Motor control & performance with aging

- Today: Examine motor abilities with advancing age
- Describe ‘motor regression’ and how it relates to
  - motor behavioural changes
  - physical changes
  - central nervous system changes
- Rehabilitative / intervention methods

Physical changes with aging

- Peak motor performance occurs during early adult years
- Beginning in the 30’s, see changes in growth and physiological function
  1) Skeletal growth
     - long bones and vertebral column stop growing between 25-30 years of age
     - can offset the decline in bone density with strength training, however (later)
  2) Maximum strength
     - muscle csa is greatest between 25-29 years
     - see a decline in max grip strength with age
3) Oxygen consumption & cardiovascular work
– Peak function occurs in the 30's (yeah!)

maximum work in a two-step climbing test

marathon records

Chronological vs physiological age
• If remain active, can have same physiological performance as a much younger individual

Even with activity have a regression in fitness factors & motor performance
• See declines in cardiorespiratory function and muscular strength
  – after age 30, see a reduction in the body’s physiological capabilities by about 1% / year
  • While much of this loss may be due to inactivity, still have a decline in physical work capacity
Tissue and body fat changes influence overall performance ability

- flexibility affected by changes to connective tissue and joint fluid → range of motion ↓
  - although activity a better indicator vs. age
- decline in muscle mass (30%) reduces strength
- increase in body fat %
  - ~ 15-20% between 20 & 60 years old
  - increases mechanical work for the heart, more mass to move!
- bone density decreases
  - females: 30% by age 70, males 15%

Neuromotor behavioural changes

• Reaction time
  - see a marginal decrease in simple RT, more dramatic decrease in choice RT
    - decision component problematic
    - decline in performance of speeded decisions, complex tasks

• Movement times grow longer with age
  - speed-accuracy shift
• Movement steadiness affected
  – particularly for precision tasks
• One study looked at grip force and safety margin (remember grasp development!) across a range of ages
  – varied the objects’ weight or friction in a lift & hold task


• Older subjects showed larger grip forces

& safety margin

• Also found that adjustments to new surfaces were delayed
  – release time not different, though
  – still see anticipatory grip force based on previous weight

• A second study measured steadiness by comparing isometric and anisometric force variation in a matching task


• Found steadiness difference for anisometric load, but not isometric one
  – related to EMG variation, different activation of elbow muscles in older adults

Variations greater

Relative muscle activations change
Balance and Gait

• As with postural control itself, multiple causes
  – decreases in vestibular, somatosensory, and visual function
  – greater postural sway (starting in 30’s)
    • use wider base of support to counteract
• Leads to falling
  – often causes a hip fracture
    • due to structure, bone loss, esp. in women

Mechanism of age-related decline

• peripheral & central neural processing decline
  – referred to as ‘psychomotor slowing’
  – 15% decrease in conduction velocity
  – decrease max discharge rate of motor neurons
  – remodeling of motor unit territories
    • affects smaller force tasks
• loss in brain cells overall
  – cerebellum, brainstem, vestibular nerves
  – contributes to balance & coordination losses
• decision making time increases
• caution a factor too = strategy shift

• declining cutaneous afferent function:
  decrease in Fast Adapting I afferents
    – endings = meissner corpuscles
    – decrease in #, morphology changes

• increase in skin slipperiness
  – beginning at age 50
  – related to reduced hydration, changes skin mechanics


**Intervention strategies**

- **strength training**
  - one experiment found hand steadiness decline was reduced (force less variable) after 12 weeks of hand strength training

![Image](source.png)


- **sensory enhancement**
  - random vibrations applied to the soles of the feet can help with balance (Jim Collins, Boston University Bioengineer)
  - below level of conscious awareness
  - With the vibration on the soles of their feet, elderly subjects swayed 5-20% less
    - a range similar to the difference between young and older subjects
    - vibrating shoes for the elderly?!

![Image](source.png)

- Generally, a healthy active lifestyle can negate decrement in psychomotor slowing as well as cardio function

![Graph](source.png)