Improving inclusive design by understanding the biomechanical and psychological performance of older adults.

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Is it fair to exclude people?
Inclusive Design

- a design approach to prevent *unintentionally* excluding those with impaired capabilities from using products through *lack of consideration* of their needs and wants.
Current situation for designer
Alternative situation
Inputs to software tool

- Physical abilities
- Biomechanical performance
- Psychological attributes

Software tool
Lab testing – University of Strathclyde

- 84 healthy older adults
- 3 age groups: 60+ (15♀ 15♂), 70+ (15♀ 15♂), 80+ (11♀ 13♂)
- 900 hours of lab testing
Inputs to software tool

- Physical abilities
- Psychological attributes
- Biomechanical performance
Physical Assessment

• Hip and knee strength in three positions

• Grip strength

• Range of motion of upper and lower limb joints
Inputs to software tool

- Biomechanical performance
- Physical abilities
- Psychological attributes
Biomechanical Assessment

- Full body biomechanics
  - Stairs
  - Chair
  - Door
  - Lifting
  - Walking

- Hand biomechanics
  - Remote control
  - Turning key
  - Opening jar
Inputs to software tool

- Physical abilities
- Biomechanical performance
- Psychological attributes
Psychological input

Problems for designers:

• Capability beliefs of older adults

• Ability of older adults to deal with novel objects and procedures
Capability beliefs

Do older adults acknowledge changing abilities?

- Over-estimation: risks physical injury
- Under-estimation: loss of independence spirals
Capability beliefs questionnaire

- Physical flexibility
- Physical endurance
- Walking ability
- Manual ability
- Co-ordinate precise movements
- Motor ability in demanding contexts
- Motor ability in novel contexts
- Confidence in motor ability in face of aging
- Motor ability relative to same-age peers
- Over-cautious and over-confident indicator
Levels of capability beliefs

Confidence level (%)

Older age-group

- confidence with aging
- relative to peers
- novel contexts
- walking
- manual
Levels of Capability Beliefs

Over-confident:
- 56% of 60’s
- 61% of 70’s
- 32% of 80’s

Over-cautious:
- 30% of 60’s
- 7% of 70’s
- 49% of 80’s
Over-riding the ‘old way of doing things’

Failed to over-ride:

- 52% of 60’s
- 67% of 70’s
- 81% of 80’s

Learned with practice:

- 80% of 60’s
- 17% of 70’s
- 22% of 80’s

Higher levels of confidence:

- Better performance among less able older adults
- Poorer performance among more able older adults
Over-riding inappropriate action

More ‘failures to over-ride’
• In 60’s compared to 20’s only
• In 70’s and 80’s compared to all younger age-groups

Even when succeeded to over-ride:
• Still errors in controlling ongoing action
• Emerged from as young as 40’s
• Became more frequent and extreme with older age
Over-riding inappropriate action

For each older age-group:

• Different types of capability beliefs related to
  – Type of motor errors produced
  – Increases in error frequencies
Inputs to software tool

- Physical abilities
- Biomechanical performance
- Psychological attributes
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Key points

• Information which designers cannot find out on their own
  – Only externally visible through the effects on movement

• Data (+ specialist knowledge) must be translated into a meaningful form for design
New model
What happens in real movements?
What happens in real movements?
Interaction with design software
Interaction with design software
What if?
Next steps

• Integrate psychological findings
• Expand richness of information
• Add design guidelines and strategies
• Investigation of ways to enable the designer to empathise with the situation of the user
Questions