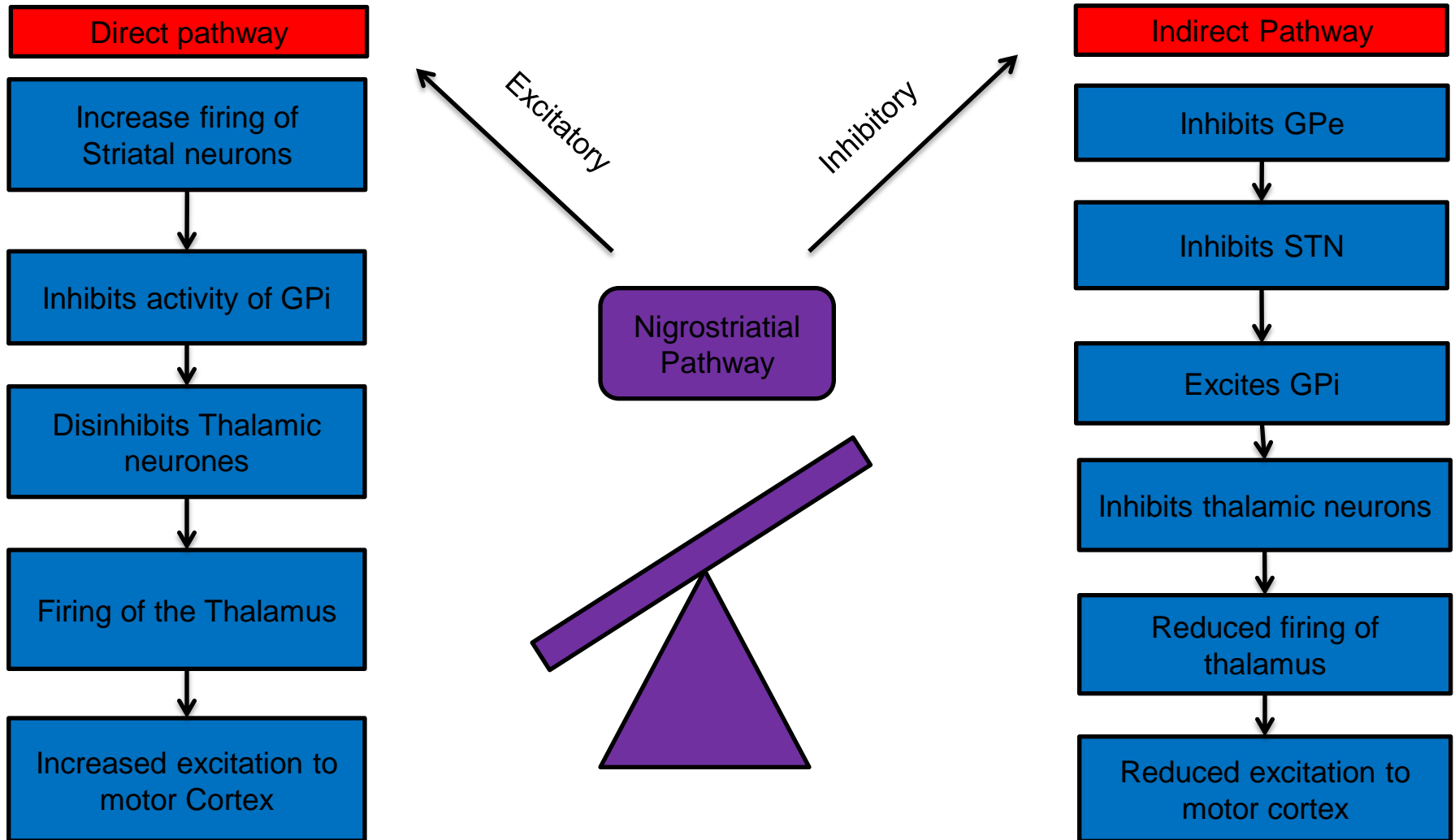


Motor preparation

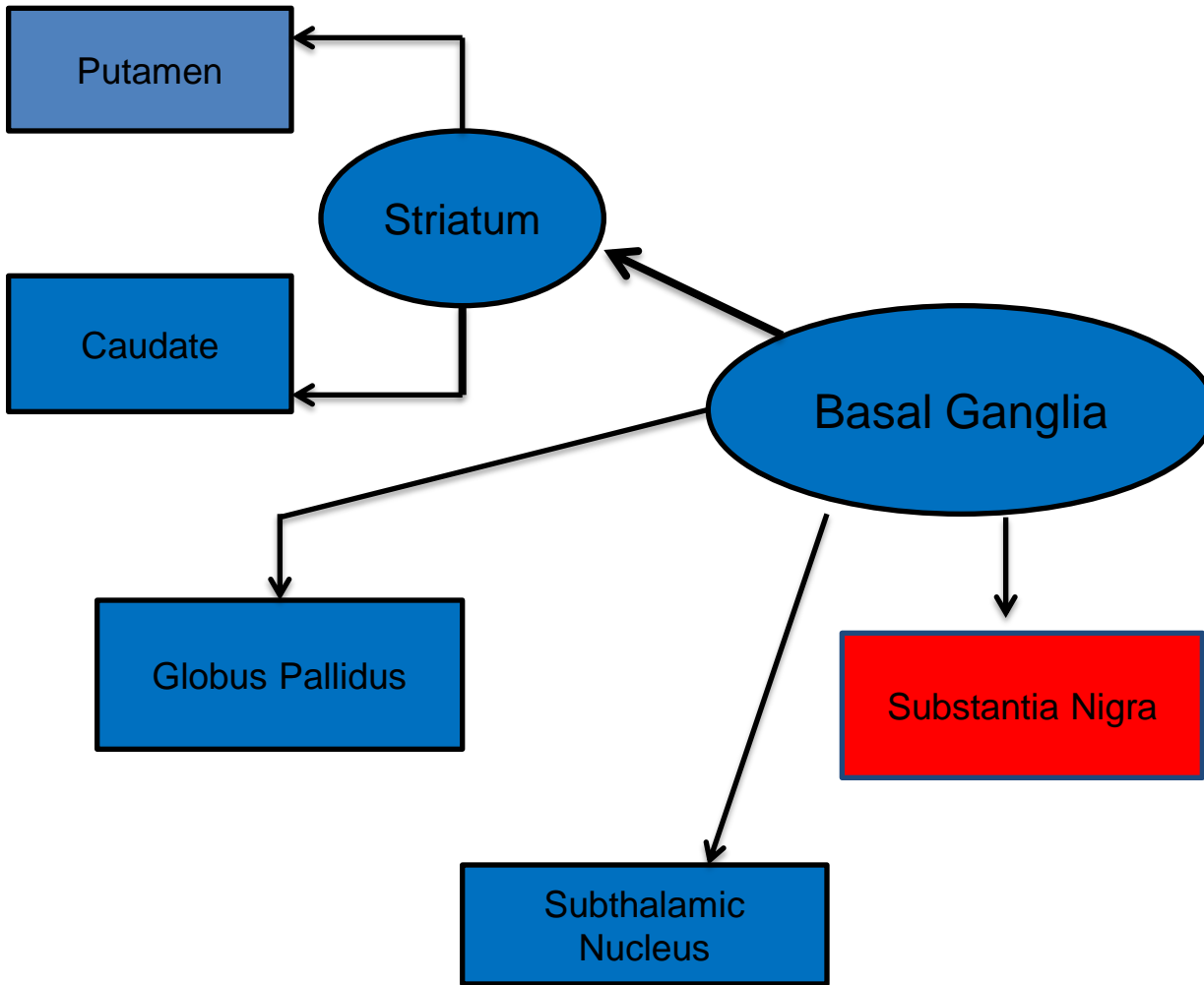
Sequencing, & amplitude

Learning

What happens in PD

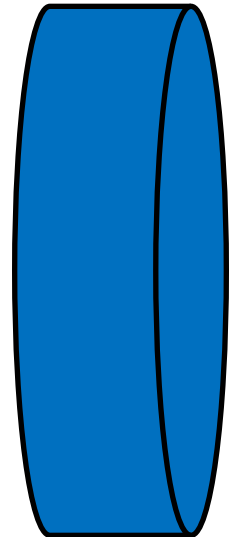
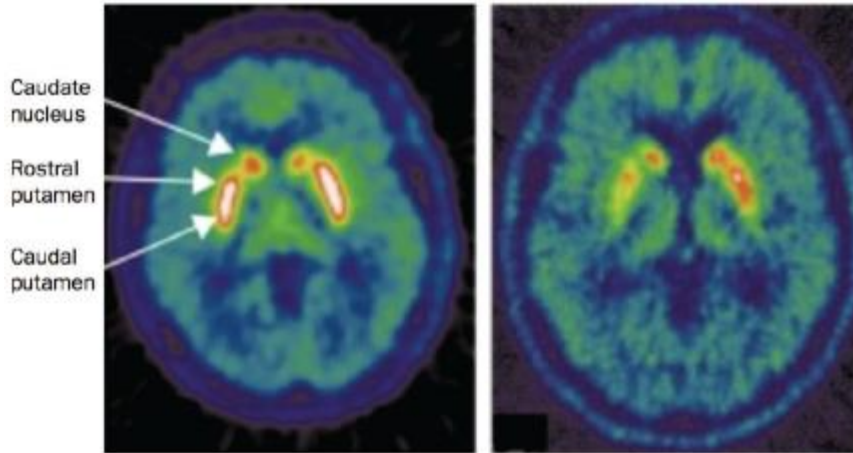
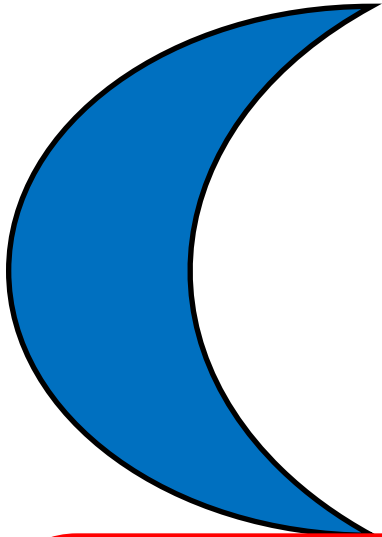


The Basal Ganglia



- Modulates motor control
- Well learnt/automatic movements
- Regulation of movement
- Timing & sequencing of movement
- Motor set
- Motor learning
- Non motor regulation

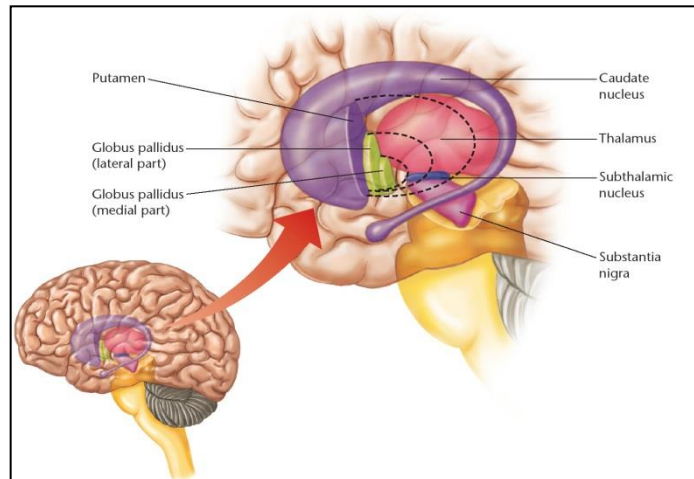
Caudate and Putamen



Speed & accuracy

Body & limb
position/posture

Linked with sleep &
social behaviour

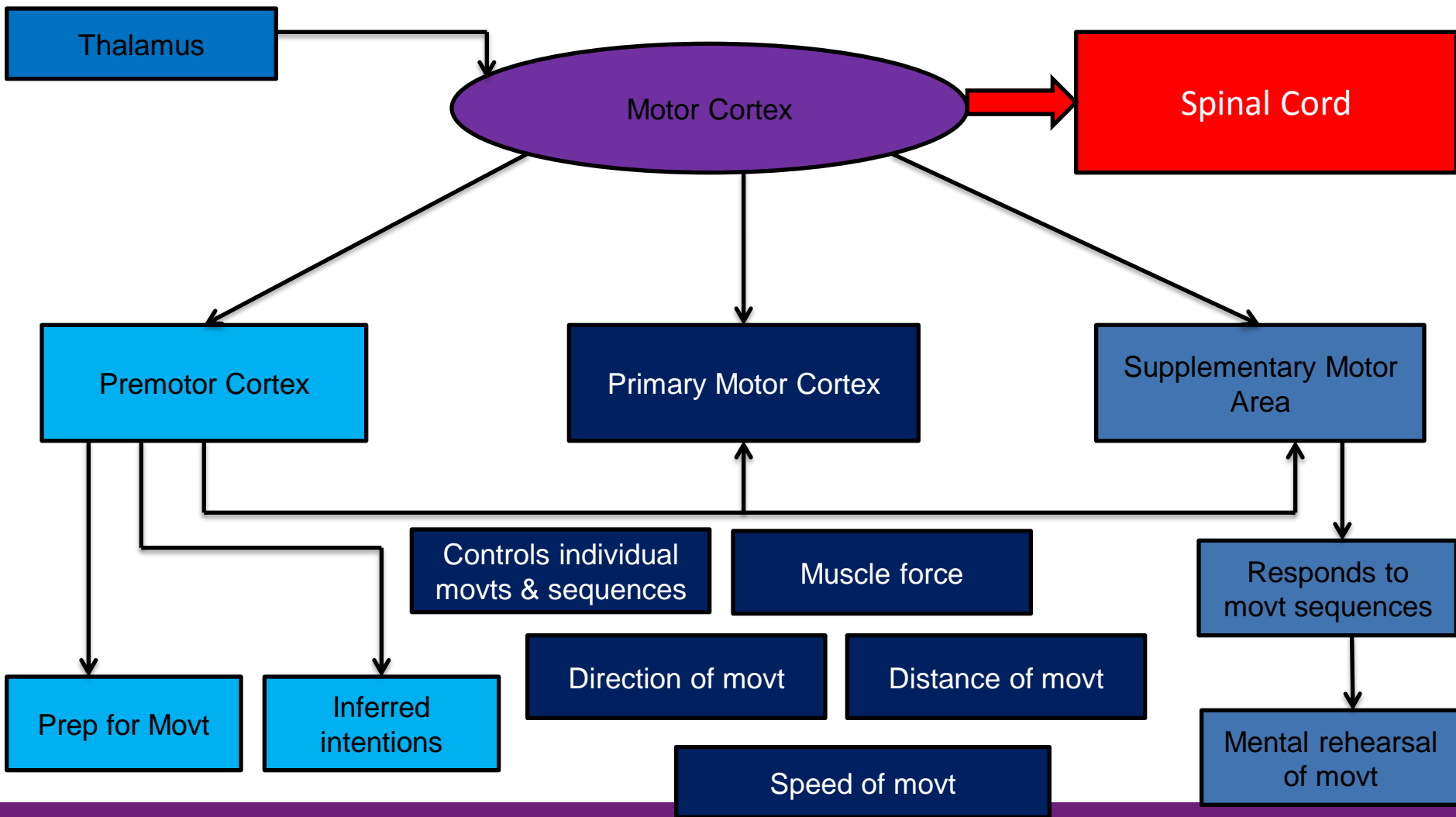


Motor preparation

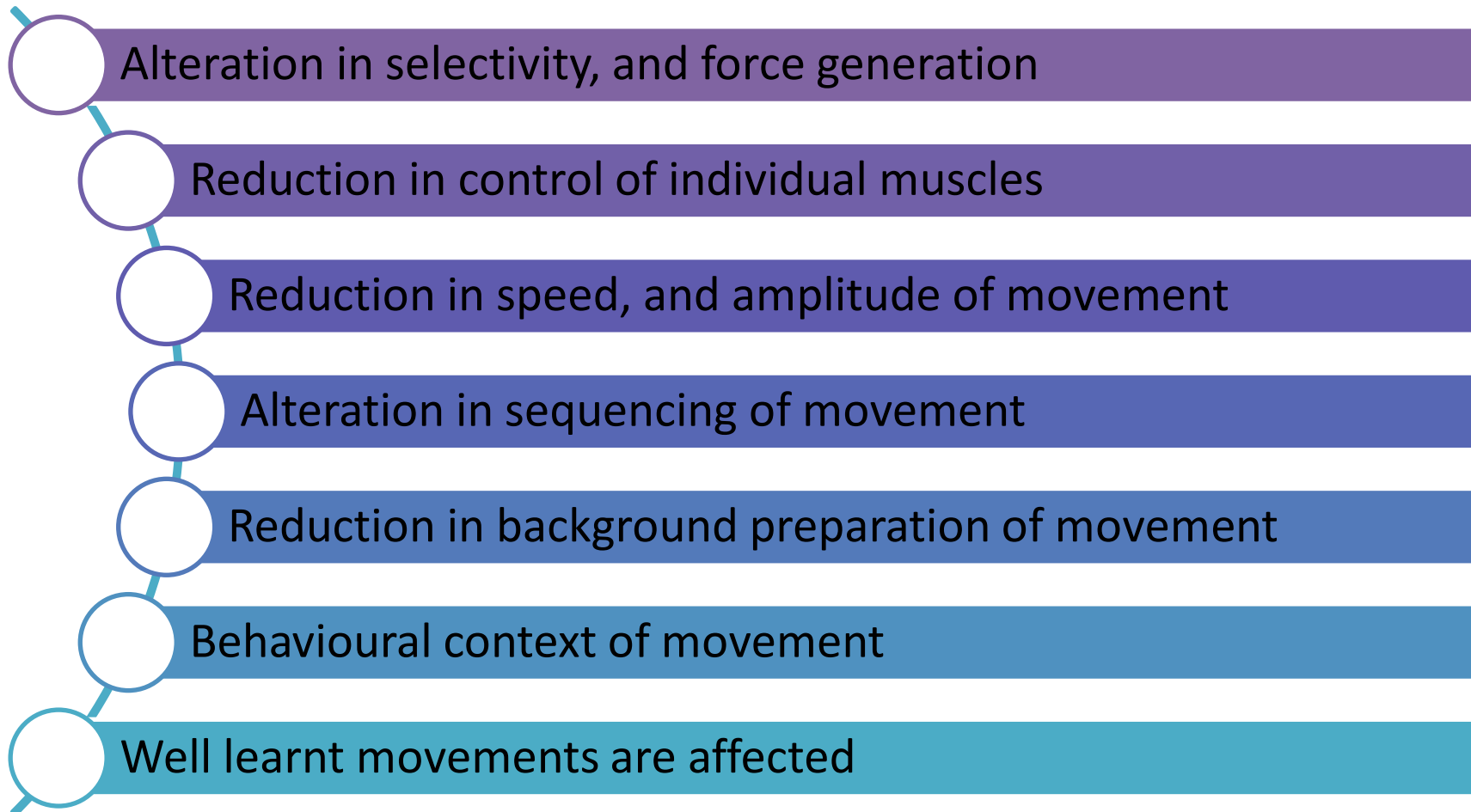
Sequencing, &
amplitude

Learning

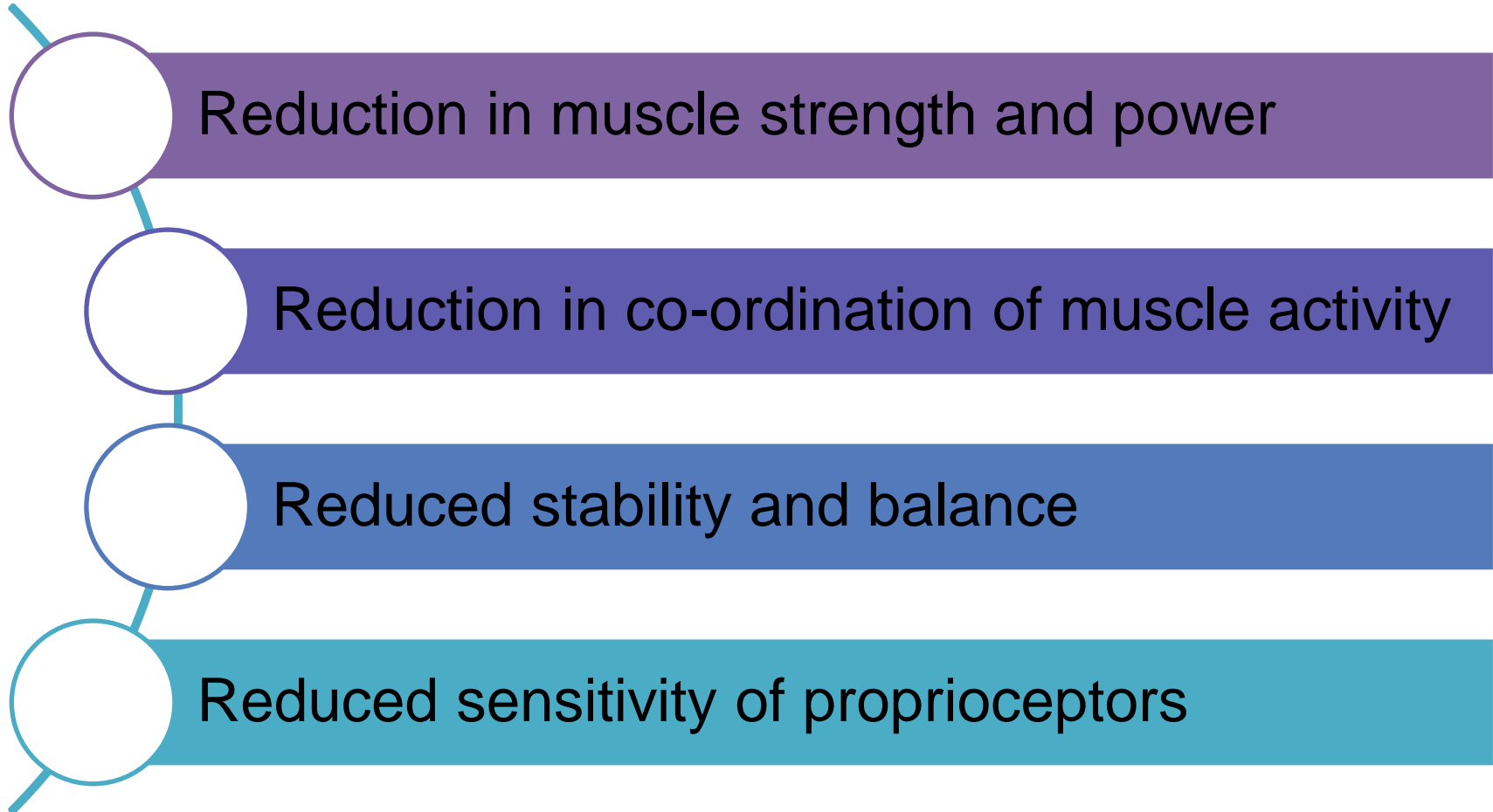
Motor Cortex



Net effect in the CNS

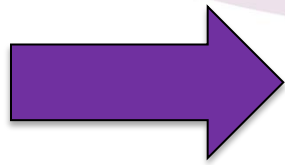


Net effect in the periphery



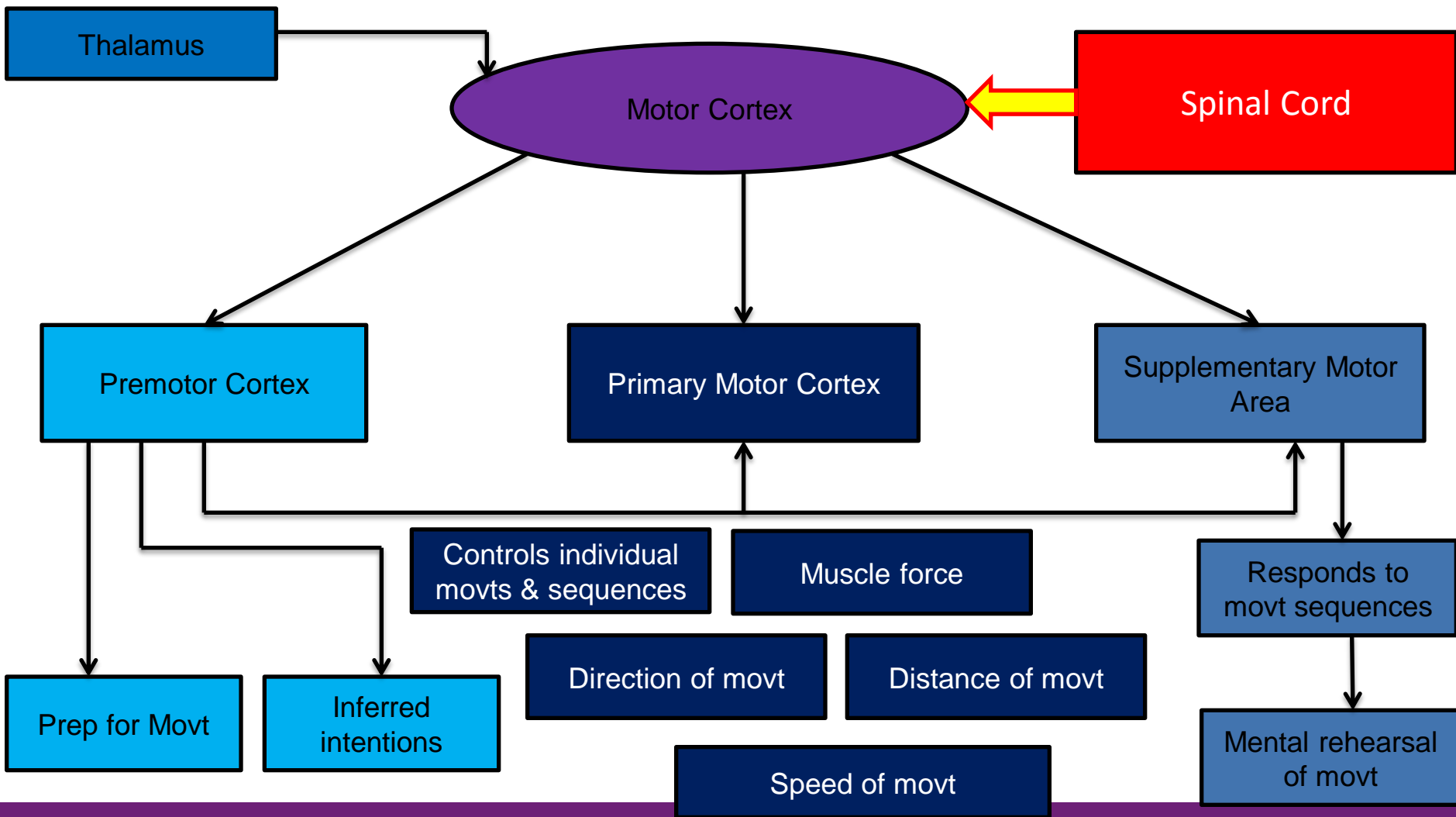
More recently

- α -Synuclein is linked neuropathologically to PD
- PNS is a target for α -Synuclein deposition
 - loss of dermal nerve fibres
 - loss of Meissners corpuscles



Sensory disturbance

Motor Cortex

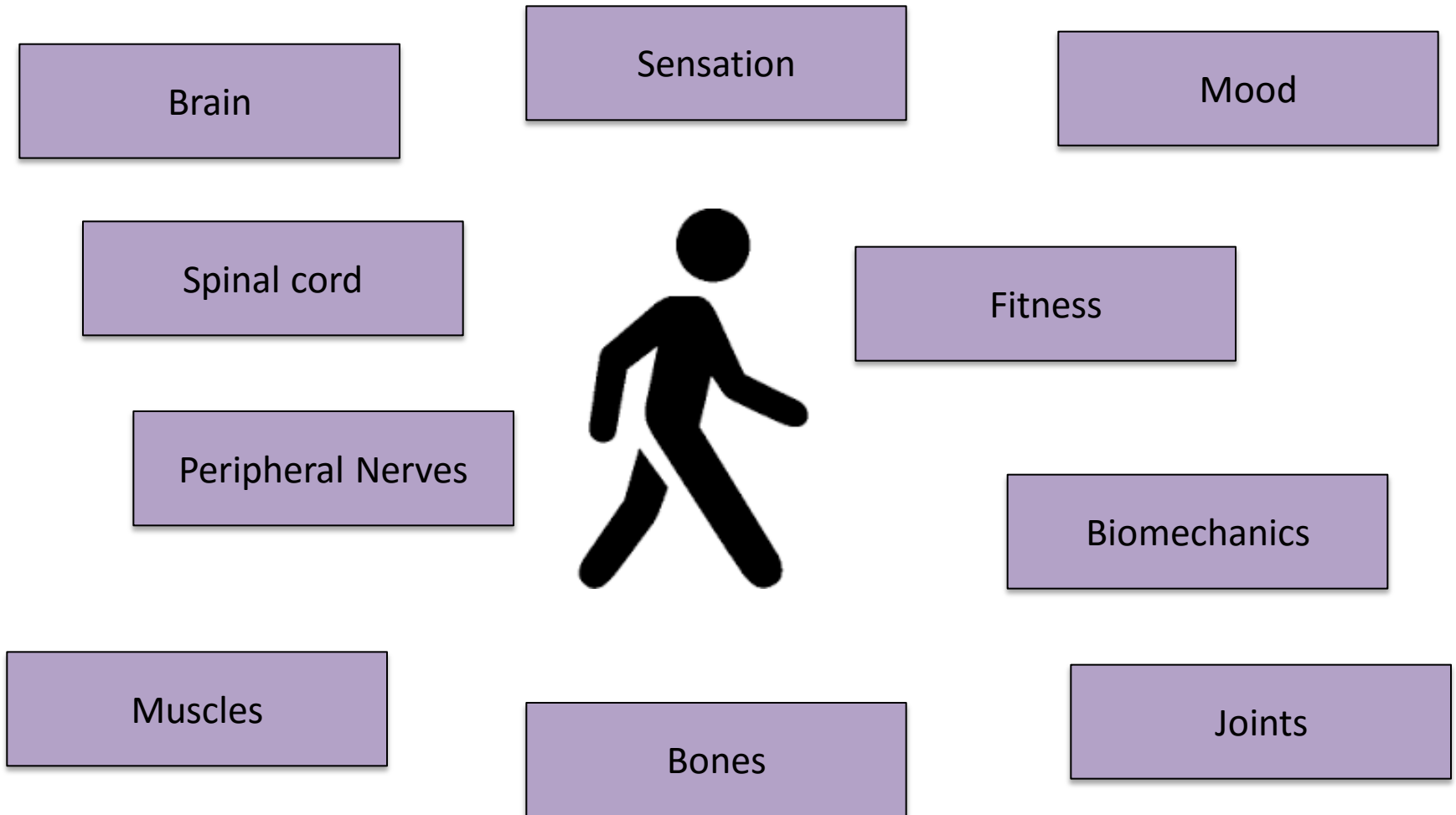




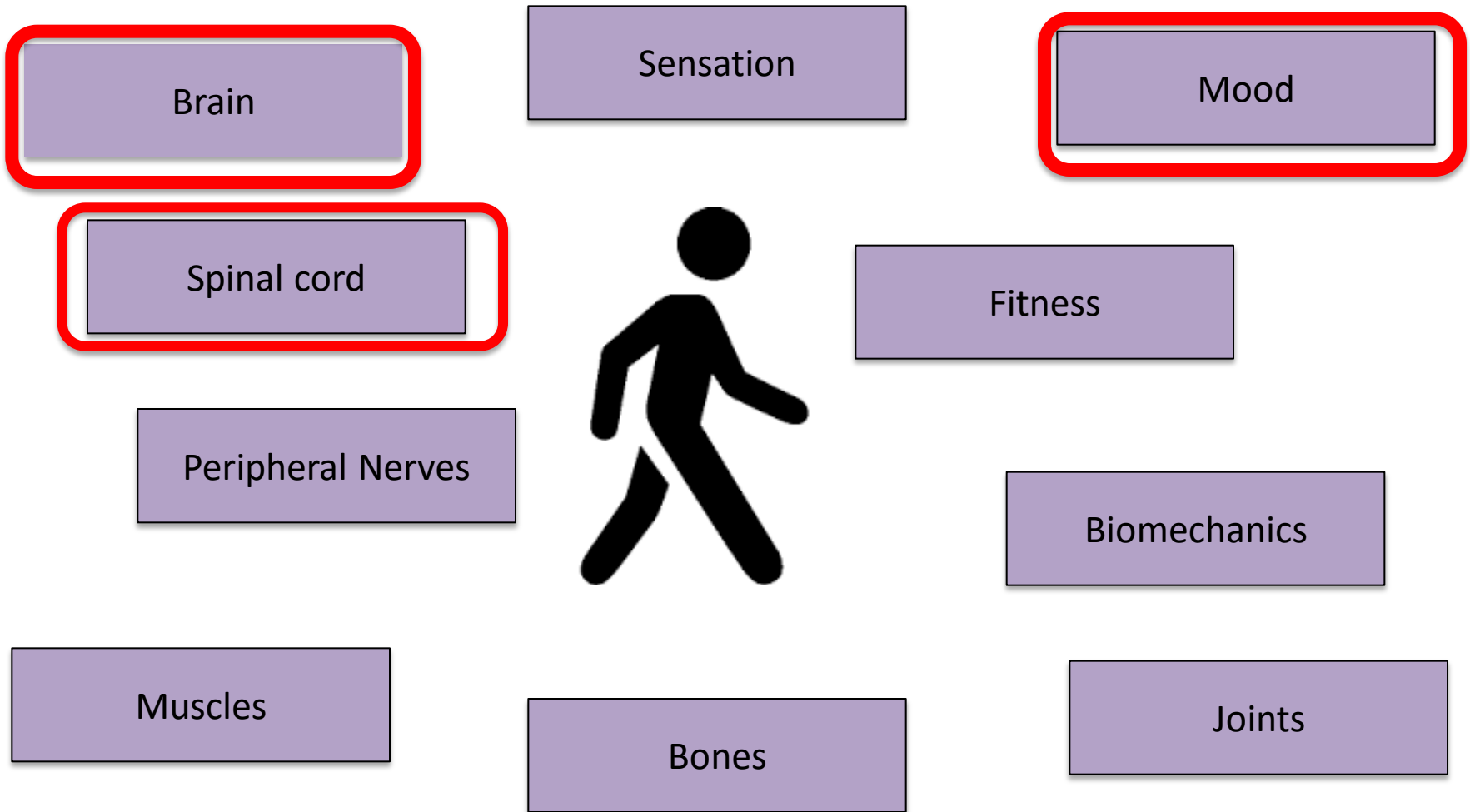
**ROBERT GORDON
UNIVERSITY ABERDEEN**

So how does this impact on
walking?

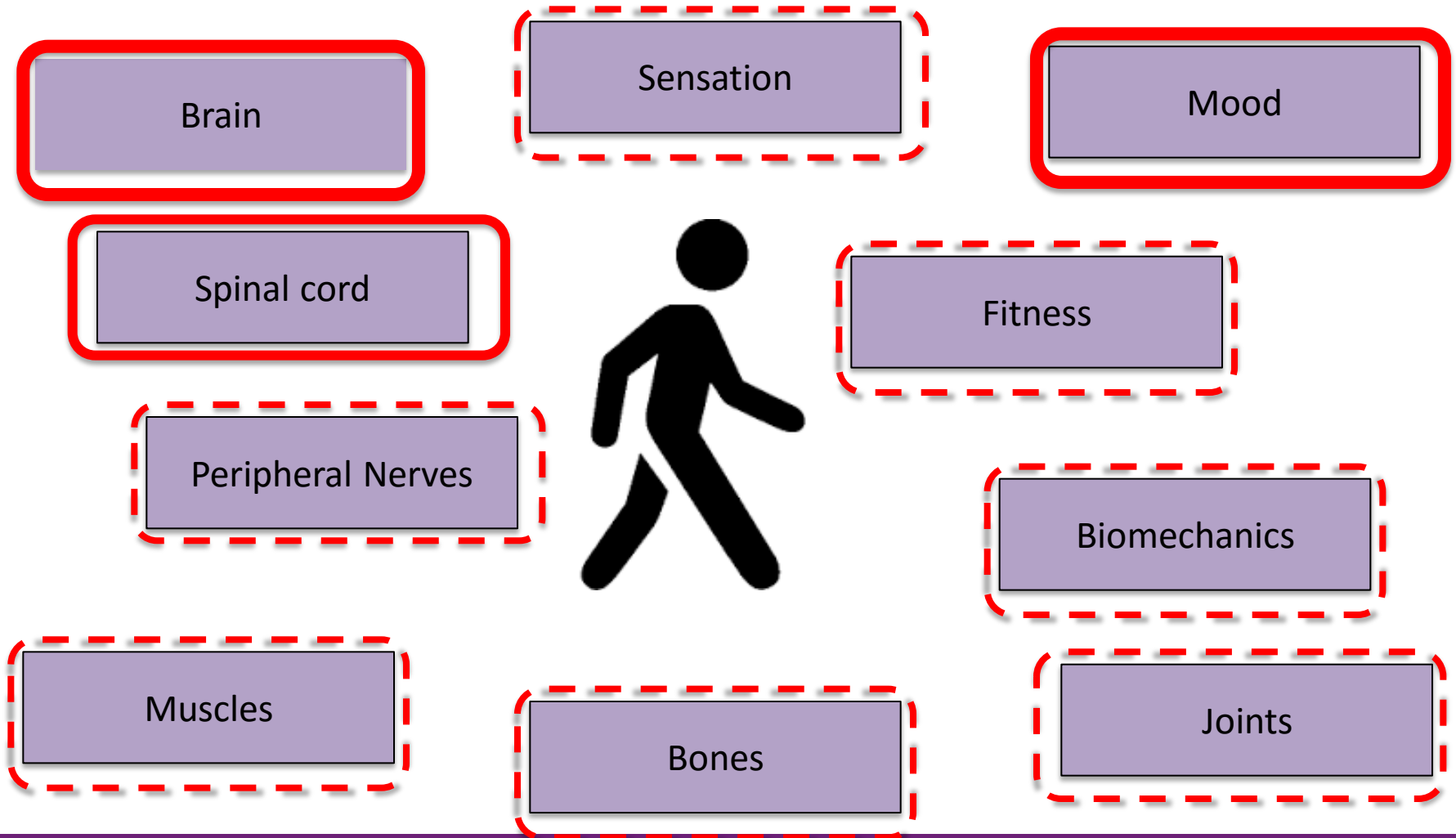
Complicated process



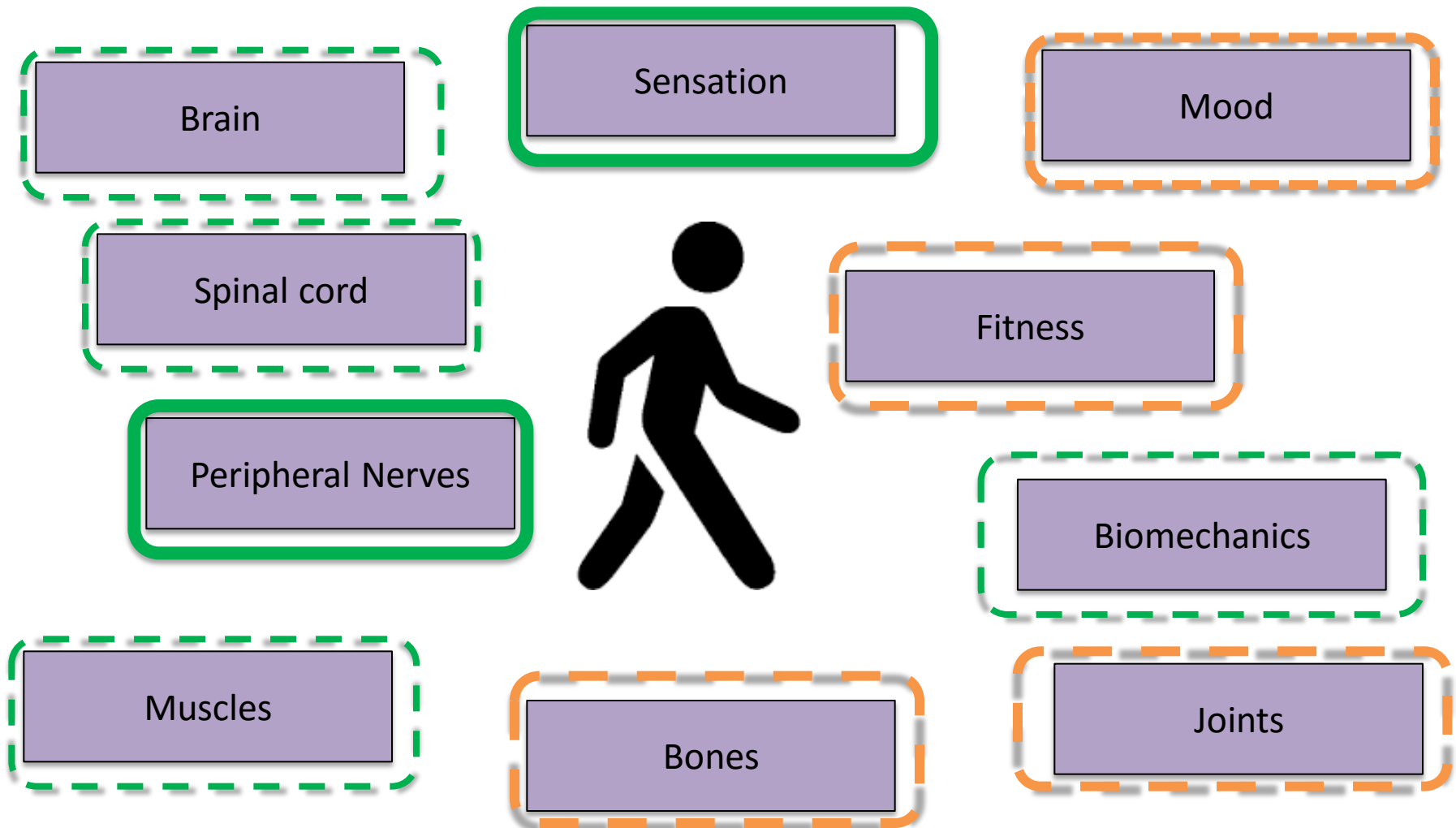
Complicated process



Complicated process



Complicated process



Walking

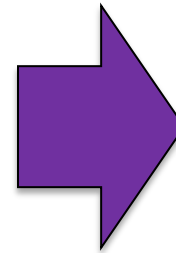
Hypokinesia

Akinesia

Reduced swing

Reduced amplitude

Reduced speed



Poverty of movement

Key messages for therapists

Primary Issues:

- Amplitude of movement
- Speed and accuracy
- Regulation and sequencing of movement
- Proprioceptive
- Set shifting
- Motor learning
- Motivational

Secondary Issues:

- Strength and power
- Speed
- Posture and balance
- Biomechanics
- Endurance
- ROM
- Routine & non routine
- Skills acquisition
- Empowerment
- Education

Components of gait training

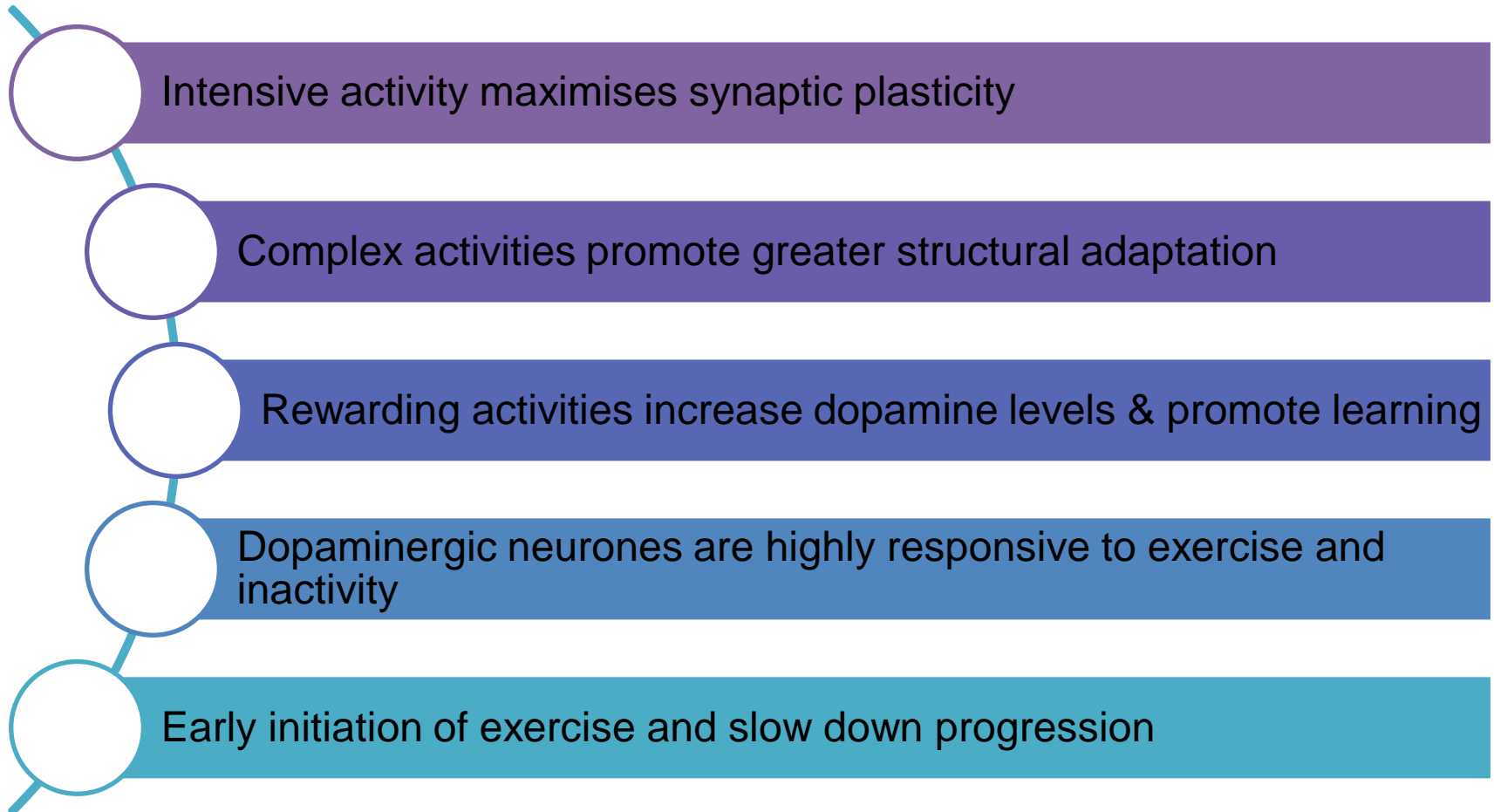




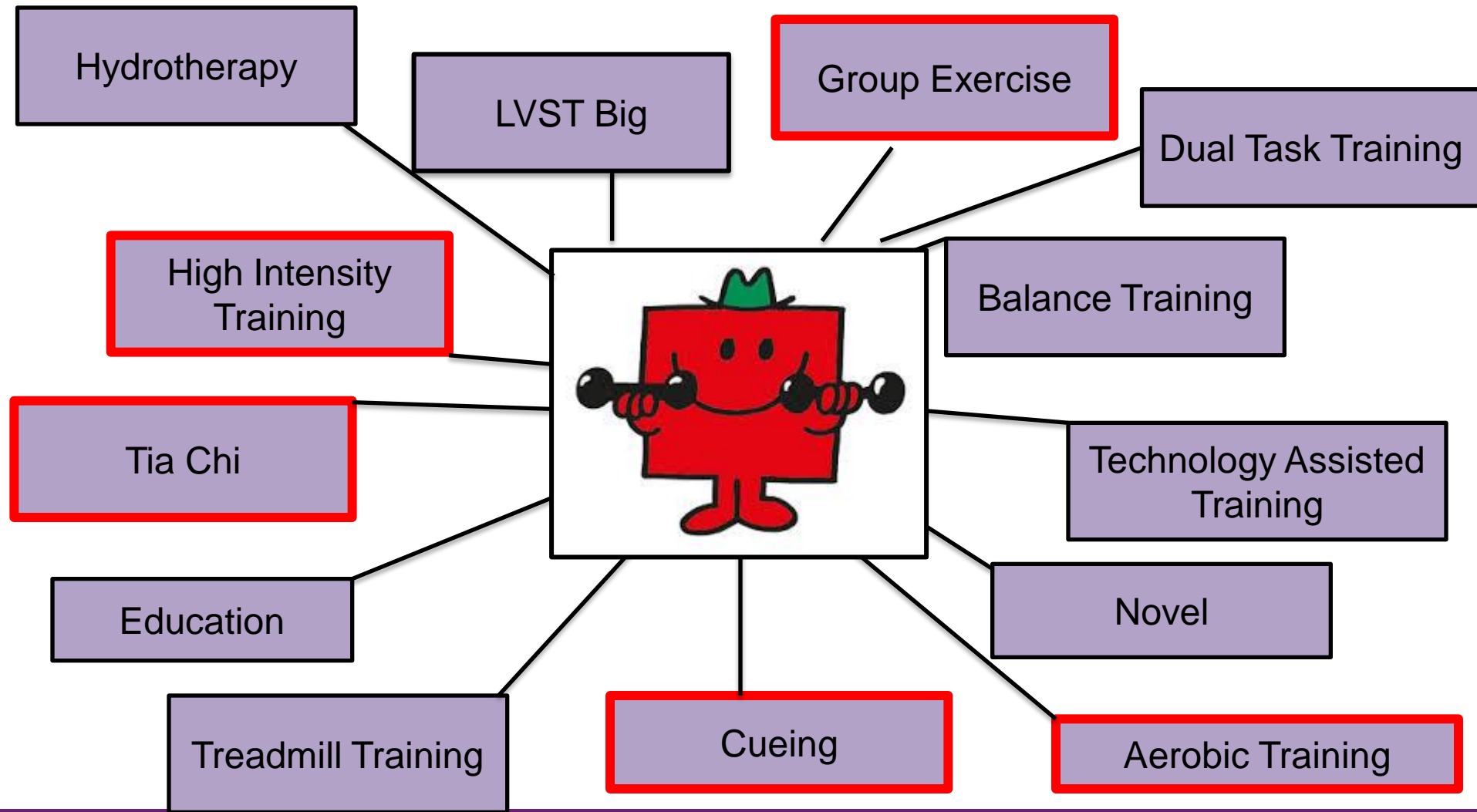
**ROBERT GORDON
UNIVERSITY ABERDEEN**

What is the evidence?

Value of exercise in PD (Fox et al 2006)



Physiotherapy



PD Rehab

Clarke et al (2016)

The screenshot shows the JAMA Neurology website interface. At the top, there's a navigation bar with 'The JAMA Network' and various menu items. Below that, the article title 'Physiotherapy and Occupational Therapy vs No Therapy in Mild to Moderate Parkinson Disease' is prominently displayed. The authors listed are Carl E. Clarke, MD¹; Smitaa Patel, MSc²; Natalie Ives, MSc³; Caroline E. Rick, PhD⁴; Francis Dowling, BSc⁵; Rebecca Woolley, MSc⁶; Keith Wheatley, DPhil⁷; Marion F. Walker, PhD⁸; Catherine M. Sackley, PhD⁹; and the PD REHAB Collaborative Group. The article is dated March 2016, Vol 73, No. 3. On the right side of the article, there are statistics: 7,030 Views, 2 Citations, and a circular icon with '110'. Below these are sections for 'Sign in', 'Purchase Options', and 'Related Content'. The abstract section is partially visible, starting with 'Importance It is unclear whether physiotherapy and occupational therapy are clinically effective and cost-effective in Parkinson disease (PD). Objective To perform a large pragmatic randomized clinical trial to evaluate the clinical effectiveness of individualized physiotherapy and occupational therapy in PD. Design, Setting, and Participants The PD REHAB Trial was a multicenter, open-label, parallel group, controlled efficacy trial. A total of 762 patients with mild to moderate PD were recruited from 38 sites across the United Kingdom. Recruitment took place between October 2009 and June 2012, with 15 months of follow-up.'

Multicentre Trial

N = 762

38 UK wide sites

NEADL, PDQ-39, ED5D

4 visits over 8 week period

No immediate or medium term benefit

Exercise SRs focussing on gait

Author and Year	Title
Allen et al 2010	The effects of an exercise program on fall risk factors in people with Parkinson's disease
Combs et al 2013	Community-based group exercise for persons with Parkinson's disease: A randomized controlled trial
Hass et al 2012	Progressive resistance training improves gait initiation in individuals with Parkinson's disease
Paul et al 2014	Leg muscle power is enhanced by training in people with Parkinson's disease: a randomized controlled trial
Schilling et al 2010	Effects of moderate-volume, high-load lower body resistance training on strength and function in persons with Parkinson's disease: a pilot study
Shen & Mak 2012	Repetitive step training with preparatory signals improves stability limits in patients with Parkinson's disease
Shulman et al 2013	Randomized clinical trial of 3 types of physical exercise for patients with Parkinson's disease

Outcome measures included

Author & Year	TUG	6 MWT	10 MWT	2.5/5m walking velocity	Stride Length	Initial Stride Velocity	Cadence	FOG Question Yes/No	FOG Questionnaire
Allen et al 2010				✓				✓	✓✓
Combs et al 2013	✓✓	✓		✓✓					
Hass et al 2012					✓✓	✓✓			
Paul et al 2014	✓		✓						
Schilling et al 2010	✓	✓✓							
Shen & Mak 2012				✓✓	✓		✓✓		
Shulman et al 2013		✓✓	✓						

Conclusions

Exercise is effective

Longer duration and functional based exercises Allen et al 2010

Strength increased by 25%. No improvement in walking, or skill acquisition. Schilling et al 2010

Training specificity

Functional based exercises Speed and motor planning components. Combs et al 2013

Balance V strength. Balance had LT impact on SL & velocity. Shen and Mak 2014

Functional & high resistance 2-3 weekly

Power training sig. improvement over low intensity training. No imp on gait or fall. Paul et al 2014

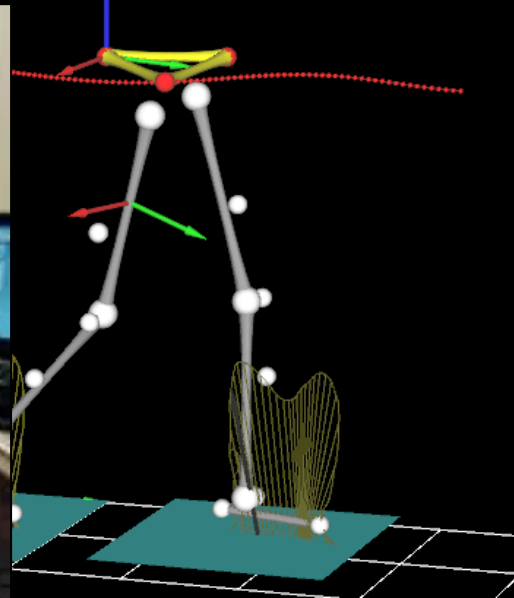
HI TT and LI TT improvements in CV fitness and gait speed. No impact on strength. Schulma et al 2013

Combined approach

PRT group significantly improved initial stride length, gait initiation and gait velocity. No functional improvement. Hass et al 2012

- Cueing results in improvements in Stride length, step length, speed, and cadence.
- Visual provide better improvement in cadence
- Sensory cues decrease cadence, but increase speed and stride length
- Combined cueing with auditory and visual also show improvements in the UPDRS and freezing

Issues



Tai Chi Yang et al (2014)

- Supports the efficacy of Tai Chi in particular motor function, balance.
- Little benefit on walking, aerobic capacity, and muscle strength
- Functionally beneficial



Treadmill Training Mehrholz et al 2015

- 18 trials with sample of 633 PwPD
- Improvements in gait speed, and SL
- No improvement in walking distance and cadence
- ? Long term improvement, optimal freq and intensity
- Low to moderate quality evidence

LSVT Big



LSVT Big Ebersbach et al 2010

- 3 groups –BIG, Nordic Walking, & U/S Exercise
- 16 hours of training within 4-8 weeks
- UPDRS Motor scale used
- Improvements made in BIG in UPDRS, TUG and 10MWT
- No changes on QoL

Where does this leave us now?

What type exercise is best?

When should PwPD begin exercising?

At what prescription?

Combined approach would seem best but which forms of exercise?

Does current therapy address the complexity of the condition?

How long will do the benefits last?



So where does this leave us?

We know that improvements can be made in:

- Strength
- Power
- Flexibility
- Balance
- Gait

What we don't know:

- Which type of exercise would be best?
- Combined approach would seem best but which forms of exercise?
- At what prescription?
- How long will it last?

ParkFit (Speelman et al 2014)

540 sedentary PwPD

Activity Coaches

Educational workbooks & health contract

Joint Goal setting

Activity monitor

Individual PT

LAPAQ, UPDRS, H&R, Disease duration, PDQ-39, TUG, NHPT, FSS, HADs, 6MWT, BMI. L-dopa

63%
Physical
Limitations

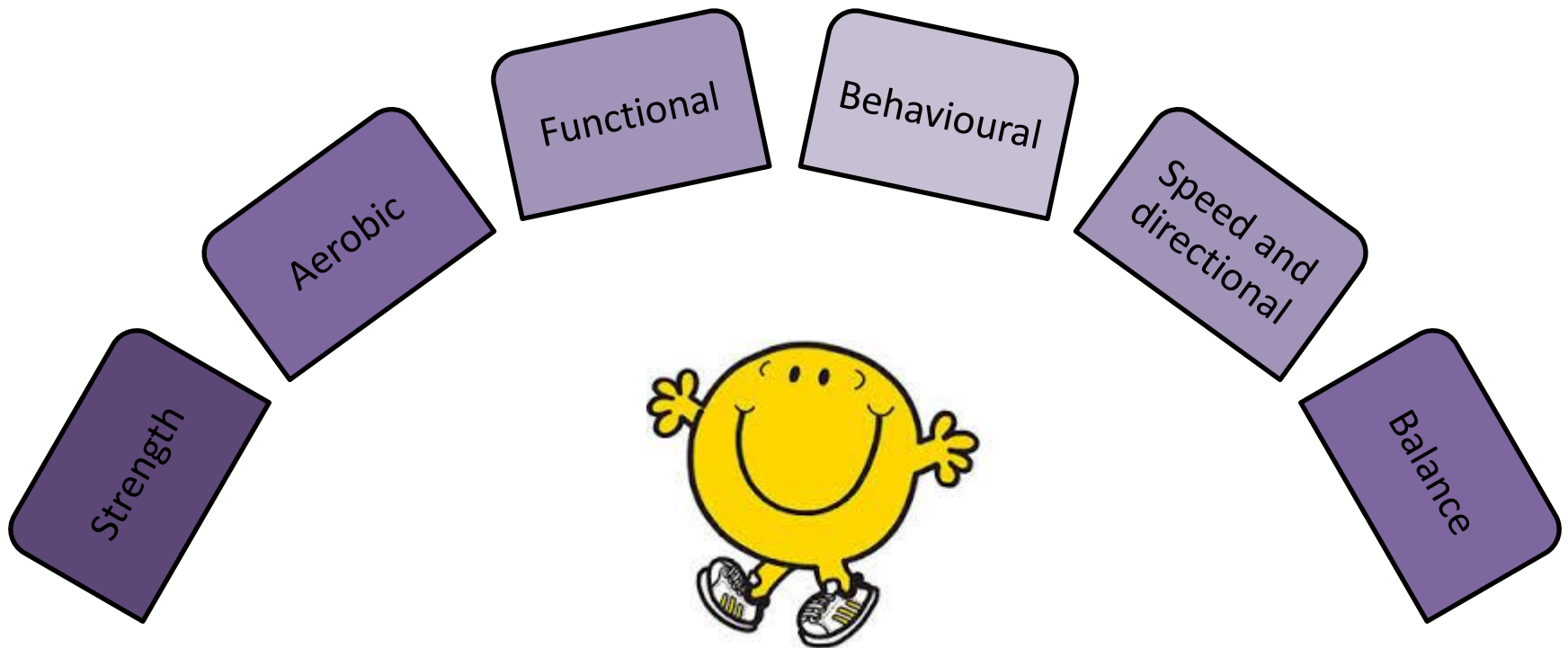
Effective:

- Sedentary people
- Women
- Higher disease severity
- Shorter disease duration
- Older

ParkFit 34%
more active
than controls

Behavioural
change

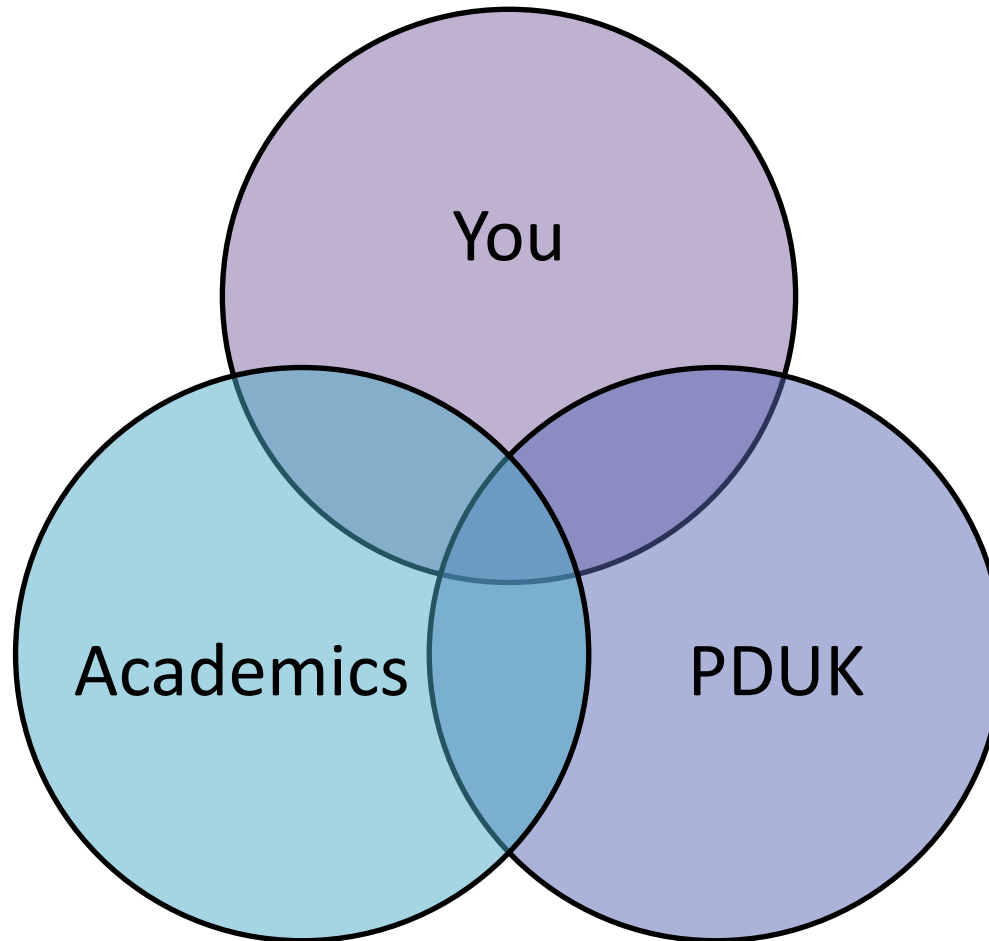
The Future



How can we do it

- Well designed research methodologies
- Larger sample sizes
- Research function
- More research trials

Working in partnership





**ROBERT GORDON
UNIVERSITY ABERDEEN**

Thank you

j.c.jones@rgu.ac.uk