Biomechanical and Sensory Constraints of Step and Stair Negotiation in Old Age

3-year project: RES -356-25-00037

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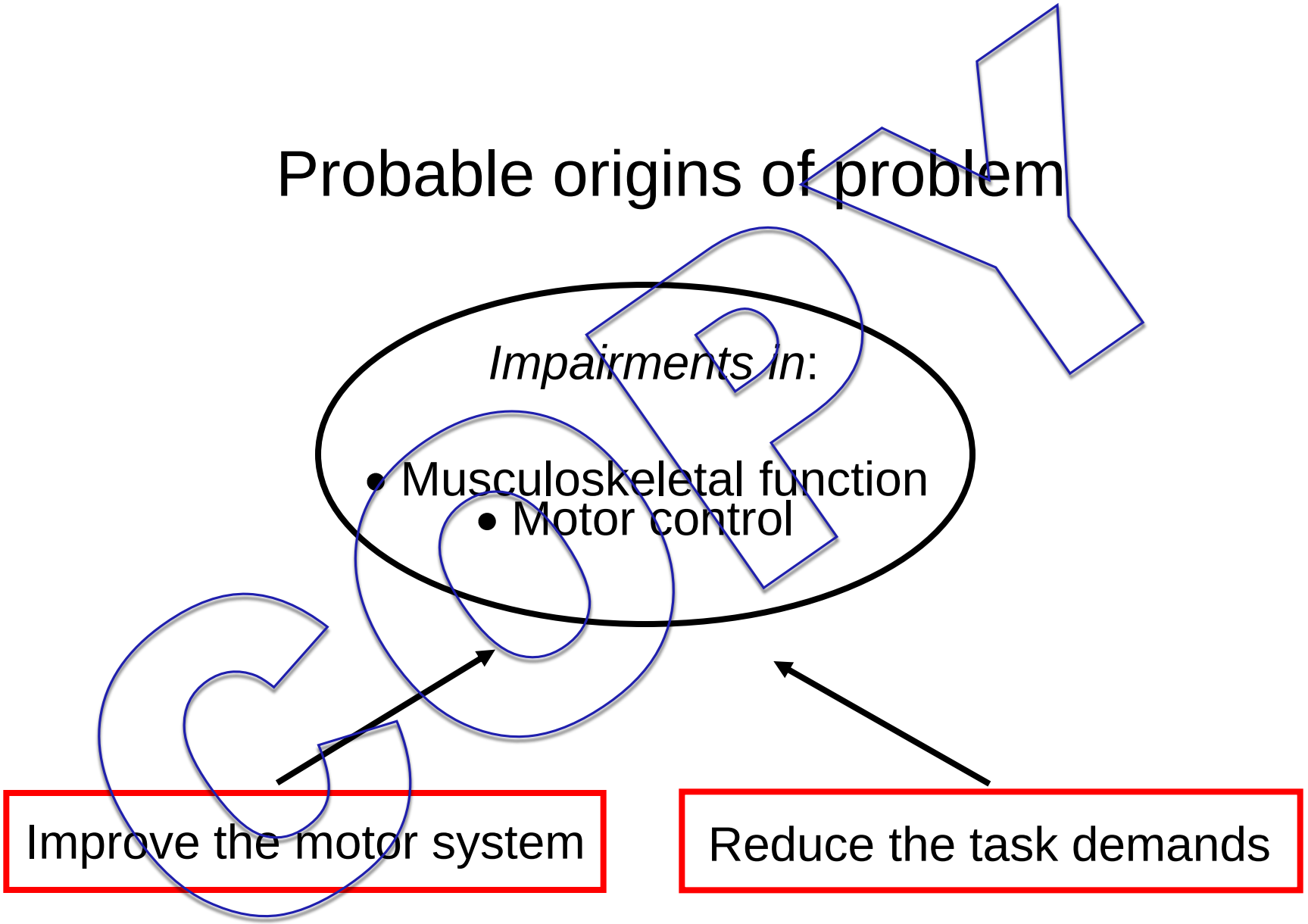
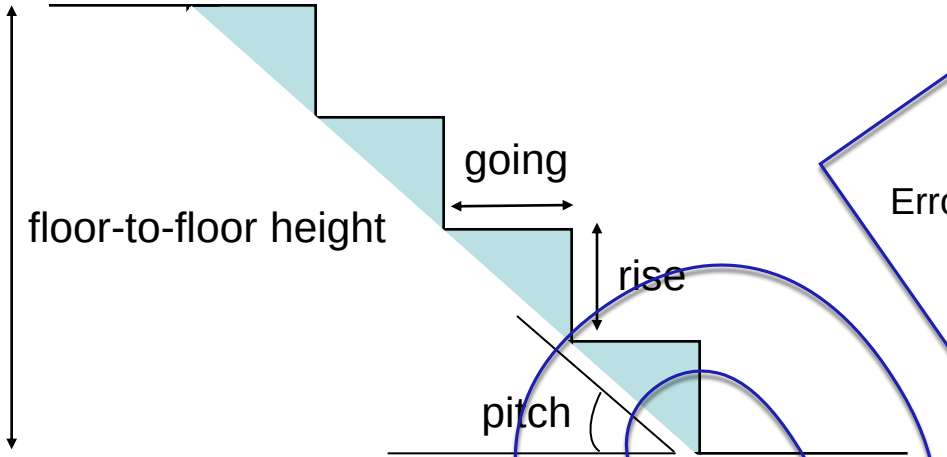
Stairs are hazardous!

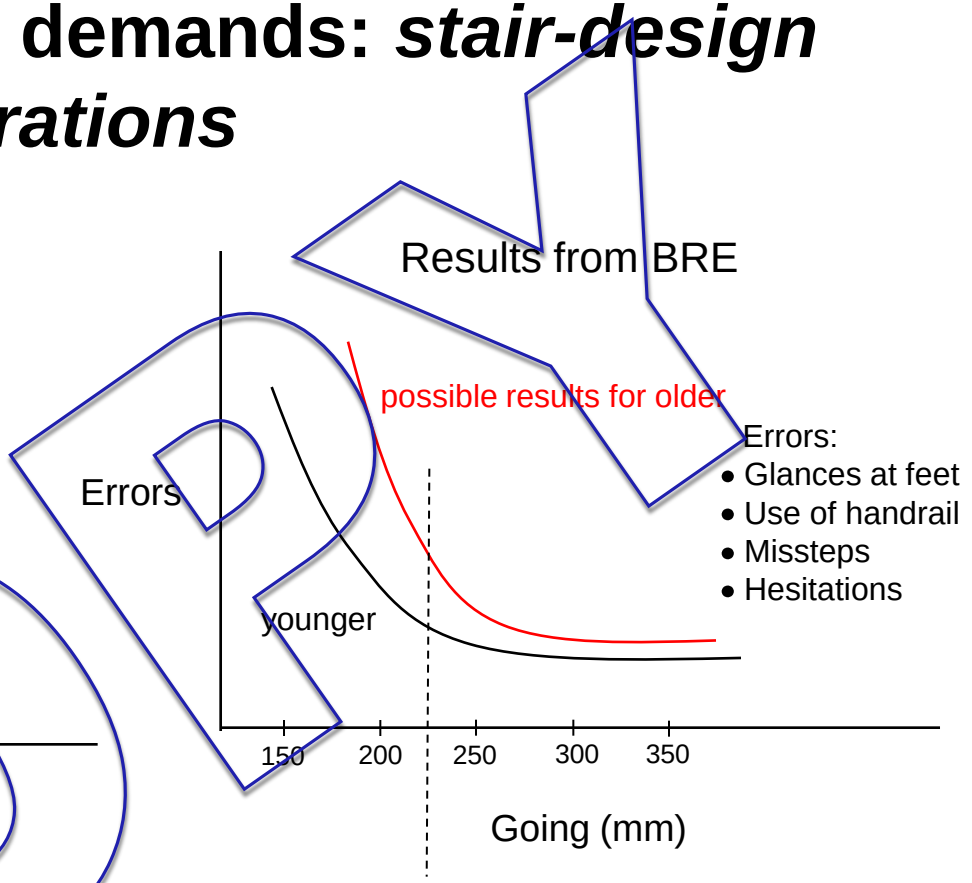
- 1/3 of people > 65 y and 1/2 of people > 80 y fall on stairs each year
- Consequences: Fractures, fear of falling, functional deterioration, social isolation & institutionalization
- Cost of fracture treatment to NHS: £ 1 billion/y
- Falls on stairs: Leading cause of accidental death– 40,000-50,000 deaths/y in EU

Probable origins of problem

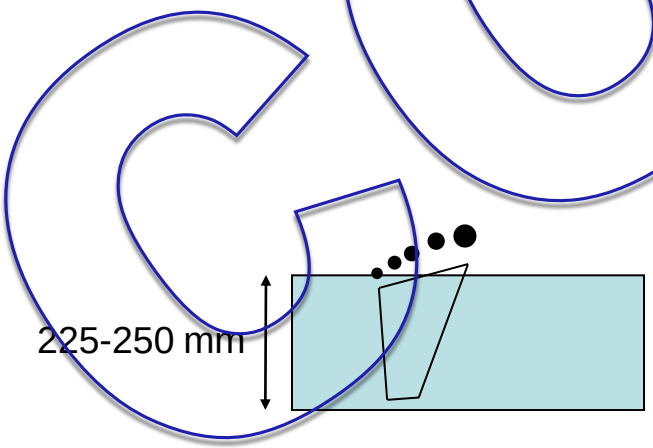


A. Reduction in task demands: *stair-design alterations*



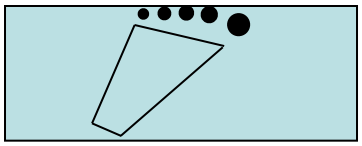


many old homes in the UK



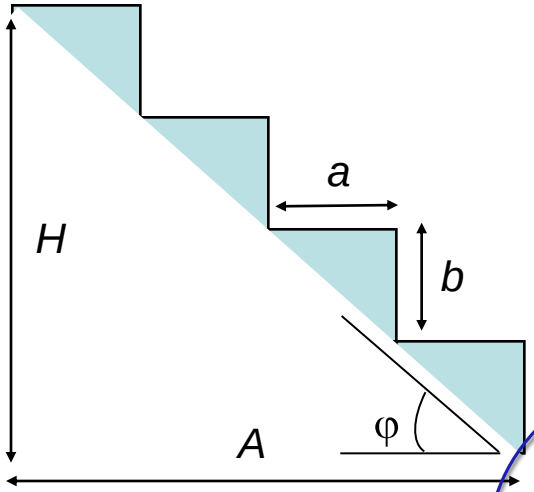
forward foot landing

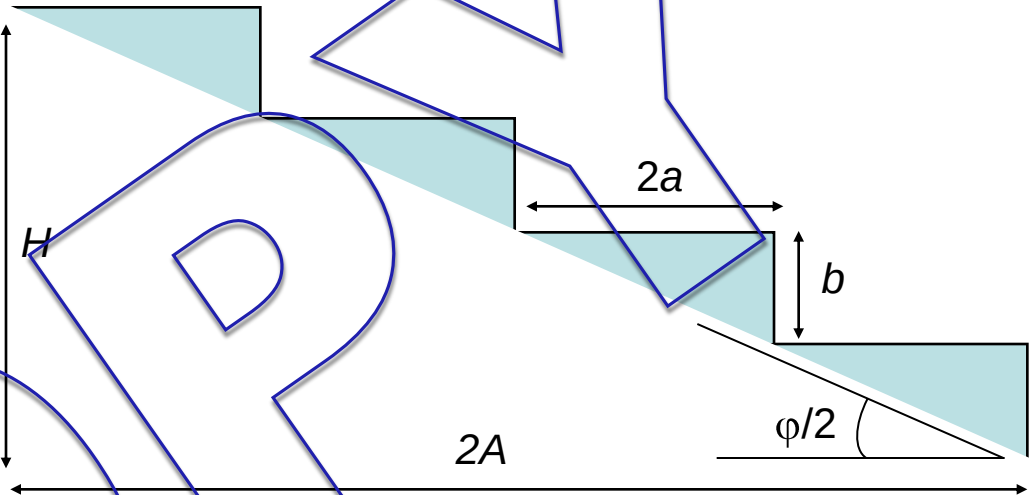
or

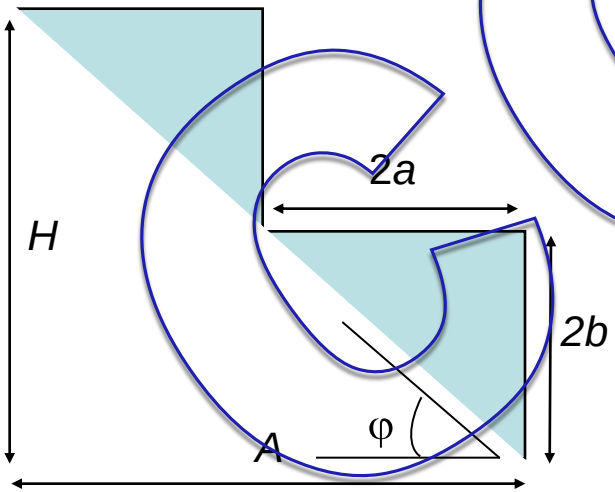


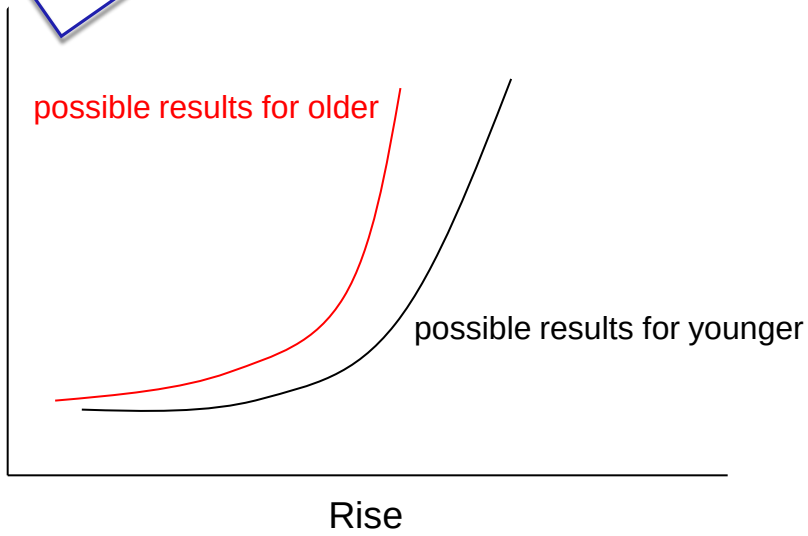
sideways foot landing

So why not increase the going?









B. Improving the Individual: *Exercise-training interventions*

- Strength training is the conventional exercise-intervention

- Is muscle strength a limiting factor in stair descent in old age? No, for standard step-rises in non-fallers, the major muscles operate well within their limits (Reeves et al. 2007)

- *"Task-specific" training emphasizing correct task execution should be a more effective intervention for some older people*

Aims

1. To establish the biomechanical demands of stair descent in older fallers and non-fallers

2. To identify the optimum combination of step-going and step-rise for elderly people

3. To determine the extent to which stair descent can be improved with tailor-made exercise training

Methods

A. Subjects:

• 50 individuals <40 y and 50 “fallers” and “non-fallers” >65 y recruited from the local community - Participation after medical clearance and ethical approval.

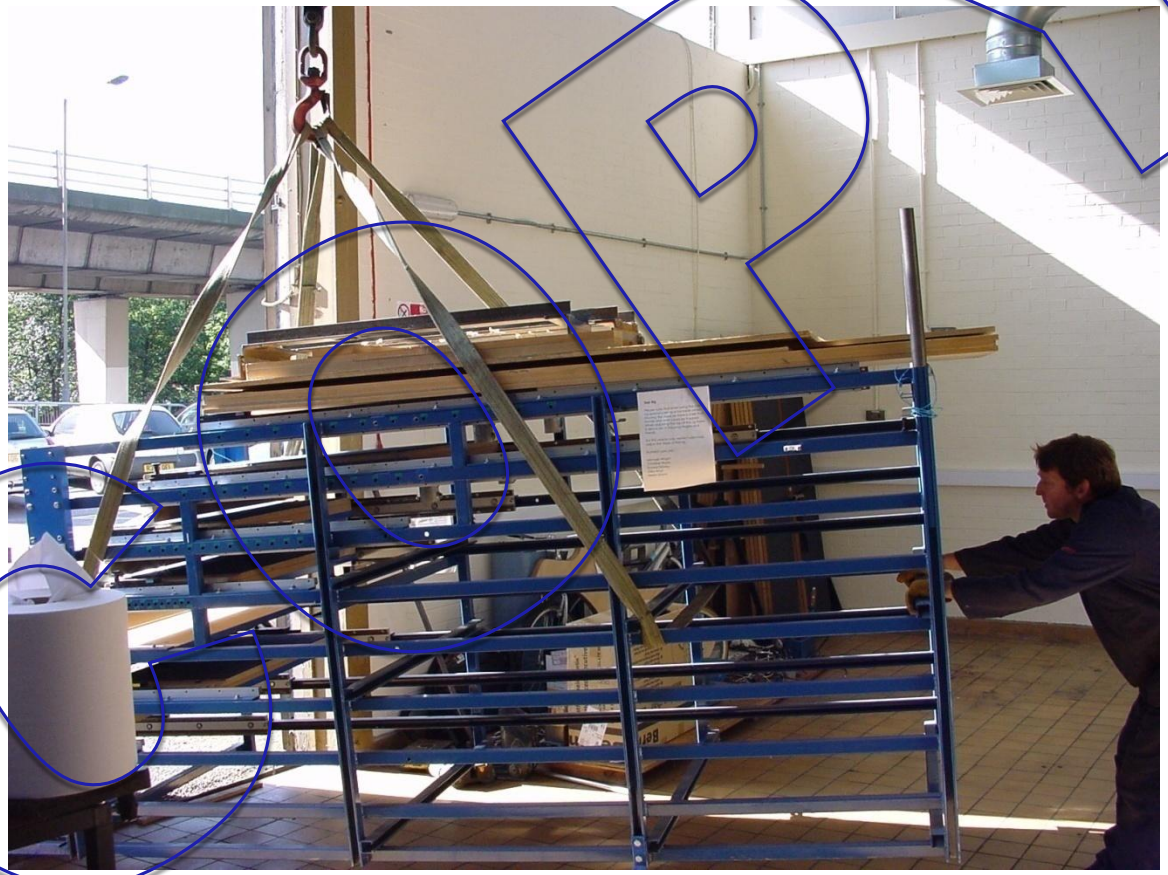
Methods

B. Equipment:

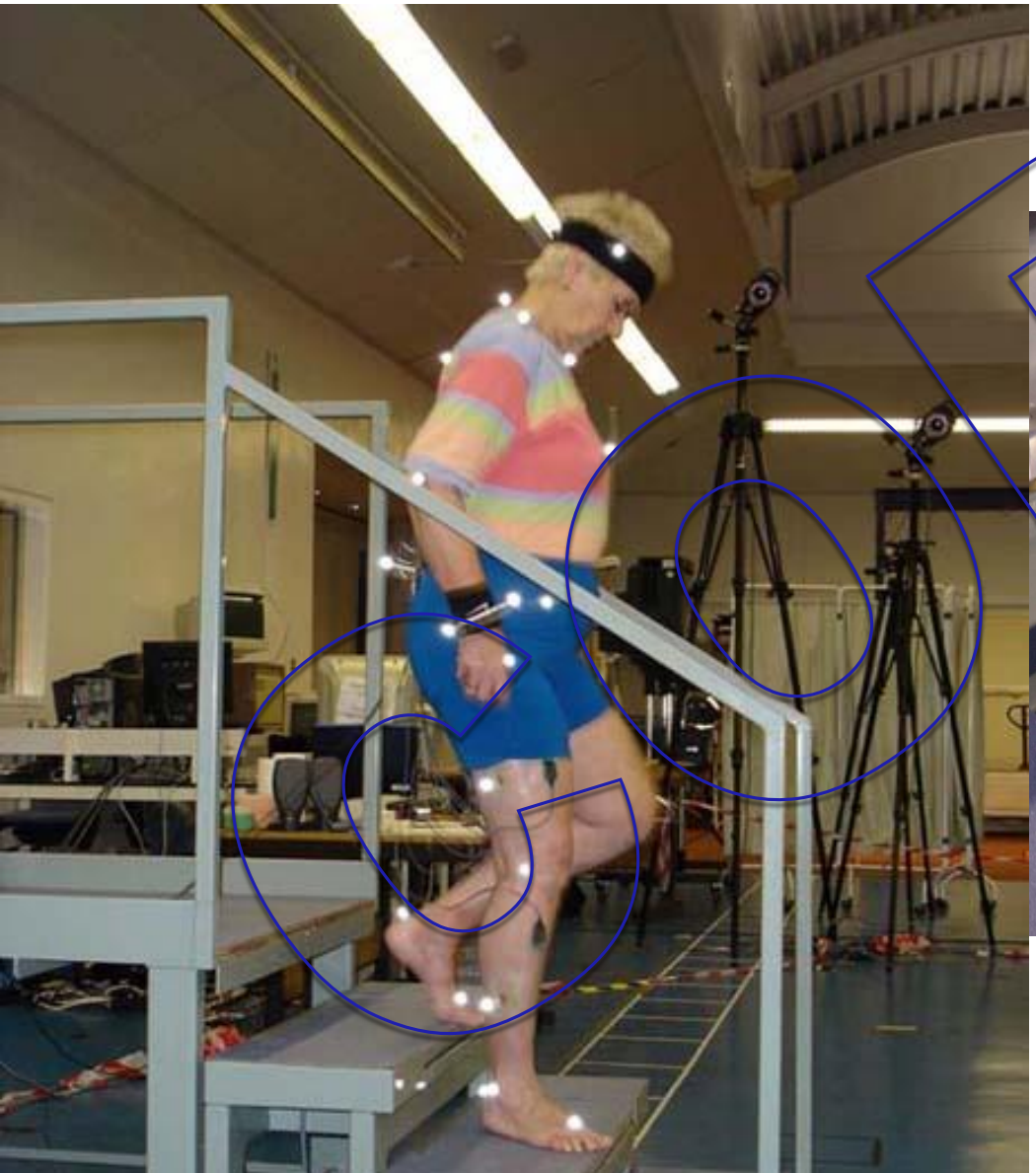
Adjustable steps, designed and used at BRE

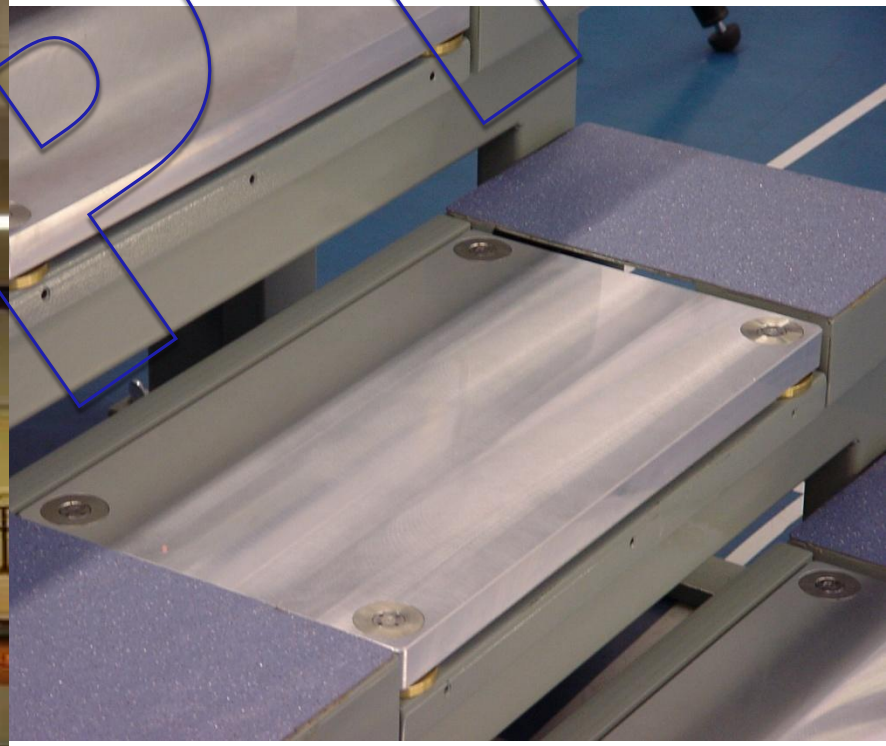
- Going: 220-350 mm – Rise: 150-250 mm
- Pace: self-selected, 80-120 steps/min
- Optoelectronic 3D movement recording system (VICON)
- Force plates to determine muscle strength reserves
- Eye-tracking system
- Ultrasound scanning of muscles during stair descent

BRE stairs arriving at the IRM!



Biomechanical analysis of stair negotiation at the IRM





Methods

C. Exercise-training:

- Older individuals with stair descent problems due to reduced strength reserve will undergo 8 weeks, 3 times/week of resistance exercise and flexibility training

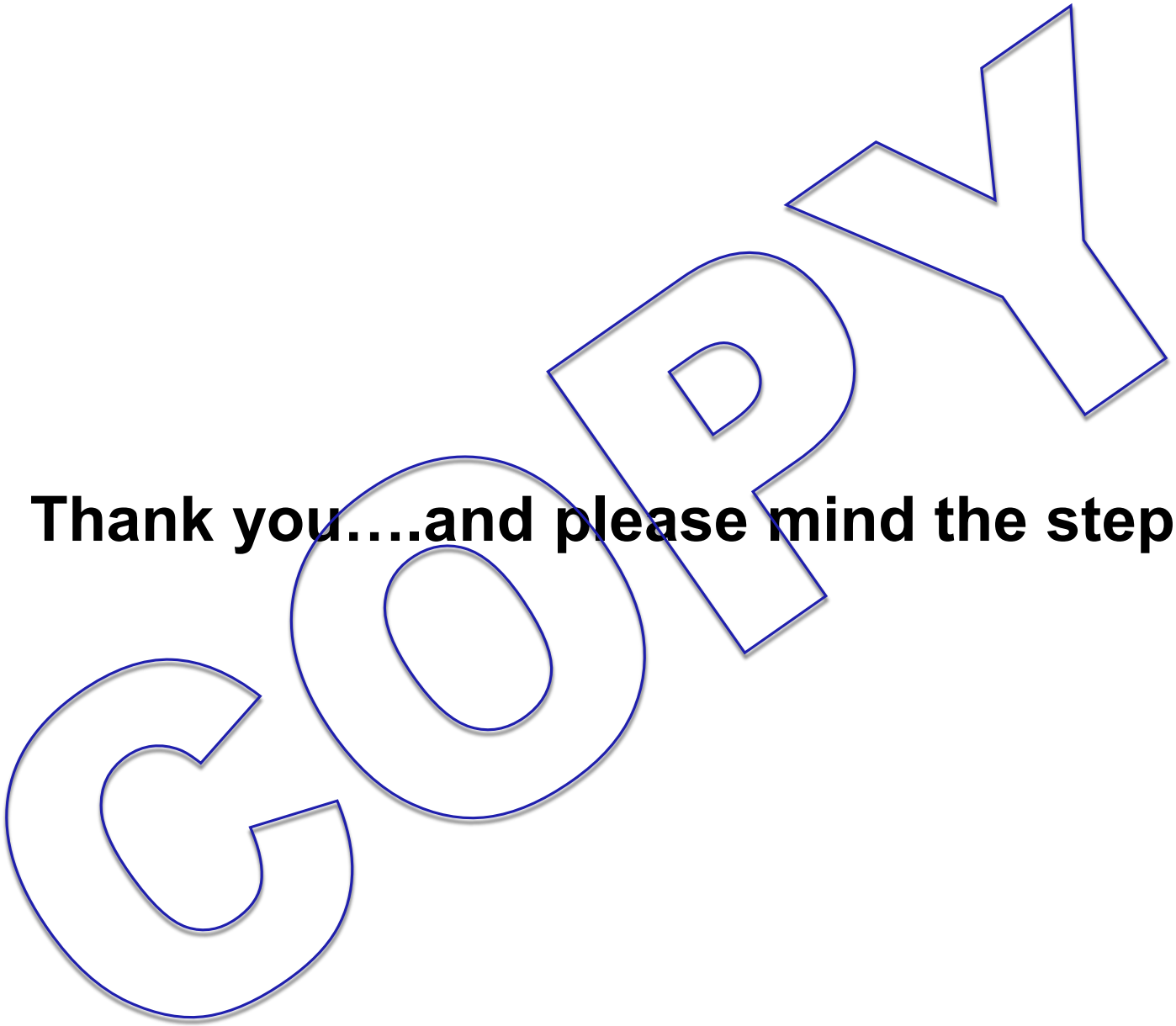
- Older individuals with stair descent problems due to motor control/balance deterioration will undergo 8 weeks of balance training and supervised repetitive execution of stair-descent trials avoiding errors and using safer strategies.

- Post-training re-testing on the BRE stairs using “challenging” step settings

Exercise-training at the IRM

Expected Outcome of Project

Establishment and implementation
of evidence-based guidelines for increasing
the ***safety of older people on stairs***



Thank you….and please mind the step!