Electric Fields

Orientation
Linear and Angular Acceleration

Lateral line system
Internal ear is derived from part of the lateral line system.

**Internal ear** - Vestibular system - otolith organs - semicircular canals - Hearing
Control of posture

Postural control is adapted to suit specific behaviors.
Appropriate anticipatory responses to perturbations are learned.

Activity of ankle extensor muscles

Adaptive posture control is learned during locomotion.

With blindfold
Motor learning requires an intact cerebellum.

Tuning of postural responses requires a functioning anterior cerebellum. Platform on which the subjects stood was moved at either random amplitudes or the same amplitude in ten trials.
Cerebellum is central to motor learning.

Individuals with a damaged cerebellar cortex.

Components of Motor Control

Central Pattern Generators

Vestibular System

Vision

Vestibular integration
Cerebellar adjustment and motor learning

Proprioception and Spinal reflexes
The Human Portrait

Why do trained athletes have to train?

What is the effect of this?

What happens to motor control as we get old?

Leading Causes of Injury Deaths among Seniors
San Francisco, 1987 - 1996 (n = 1186)

Source: CDHS, 1998
Leading Causes of Injury Hospitalizations among Seniors
San Francisco 1996 (n=2329)

- Falls: 76.8%
- Unspecified/other: 13.0%
- Poisoning: 3.6%
- Motor Vehicle-traffic: 6.6%

Source: OSHPD, 1998

Hospitalizations due to Falls, by Gender and Age
San Francisco, 1996 (n=2575)

Source: OSHPD, 1998
Eighty-three percent of fall injury deaths occurred among persons 65 years and older.
*The death rate for falls among persons under 65 years was 1.1 compared to 34.6 for persons 65 years and older.
*Among all ages, the fall death rate for whites was 6.4 compared to 1.8 for all other races combined.
*Falls were the leading cause of injury death among white and Native American females 65 years and older.

Does “intervention” help?
Multisensory Training of Standing Balance in Older Adults
(Hu and Woollacott, 1994, J. Gerontology 49, M52-M61)

Platform-knockdown test

10 hours of training, over a 2 week period, in standing postures that manipulated sensory inputs from visual, vestibular, and proprioceptive systems. 24 subjects, 65-90 years old.

One-leg stance test

Fall incidence in frail older women after visual feedback-based balance training.
(Sihovnen et al., 2004, Gerontology 50, 411-416)

4-weeks, 3 times per week, of visualization of movement of center of pressure. The goal was to teach subjects to control the movement of center of pressure during dynamic weight shifting, leaning, and stepping.
Effects of physical and sporting activities on balance control in elderly people.

65 healthy people, older than 60 years.

**Oscillations of center of pressure under foot**

*Always been active in physical and sporting activities*
*Lately begun physical and sporting activities*
*Stopped physical and sporting activities at an early age*
*Never participated in physical and sporting activities*

**Why does “intervention” help?**
TIME
The Pregnant Mr. Lee
MAN(?)
of the YEAR
Awkwardness of Adolescence - an example of disintegration.

Disintegration of sensory perception and motor control.
Motorcycle fatality rates per 100,000 riders by age group.

Walking in the Mall is not going to help.
Elderly Tai Chi practitioners have better balance capacity, proprioceptive function, muscle strength, and initiate corrective responses to perturbation faster.
Strength Training

Boxing
This is the part of the problem for motor control as we age.

"The moment I get on one of those sidewalks, I start to fall down."

Emiliano Zapata