THE MEASUREMENT OF MOTOR PERFORMANCE
The measurement of motor performance is critical to understanding motor learning & development
PERFORMANCE OUTCOME MEASURES

- Measures that indicate the outcome of performing a motor skill
  - Reaction time
  - Error measures
  - Time to completion
  - Number of successful attempts
  - Trial to completion
PERFORMANCE PRODUCTION MEASURES

- Measures something of the movement that *led* to the outcome
  - Displacement
  - Velocity
  - Acceleration
  - Joint angle
  - EMG
Concept 1: Reaction time

- Describe the different types of reaction time and provide examples of each type as it relates to physical rehabilitation, physical education, exercise science, and/or coaching.
REACTION TIME

- RT is the interval of time between the onset of a signal (stimulus) and the initiation of a movement response.

- Types of RT:
  - Simple
  - Discriminate
  - Choice
  - Fractionated
Fractionated RT

- EMG enables one to fractionate RT.

- Fractionate RT has two components.
PRE-MOTOR & MOTOR RT

- Pre-motor RT
- Motor RT
- Signal
- EMG
- Movement
What would happen?

- How does muscular dystrophy affect the motor reaction time component of fractionated RT?
- How does multiple scoliosis affect the pre-motor time component of fractionated RT?
RELATIONSHIP OF RT TO MOVEMENT TIME & RESPONSE TIME.

Warning Signal | Go Signal | Initiation of response | Termination of the response

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Foreperiod

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Reaction Time | Movement time

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Response Time
USE OF RT

- Used as a basis for inferring what a performer does or what information a person uses while preparing to produce a required action.

- A long or short RT provides information on how we interact with the environment.
Concept 2: Error Scores

Describe and discuss the different one-dimension errors and what each error score means.
ERROR MEASURES

- Error measures allow us to evaluate performance for skills for which accuracy is the goal.

- Examples of these skills are?
ONE-DIMENSIONAL ERRORS

- Absolute error (AE)
- Constant error (CE)
- Variable error (VE)
Each archer shot a score of 15 points

Which error score (AE, CE or VE) would determine who is better?
TWO-DIMENSIONAL ERRORS

- Radial error

X-axis

Y-axis

X=7; Y=5
ASSESSING ERRORS FOR CONTINUOUS SKILLS

- Root-mean-squared error
Concept 3: Kinematic measures

Describe and identify the different types of kinematic measures and provide an example of each type that relates to your future profession.
KINEMATIC MEASURES

- Displacement (spatial location)
- Velocity (rate of change)
- Acceleration (change of velocity)
- Linear and angular motion
FIGURE 2.6 Angle-angle diagrams showing knee-thigh relationships during running by a skilled runner (top) and three below-knee amputees (bottom). The abbreviations indicate ipsilateral (left) footstrike (IFS), ipsilateral takeoff (ITO), con-
Concept 4: Kinetic Measures

Describe and identify the different types of kinetic measures and provide an example of each type that relates to your future profession.
KINETICS

- Magnitude of force
- Direction of force
EMG

- Shows electrical activities in the frequency and amount of involvement of each muscle measured in a movement.

- Shows the start activity of a specific muscle in a movement.
FIGURE 2.8 Using EMG recordings to measure a movement response. The figure on the left shows the reaction-time appa-
Concept 4: Brain Activity Measures

- Describe the different types of brain activity measures and their purpose.
EEG (electroencephalography)

- Neurologists commonly use EEG to assess brain disorders.
  - Noninvasive and painless procedure of placing 4-16 surface electrodes on the frontal, central, parietal, and occipital lobes for right and left hemisphere.
  - Since brain activity is rhythmic (waves)
    - Beta (fast waves when cortex is active)
    - Alpha (occurs when brain is quiet; one is awake)
    - Theta (slow wave during sleep)
    - Delta (slowest wave…deep sleep)
PET (positron emission topography)

- Used to provide clear and precise images of the activity of brain
  - Show blood flow or metabolic activity in brain
  - Inject or inhale radioactive solution
- Researchers engage a person in performing a motor skill while the scanner surrounds the head.
fMRI (magnetic resonance imaging)

- Produces an image of any part of the body from any direction in “slices”
  - fMRI determines brain function in terms of blood flow changes.
MEG (magentoencephalography)

- Assesses magnetic fields created by neuronal activity of the brain.
  - Directly measures the function of brain
  - Has a very high temporal resolution to determine damaged brain tissue
  - Used to observe people performing cognitive and motor activities.
TMS (transcranial magnetic stimulation)

- Measures motor activity via a scan of the brain and recording electrical, magnetic, or bloodflow activity.
  - Place a coil on a person’s skull at brain cortex area of interest.
  - Short burst of magnetic waves then disrupts brain activity at the area of interest.
Concept 6: Movement-Related Coordination Measures

- A person performs a motor skills in a specific time (temporal) and space (spatial).
  - One way to measure a person performing is create a graphic angle-angle plot of the movement joints.
    - Angle (X) – angle (Y) plot at specific times during the movement can be compared (cross correlation).
  - Another way is a person repeats a movement pattern for a certain amount of time.
    - From repeating the movement one can gain a sense of the relative timing of the movement.
    - Phases of the movement (parts of movement) can be described by a displacement-velocity graph of the temporal and spatial characteristics.
SUMMARY

- Understanding the measure used to assess a motor performance provides a better understanding of one’s behavior or performance.
  - One’s rate of learning
  - One’s present status of a motor or sport skill
  - Help’s identify deficiencies
  - Provide a quantitative or qualitative aspect of one’s performance