Execution Processes

• What limbs to move.
• When they should be activated.
• How much they should be activated.
• How they should be coordinated
What Happens Here?

1. The limbs and body must be given directions to carry out the action.

2. This process is the development of motor pathways. (engrams)

3. Example: kicking a stationary ball. What all is involved?
Program for action

- In order to perform complex movements with coordination and grace, and organize the complex sequence of events involved in a movement, a **program of action** must be developed.

- What is a program for action?
Pattern Generators

- The **central pattern generator (CPG)** is a neuronal circuit that serves to organize the pattern of actions for locomotion, such as walking, running and even swimming.
- The **CPG** allows the motor system to produce rhythmic, stereotypical movements using a neural circuit in the lower brain and/or spinal cord without interaction from the higher order centers of the brain.
Applying CPG to physical activities

• What are some activities that require us to have a CPG and to utilize a motor program in order to perform simultaneous movements?
Motor Programs

• The best motor program theory to describe skilled/learnt action is the generalized motor program (GMP).

• What happens when we develop a new skill? Do we have to develop a new GMP?

• There is a GMP for throwing. How does this work?
GMP

• The beauty of the GMP theory is that it accounts for the many variations of a similar pattern we might perform, eg throwing action.

• Rather than create a totally new plan/program we adjust the pattern’s parameters
GMP (Invariant) Features

However, there are invariant features which describe that pattern:

- **Relative timing** — time of a movement segment relative to overall backswing in golf

- **Relative Force** — applied force at varying times during a movement — signing name

- **Movement sequence** — preparation, action, follow-through — tennis serve
Parameters are adjusted according to the goal of the movement pattern

- Overall timing – practice vs game
- Overall Force – hitting long vs short
- Muscle selection - sequencing
Programming Movements

• The organization, translation and transmission of execution information requires both time and attention.

• There has to be some degree of cognitive activity, including memory.

• What will happen if the wrong commands are sent to the muscles?
Program efficiency

• What influences programming efficiency?

Movement complexity

Movement duration
Movement complexity

- The number of limbs involved.
- Sequencing of actions
- Overall difficulty of the movement.
Movement Duration
a.k.a. Movement time

• Length of time required to complete the movement.

• A long duration movement leads to a long reaction time.
Movement Control Systems

• Two types of movement control systems:

A. open-loop control
B. closed-loop control

These two processes account for the majority of voluntary movements performed in sports and everyday situations.
Open-Loop Systems

- This system does not involve feedback, there is little integration of sensory information to modify the movement.
- Many rapid actions are governed by open-loop systems.
- Examples: throwing darts or the long-jump.
- Generally, any movement that is rapid or less that 150 milliseconds is controlled by open-loop systems.
Closed-loop System

- Movements that use information about the body and the environment to modify the behavior are controlled by the **closed-loop system**.

- The closed-loop system incorporates sensory information about the movement and the environment.
Sport is an UNFOLDING of events in which one PERFORMER tries to PREDICT what is going to happen before it actually does. The opponent tries to prevent prediction.

Changes in Performance take place because of refinement in INPUT, DECISION MAKING, OUTPUT and FEEDBACK.
Changes in Performance

- **Chunking** – beginners process information one piece at a time
- **Schema** – rules or guidelines, sometimes called ‘sets’
- **Automatization** – less attention to execution, allows overall executive control (order & timing) rather than detail control
- **Inter-sensory integration** – combining sensory, not letting one dictate. Each sense also becomes sharper (intra-sensory)
Changes leads to performer is more

- Accurate
- Consistent
- Coordinated
- Controlled
- Adaptable
- Deliberate
- Better planned
Changes

- Where to look, what to look for
- Quicker interpretation, reduce amount of information
- Anticipate routines required for best result
- Develops sets or patterns, become automatic
- Recognize movements suitable, accommodate novel
- Integrate information, external & internal
- Wider repertoire
- Moves to strategizing
- Guides own learning
Input Changes

- ORIENTING
- SELECTIVE ATTENTION
- CUE ABREVIATION
- PROBABILITY PLANNING
ORIENTING

- Beginners tend to scan whole visual/auditory sense fields.
- They have not established where to find information or in what sequence it arises.
- Knowing where to look or where to find cues and in what sequence is very important in producing a skilled performance.
ORIENTING

Learners need to be taught and then practice:

• **Establish sequence of occurrence**
• **Select important and eliminate unimportant**
ORIENTING

These come from:

- Familiarity with variables
- Extent of sensory perception
- Experience, # of times before, repertoire
- Cues from others
- Ability to screen (intensity of unimportant)
SELECTIVE ATTENTION
(What should I attend to?)

KEY:
• Knowing what is important and what not
• What is fake or disguise
• Which parts are the most important

• EXPERIENCE is key
Instruction can guide
SELECTIVE ATTENTION

Teaching/ coaching

- Contrast between important / unimportant
- Ratio of important / unimportant
- Practice/ familiarity
- Ownership (thinks)
- Intensify important, make distinguishable
CUE ABBREVIATION

Ability to predict outcomes from smaller number of cues

• **Recognize and establish patterns of occurrence in the environment** (If this ..., then this ...)

• **Chunk bytes of information** (piece together as a jigsaw)

• **Knowledgeable about movement characteristics**
PROBABILTIY PLANNING

The likelihood of certain events following on from one another

If a player hits return down the line 90% then the probability is 9/10 will go down line or 1 in 9 it will go somewhere else
PROBABILITY PLANNING

- Players can help themselves by practicing making predictions
- Trying to pick out commonalities
- Know strategies used to deceive
- Watch better players (focus on one thing)
- Ask questions (what’s going on?)
- Try to make response automatic (don’t over-analyze)