NUTRIM Graduate Programme Symposium

Locomotor stability and adaptation during perturbed walking across the adult female lifespan

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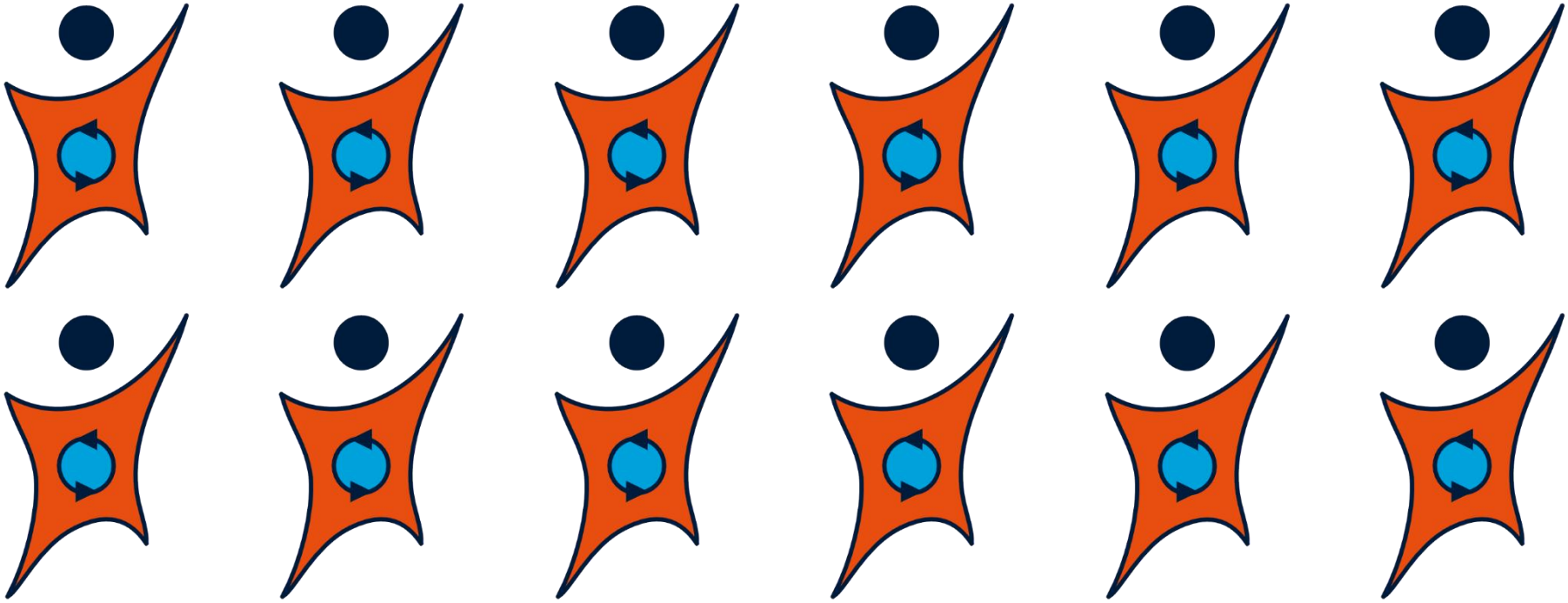
Falls among Older Adults



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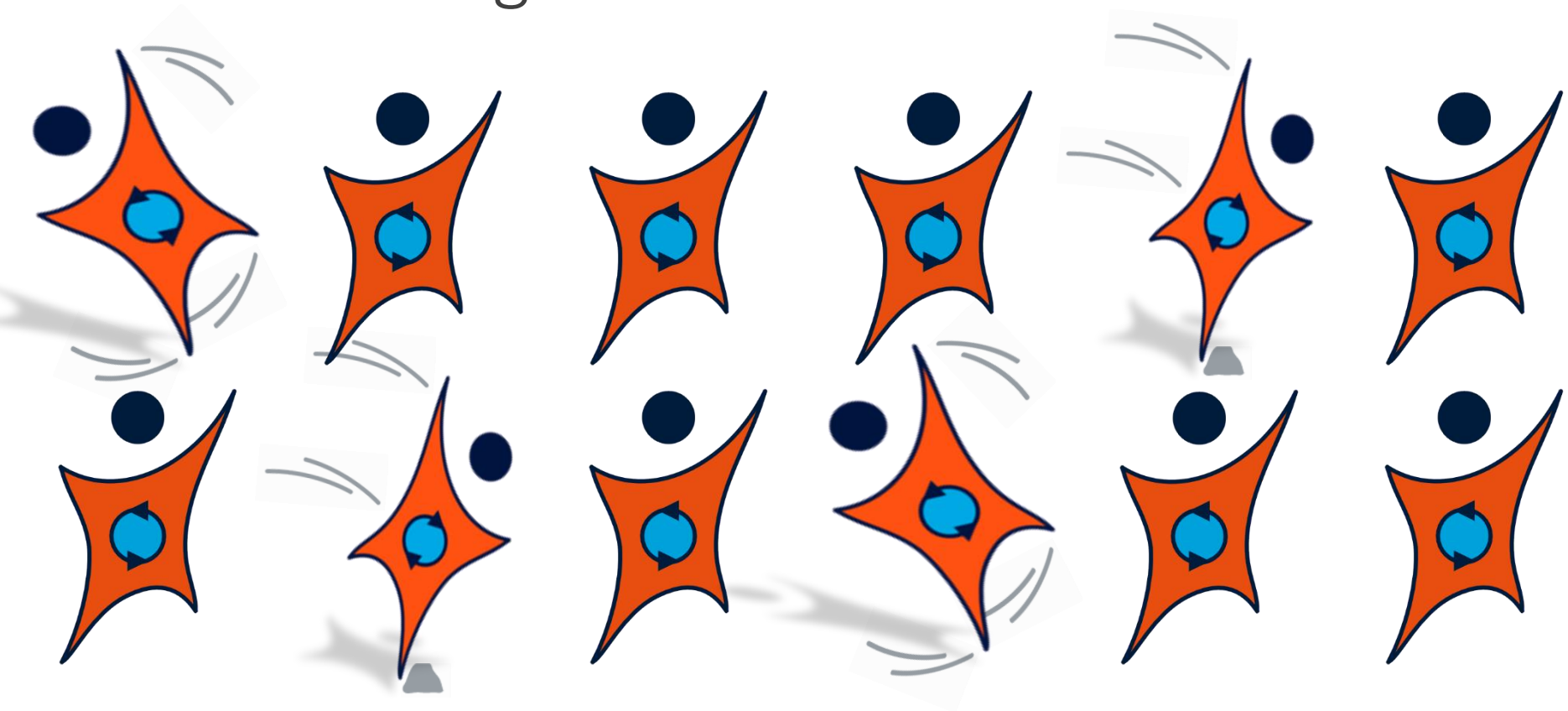
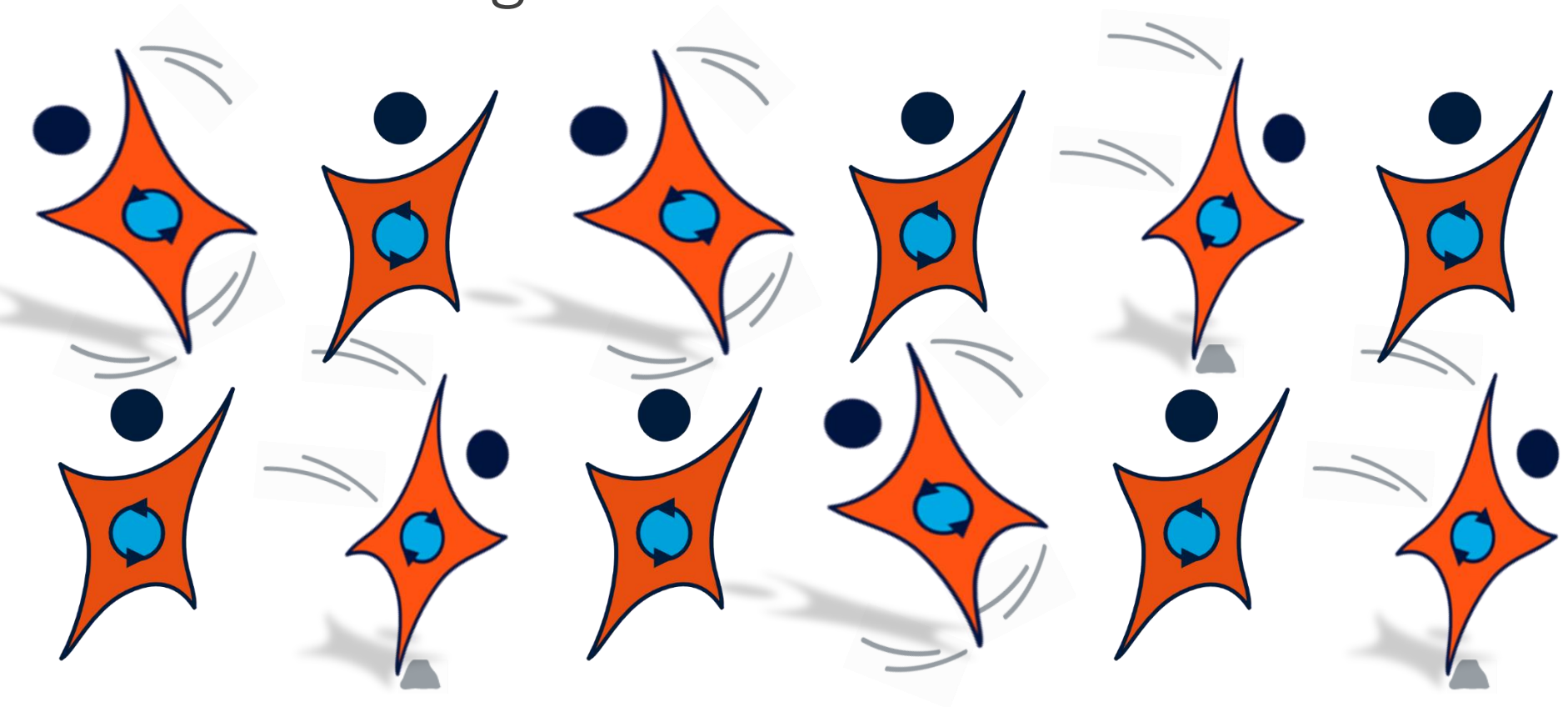


65+: 1 in 3

Falls among Older Adults



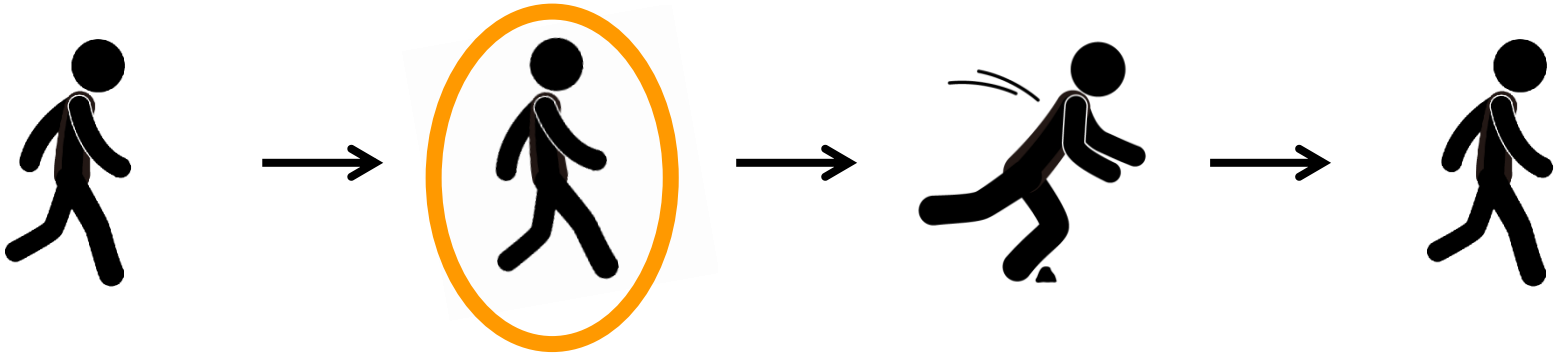
65+: 1 in 3

80+: 1 in 2

Reactive and Predictive Adjustments

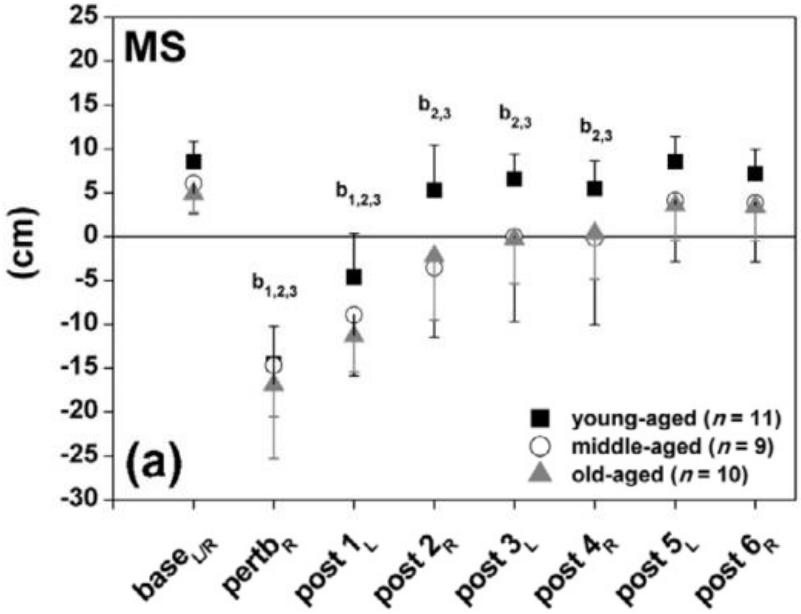
Reactive Adjustments of Gait:

Predictive Adjustments of Gait:



Trip Recovery with Age

McCrum et al. (2016)



11 younger (22-30y)
9 middle-aged (41-59y)
10 older (62-75y)

Süptitz et al. (2013)

Aims

To analyse locomotor stability adaptation potential in young, middle and older aged adults in response to a sustained resistance perturbation during walking

Hypothesis

Older adults remain capable of adapting their locomotor stability to external gait perturbations, but not to the same extent as young and middle aged adults.

Methods

Participants:

11 young (25.5(2.1) years),

11 middle aged (50.6(6.4) years) and

14 older (69.0(4.7) years) healthy women

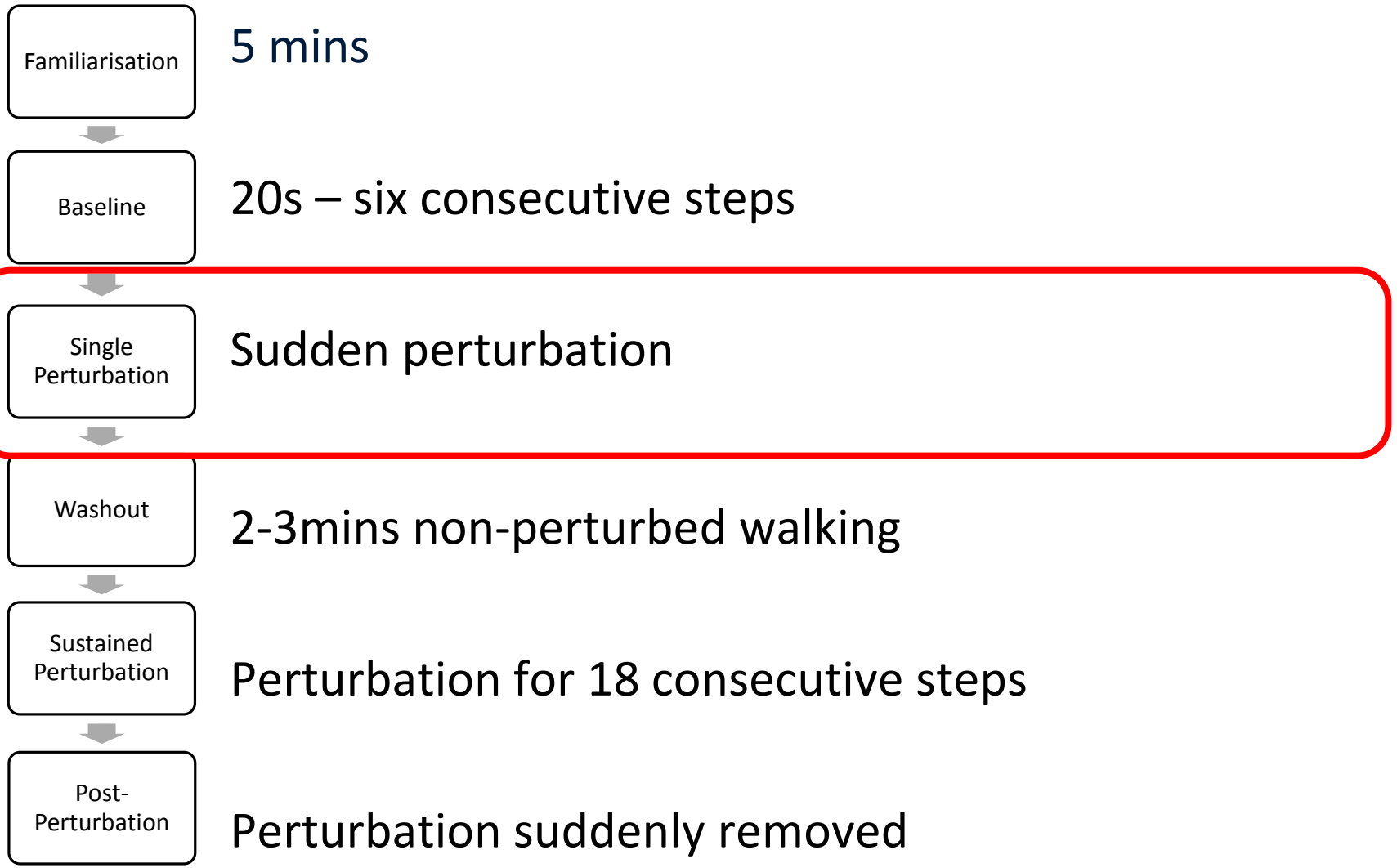
Experimental Setup:

Subjects walked on a treadmill at 1.4m/s

Familiarisation carried out 4-7 days before analysis

On day of analysis, subjects walked on the treadmill for 5 minutes to once again get used to the treadmill

Methods


Familiarisation
5 mins
Baseline
20s – six consecutive steps
Single Perturbation
Sudden perturbation
Washout
2-3mins non-perturbed walking
Sustained Perturbation
Perturbation for 18 consecutive steps
Post-Perturbation
Perturbation suddenly removed

Methods

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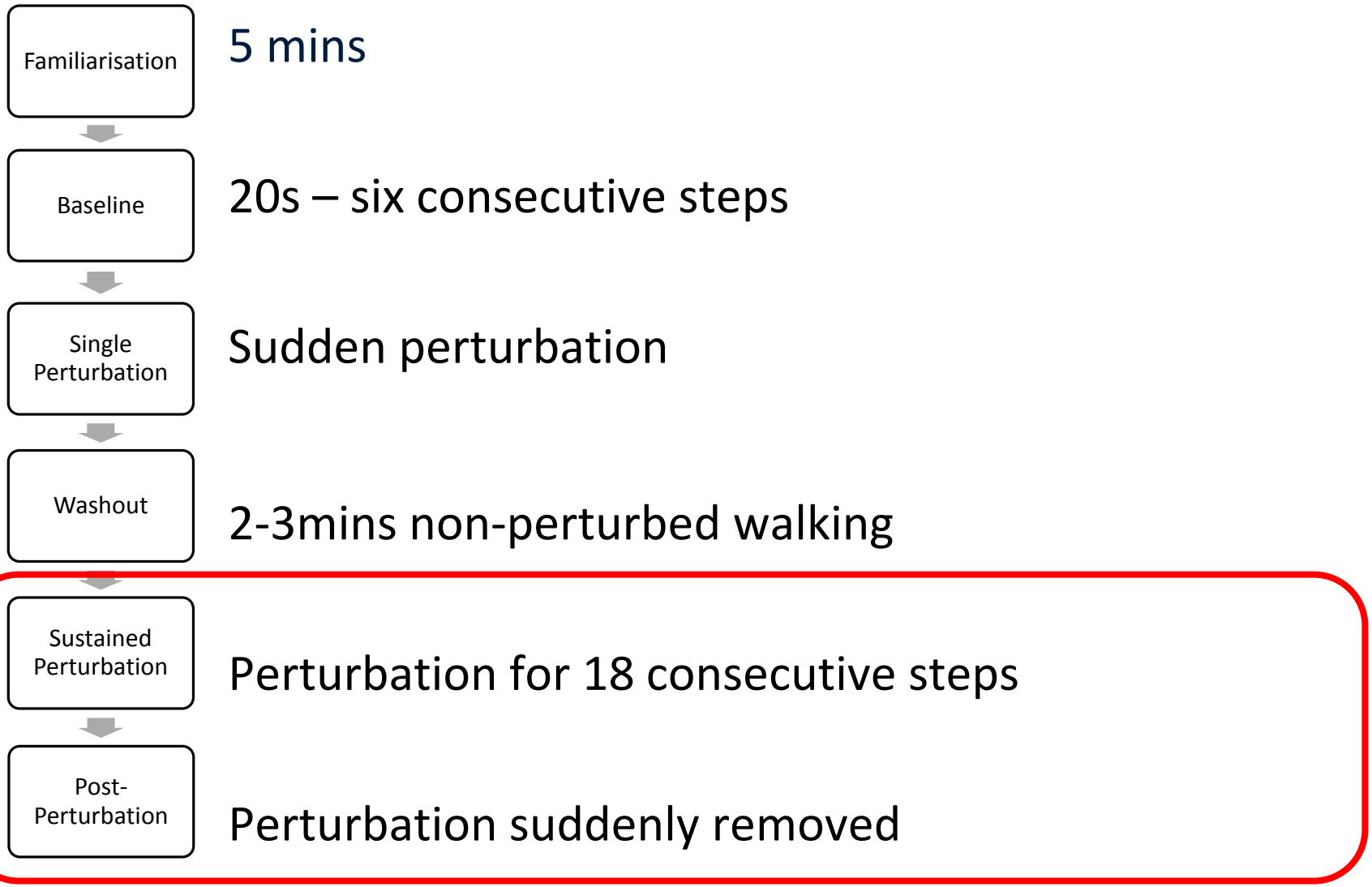
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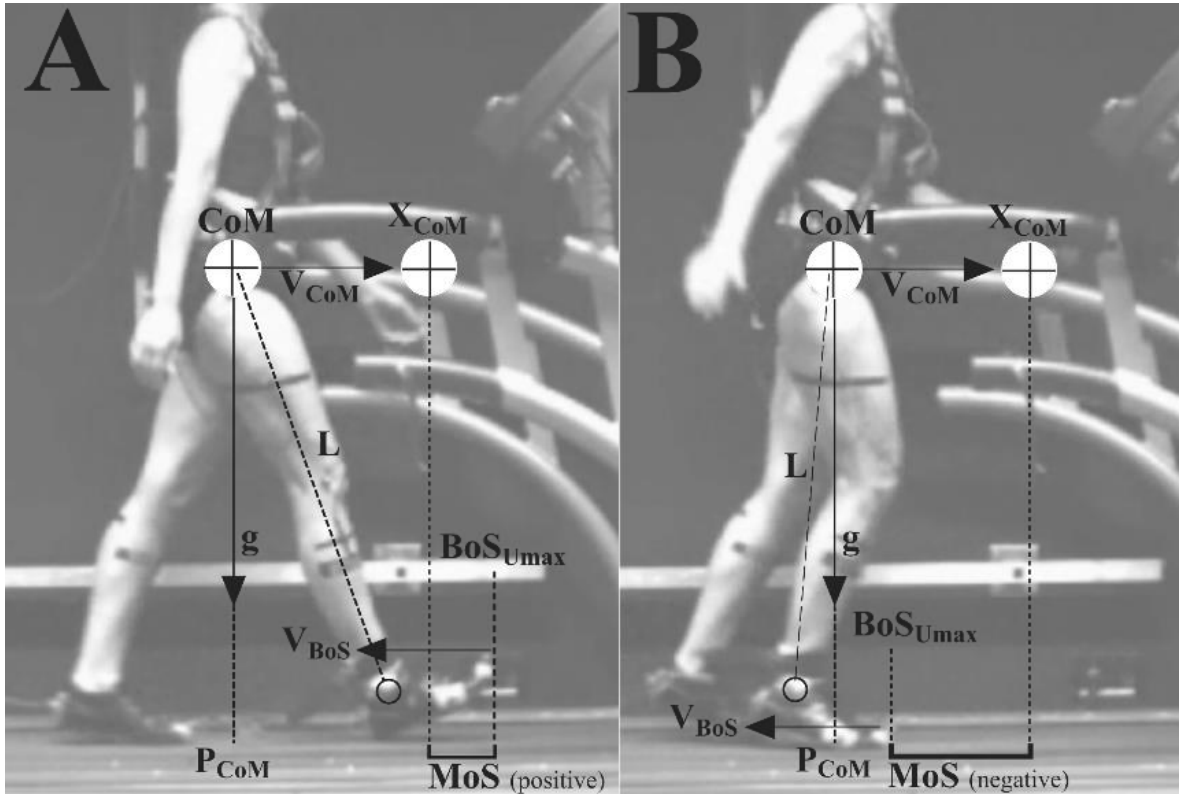
Perturbation suddenly removed

Methods

Extrapolated Centre of Mass (Margin of Stability) (Hof et al., 2005).

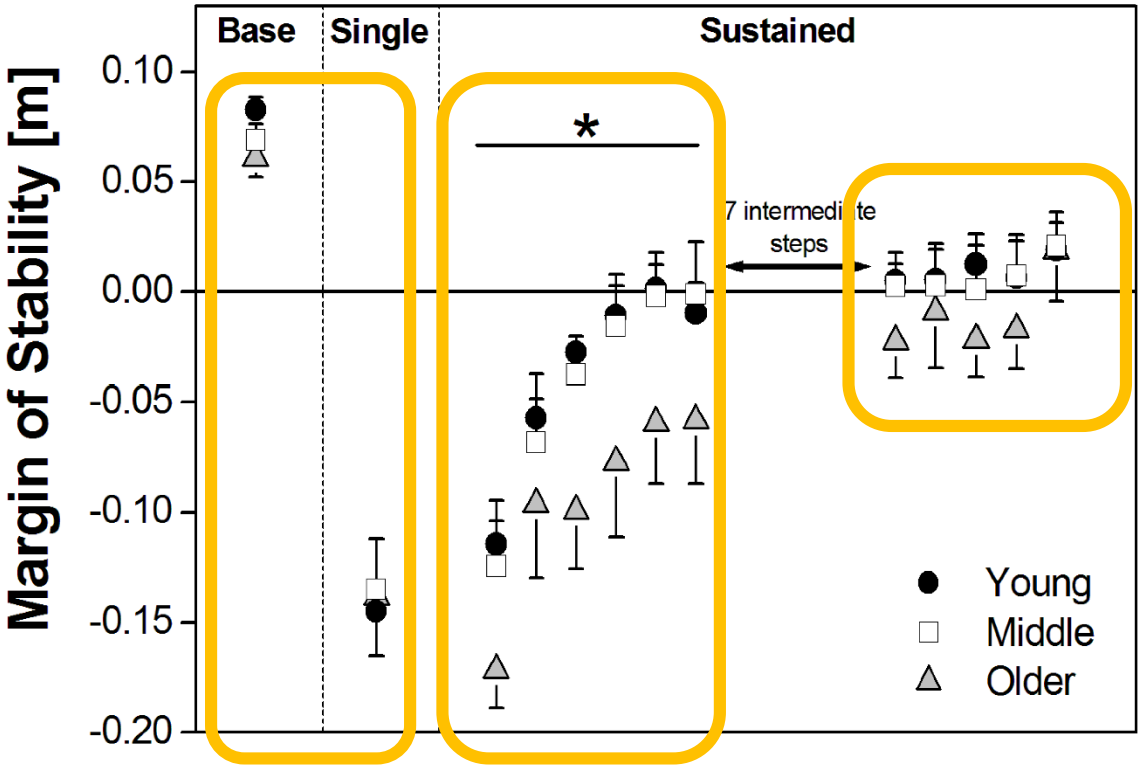


McCrum et al. (2016)

$$\mathrm{MoS} = \mathrm{BS_{Umax}} - \mathrm{X_{CoM}}$$

$$X_{\mathrm{CoM}} = P_{\mathrm{CoM}} + \frac{(V_{\mathrm{CoM}} + |V_{\mathrm{BS}}|)}{\sqrt{g \cdot L^{-1}}}$$

Results

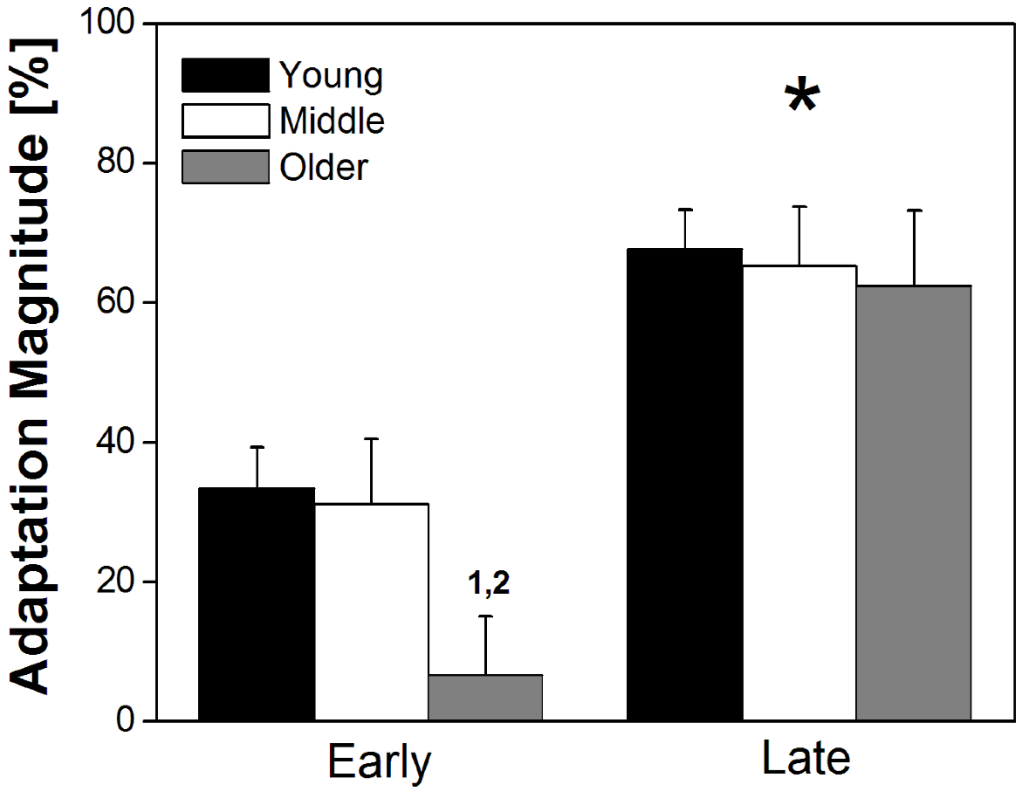


*Mean and SE. *Sig. differences between old and the younger groups (P<0.05)*

All groups were able to adapt comparably by the last steps, but older adults required more steps to reach this level of adaptation.

McCrum et al. (2016)

Results



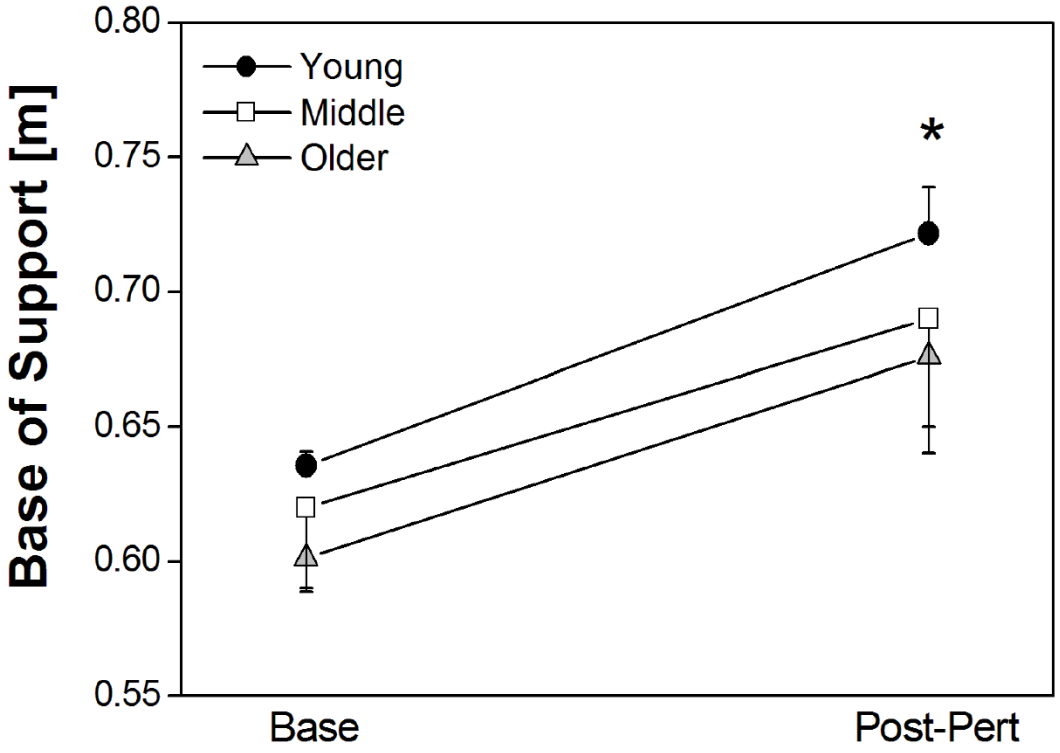
Mean and SE

1 and 2: Statistically significant difference during the early adaptation period to the young and middle aged groups respectively ($P < 0.05$).

*Statistically significant difference to the early adaptation period for all groups ($P < 0.05$).

McCrum et al. (2016)

Results



All groups showed comparable aftereffects in the BoS once the sustained perturbation was removed.

This indicates that a predictive recalibration of motor commands was present and similar between all age groups

*Mean and SE. *Sig. difference to baseline for all groups (P<0.05)*

McCrum et al. (2016)

Conclusions

Older adults retain the ability to recalibrate their gait stability, however, the rate of adaptation is declined in old age

In middle age, adaptation rate was similar to the young adults

It appears that locomotor stability adaptation rate does not decline until later in life

PhD Project:

Locomotor Plasticity in the Elderly: Biomechanical, Muscle-Tendon and Vestibular Influences

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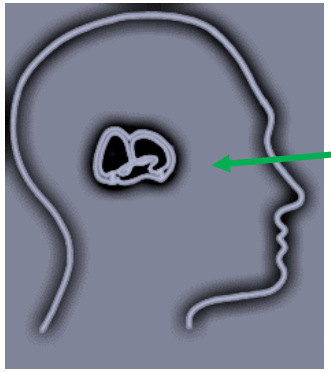
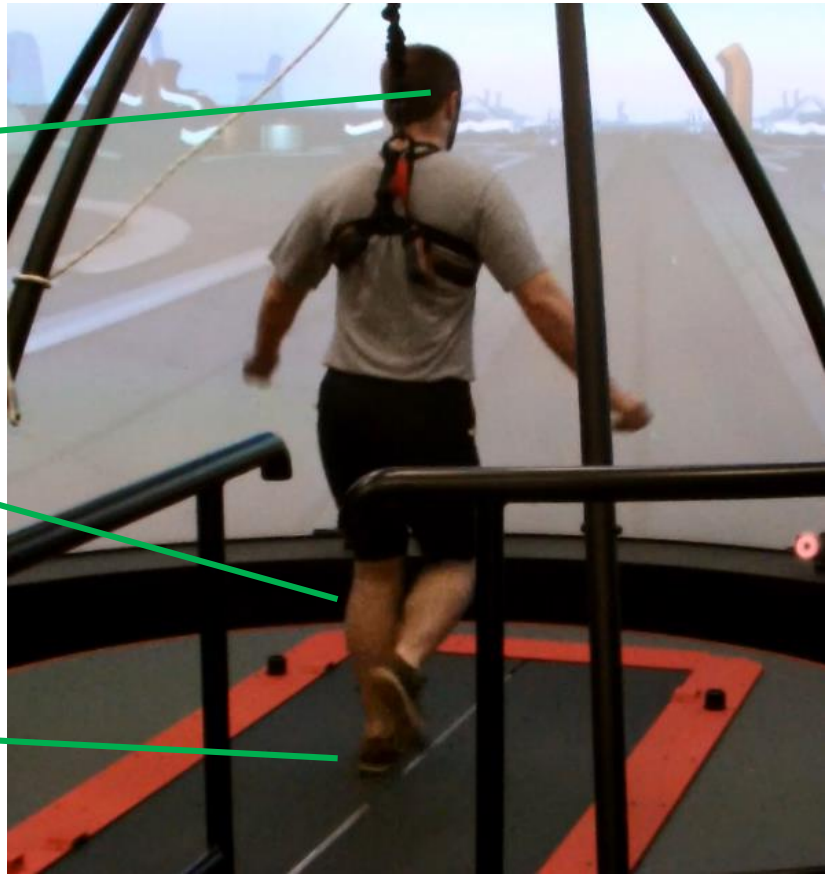
Locomotor Plasticity in the Elderly: Biomechanical, Muscle-Tendon and Vestibular Influences

Contributing Factors to Stability Control

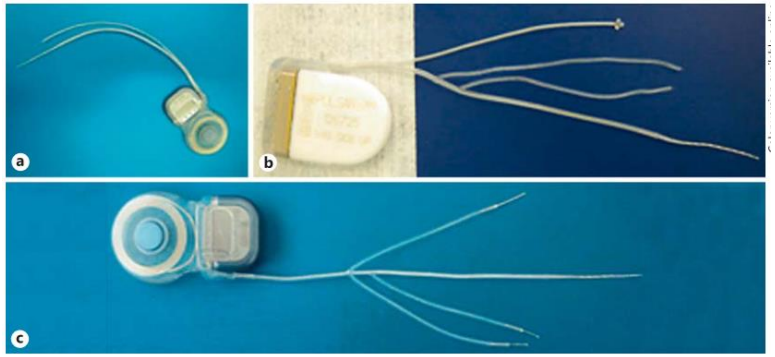




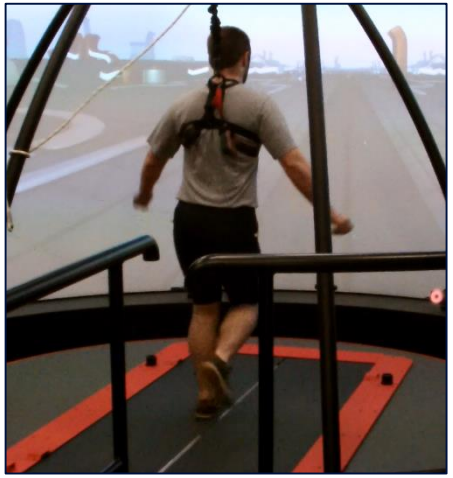
Interventions

Strength
Power
Stiffness

Vestibular
Function/
Sensitivity

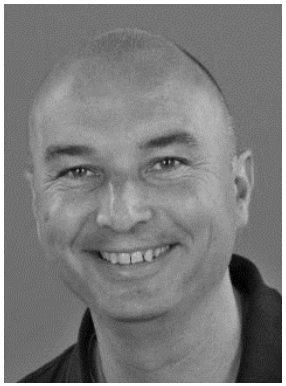


Stability
Reaction Time
Plasticity



Supervising Team

Maastricht UMC+



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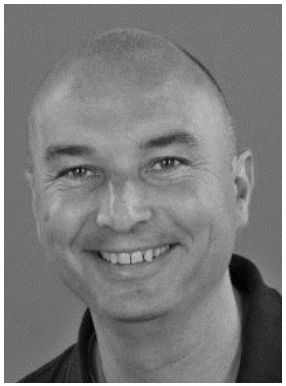

Gait & Muscle Biomechanics

Deutsche Sporthochschule Köln
German Sport University Cologne

Tendon Biomechanics
Gait Mechanics during Perturbations

Physiology & Physics of the Vestibular System
Balance control

Falls and Mobility
Daily Life Gait Biomechanics

Collaborators

Maastricht UMC+

Deutsche Sporthochschule Köln
German Sport University Cologne

CAREN Team:
Operators: Rachel Senden & Rik Marcellis
Technician: Paul Willems

Vestibular Lab:
Raymond van de Berg
Floor Lucieer
Robert Stokroos

PROTENDON Company: Device for Assessing Tendon Mechanical Properties

PhD Students:
Gaspar Epro
Matthias König

Advice

Find supervisors who suit you!

Seek out people with the expertise you need/want

Make the roles of each person clear for each stage of the project

Communicate!

Be clear and honest with your team

Get to know your methods/devices as much as possible

Thank you for your attention